

Environmental, Industrialization, Management, Economics, Agriculture, Rural and Urban Development towards Sustainable Potential

Editors

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Dr. Babalola Ayodele Samuel

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Sustainable Agriculture



**Book Chapter as
Per UGC Guideline**

Title	: Environmental, Industrialization, Management, Economics, Agriculture, Rural and Urban Development Towards Sustainable Potential
Editor Name	: Dr. Babalola, Ayodele Samuel, Riswan M, Dr. Prasanna Srinivas, Santosh P. Mane
Publishing Agency	: Fern International Publication Pune
Publisher Address	: Jyoti Kerappa Mane Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras , Malshiras, Solapur, 413107
Printed By	:Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	:I st
ISBN	: 978-81-959050-0-3
Copyright	: Jyoti Kerappa Mane
Publication Date	: 31/01/2023

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Published by –

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras, Solapur, 413107

Mob- 8888454089

Email- fppune2003@gmail.com

Publication- Fern International Publication Pune

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E-Waste Management with Special Reference to India

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DOI-10.5281/zenodo.7631679

Abstract

Today, the generation of e-waste particularly in developed and developing countries has become a cause of concern due to its hazardous effects on human health and living organisms. India is not an exception to this. However, the management and treatment of e-waste in India have certain limitations. Thus the issue of E-waste has to be studied systematically. With this view, the present paper attempts to understand the present scenario of e-waste management in India. The paper is based on secondary data, which reveals that the e-waste generation in India varies from state to state and city to city. There are certain challenges to e-waste management in the country like lack of reliable data on e-waste generation and its management. The paper gives some suggestions for effective e-waste management and concludes that there is an urgent need for an in-depth investigation and assessment of present and future scenarios of e-waste management in India.

Key Words: Management, E-waste, Disposal, Recycling, India

Introduction

Today, the advancement in science and technology has brought spectacular developments in modern times that have enhanced the quality of our lives. At the same time, these have led to diverse problems of hazardous waste and other wastes generated from electric and electronic products. These harmful and other wastes pose a great threat to human well-being and the environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and the environment (GoI, 2011). Electronic waste (e-waste), that is, waste arising from end-of-life electronic products such as computers, mobile phones, LED bulbs, televisions, VCRs, stereos, copiers, and fax machines etc. is one of the fastest growing waste streams in the world today (Rama, M. et. Al., 2019). The annual global production of e-waste is estimated to surpass 50 million tons in 2020 (Baldé, C. P. et.al. 2017). E-waste in India is not only increasing in amount but also in its toxicity, the reason being the rapid growth in productivity and consumption in the electronics sector (Dwivedy and Mittal, 2010). About 50,000 tons of e-waste are imported to India each year (Manomaivibool, 2009). The electronic and electrical components manufacturing industries are the largest growing

sectors in India (Sepúlveda et al., 2010) producing 40,000 tons of e-waste itself every year (Sthiannopkao and Wong, 2013). Thus, the present research paper highlights the related issues and strategies to mitigate this emerging problem in India.

Objectives

1. To know about the current scenario of e-waste management in India
2. To provide suggestions on challenges in e-waste management

Materials and Methods

The present study is theoretical and is based on secondary sources of data viz. the government and private publications, research articles and reports.

E-waste and India

Today, e-waste has emerged as one of the serious environmental issues, which is related to public health matters. India is one of the major e-waste-producing countries in the world. It produces approximately 2 million tonnes of e-waste annually. In addition, it imports e-waste from developed countries around the world. Electronic gadgets, Computer and telecom devices, medical equipment's and electric equipment are the major sources of e-waste generation in India.

Table 1: Year-wise e-waste generation in India

Sr. No.	Year	E-waste generation (Million Metric Tonnes)
1	2015	1.97
2	2016	2.22
3	2017	2.53
4	2018	2.86
5	2019	3.23
Total		12.81

Source: CSE, 2020 compiled from The Global E-waste Statistics Partnership Table 1 reveals that, in the year 2015, India's e-waste production was 1.97 Million Metric Tonnes (MMT). It increased to 2.22 MMTs in 2016 and 2.53 MMT in 2017. This rising trend of e-waste generation continued in 218 and 2019 also. E-waste generation in these years was 2.86 MMT and 3.23 MMT and E-waste formally collected 30 kt , appx 1% collection rate. The yearly growth in e-waste generation was approximately 13 percent.

Table 2: Percentage contribution by states to annual e-waste generation

Sr. No.	State	% Contribution
1	Maharashtra	13.9
2	Tamil Nadu	9.1
3	Andhra Pradesh	8.7
4	Uttar Pradesh	7.1
5	Waste Bengal	6.9
6	Delhi	6.7
7	Karnataka	6.2
8	Gujarat	6.1
9	Madhya Pradesh	5.3
10	All other states	30.0
Total		100.00

Source: Electrical and Electronics manufacturing in India, ASSOCHAM & NEC Technologies, 2018
E-waste generation in India shows a state-wise variation (Table 2). In 2018, Maharashtra was the most industrialized state which generated 13.9% e-waste followed by the states of Tamil Nadu and

Andhra Pradesh (9.1% and 8.7% respectively). Uttar Pradesh generated 7.1% e-waste of the total e-waste generated in the country, while each of the states viz. West Bengal, Delhi, Karnataka, Gujarat and Madhya Pradesh generated more than 5% e-waste in 2018.

Table 3: Major e-waste generating cities in India

Sr. No.	City	e-waste generation in Metric Tonnes (MT)
1	Mumbai	96000
2	Delhi and NCR	85000
3	Bengaluru	57000
4	Chennai	47000
5	Pune	19000

Source: Vrushali P., Citizen Matters, Indian Cities Stare at a mountain of e-waste, with little Idea how to manage It, June 11, 2018

In 2018, Mumbai, Delhi and NCR, Bengaluru, Chennai and Pune were the top five e-waste-generating cities in the country (Table 3). Mumbai with its highest e-waste production in the country (96000 MT) ranked first followed by Delhi and NCR with its 85000 MT e-waste production. The city of Bengaluru generated around half (57000) of

the e-waste produced by Mumbai. Chennai generated 47000 MT of e-waste and Pune generated 19000 MT of e-waste.

Challenges before e-waste management in India

The major challenges of e-waste management found are as below

1. Unscientific handling of e-waste
2. More than 30% of the population resides in urban areas which substantially contributes to e-waste generation.

3. Scattered sources of e-waste generation make e-waste management problematic.
4. Lack of skilled and unskilled workforce needed for e-waste collection, handling and disposal.
5. Adoption of improper methods of e-waste disposal by industries.
6. Financial constraints in the field of e-waste management.
7. Weaknesses of e-waste producing industries,
8. Negligence of e-waste handling and managing institutions.
9. Implementation of unsuitable and improper technology for e-waste generation
10. Vague implementation of e-waste generation and prohibition laws.
11. Paucity and improper installation of e-waste collection bins
12. Unfocused mechanism of e-waste collection

Challenges to policymakers

1. Lack of e-waste generation, prohibition and management laws in the recent scenario.
2. Dearth of advanced methods of e-waste management
3. Absence of separate e-waste management and disposal department in local government bodies.
4. Inefficiency of the waste segregation system
5. Lack of positive attitude towards cleanliness among the citizens.
6. The unavailability of dependable data on e-waste generation is a major obstacle for policymakers ready to design an e-waste management strategy and to an industry wishing to take rational investment decisions.
7. Only a small amount of the e-waste finds its way to recyclers due to the absence of a well-organized take-back scheme for consumers.
8. It is because of the lack of harmless e-waste recycling mechanisms available in the informal sector, that there is a reliance on formal sectors, which poses risks to human health.
9. lack of infrastructures facilities, financial and policy supports also present challenges in e-waste management.

Suggestions

1. There should be a separate e-waste management department in urban local government bodies.
2. Local government bodies should collaborate with industries for collecting, transporting and processing e-waste material.
3. E-waste management targets should be achieved phase-wise and systematically.

4. Standard and proven methods for e-waste management should be adopted.
5. There should be a strict vigilance on unorganized sectors.
6. Privatization of the Recycling and reuse industry should be made. Jobs in this industry involve collection, processing, reuse, remanufacturing and more.
7. Awareness campaigning has to be created through formal and informal education systems. Mass media and social media can be used effectively.
8. Privatization and commercialization of e-waste recycling should be made.
9. Workshops on e-waste handling and management should be conducted.
10. Government should provide financial assistance in the form of incentives and subsidies to the e-waste recycling plants.

Conclusion:

The generation of a large amount of e-waste in various states and cities in India has made the problem of solid waste disposal and management more complex. Lack of reliable data, unavailability of proper disposal methods and shortage of knowledge about e-waste disposal are some of the obstacles in e-waste management. Thus, there is an urgent need for a thorough investigation and assessment of present and future scenarios of e-waste management. Quantification, characterization, qualitative analysis, evaluation of disposal practices and assessment of environmental impacts of e-waste management has become the need of the hour today. Use of suitable and standard methods of e-waste collection, transportation, treatment, storage, recovery and disposal need to be recognized and adopted considering the amount and quantity of e-waste. Public Private Partnership in recycling and disposal of e-waste is essential. Production of low waste-generating electronic gadgets, equipment's and instruments should be encouraged. Minimal use of toxic material should be used in electronic devices. Thus, a collective approach from national and international bodies, including public awareness, is crucial to managing e-waste,

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THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM



ISBN: 978-93-100-0564-6

EDITOR

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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ROLE OF YOGA AND MEDITATION IN EDUCATION

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Abstract: *Education these days is becoming challenging due to increasing competition, heavy syllabi, introduction of new teaching-learning practices, use of advanced teaching aids and learning devices. This situation leads to high stress levels among students and teachers. Considering this fact, the present paper attempts to understand the role of Yoga and Meditation in the field of education. The paper utilizes secondary information available in various modes. Discussions held with students and teachers are also considered while writing this paper. The study reveals that, in spite of numerous advantages of Yoga and Meditation in education, these are still neglected. It is found that there is an urgent need to popularize these practices among students and teachers.*

Keywords: *Yoga, Meditation, Education, Stress, India.*

Introduction:

Day by day education is becoming a challenging task in the environment we live in. Electronic devices and gadgets like Android Phones and laptops, we use in our daily life made us habituated with the speed as well as rapid and recurrent changes in activities. This is one of the key causes of increasing stress levels among people, particularly in the student and teacher community. Students come to schools and colleges where the most common methods of learning are listening, writing, speaking and reading to cope with the competition. The use of electronic gadgets like laptops, touchscreen monitors and laboratory equipment's for smoothening the teaching-learning activity needs new skills which creates stressful conditions among the students. In addition, excessive demands and too high expectations that are often put on students, result in rising stress levels and create unease among them. Most of the time, difficulties in meeting the expectations of teachers and parents are a cause of stress among students. Simultaneously, those same parents and teachers also remain under stressful conditions. We teach children the subject matter while no one teaches them how to breathe properly and thus reduce stress. Yoga is a breathing technique that is of great help in bringing down stress levels in an individual. Yoga is meant to help people achieve a level of mental tranquillity where they can fully manage their reactions to both positive and negative external stimuli and responses are moderate in intensity (Telles S., et. al. 2000). Yoga is a great way to stay healthy and enhance one's personality. In one study, it is found that a 4-week program of Yogasanas and Meditation lowers the aggressive behaviour of students (Iniew Sumanna, 1998). Thus, the practices of Yoga and Meditation are useful for both, an individual and for a stress-free society. Yoga is a way of life that emphasizes peace, balance, and bliss. (Nagendra H.R. and Nagarathna R. 1977). Having a healthy mind is a key to person's overall health and well-being. A healthy mind impacts your thoughts, feelings, behaviours, and responses and involves emotional, psychological, and social well-being. Along with Yogic Practice, Meditation, being part of Yoga, is the seventh limb of Ashtanga Yoga (Tamini L. K. 1961). While, Restraint, Observance, Posture, Breath control, Abstraction, Concentration,

Meditation and Spiritual absorption are the eight components of Yoga while ahimsa, satya, asteya, brahmacharya, aparigraha, saucha, santosha, tapah, swadhyaya and Ishwar pranidhan are the basic principles (Siddappa Naragatti, and Yoga Therapist 2018). Yoga's methods of meditation, asanas, and pranayama have a beneficial impact on teenage stress management (Krejci Milada. 1994). It helps calm the mind. Both Yoga and Meditation are proven to be helpful in improving the performance of teachers and students. Students also experience rapid physical, intellectual, and social changes at different rates and at different times, while educational contexts and social expectations are expanding (Young et al., 2012). With this view in mind, the present study is aimed at understanding the role of Yoga and Meditation in education as a healthy way of living.

Objectives:

The study has been designed to achieve the following objectives:

1. To understand the concepts of Yoga and Meditation.
2. To know the status of Yoga and Meditation practices.
3. To recognize the Role of Yoga and Meditation in education.

Methodology:

The present work is carried out with two main sources. Initially, the information on Yoga and Meditation was gathered from secondary sources viz. private and government publications, research articles, books, newspapers and survey reports. Secondly, the effects of Yoga and Meditation on students and teachers were carried out by considering the experiences shared by them.

Concepts of Yoga and Meditation:

Yoga is primarily a spiritual discipline that harmonizes the mind and body via the application of an incredibly subtle science. It is an art, science and a way to live healthily. The word 'Yoga' is derived from the Sanskrit root 'Yuj', meaning 'to join' or 'to unite'. As per Yogic Scriptures, the practice of Yoga leads to the union of individual consciousness with that of universal consciousness i.e. union with the divine, indicating a perfect harmony between the mind and body. The aim of Yoga is self-realization, to overcome suffering that leads to a state of liberation. The practice of Yoga is to live with freedom in different walks of life. Health and peace should be the major objectives of Practicing Yoga. Being measured as an 'immortal cultural outcome' of the Indus-Saraswati Valley civilization, Yoga has proved itself to cater to both the material and spiritual upliftment of humanity. The essence of Yoga Sadhana is the practice of basic humanitarian values. The practice of Yoga is supposed to have started at the beginning of civilization. The Yogic Science has been around for a very long time. Now-a-days Yoga Education is being imparted by many institutions including universities and colleges. Today, practicing Yoga is considered to be of great help in improving flexibility, endurance, balance, physical strength and immunity. Academic institutions promote health benefits among the students and faculty through Yoga and Meditation.

Meditation is a practice in which an individual uses a technique of mindfulness that focuses the mind on a particular object, thought or activity to train attention and awareness and achieve a mentally clear and emotionally sound, calm as well as stable state. This wellness platform enormously contributes to forming a stress-free environment and healthy way of thinking and living.

Meditation is a technique to still the mind. But the act is not easy enough. The human mind keeps on traveling at a great speed with numerous thoughts coming and going at the same time. Meditation starts with letting our thoughts flow without any restrictions on them. Just be an observer and let the thoughts flow. Over a period of time, we observe that without controlling our thoughts, the flow of thoughts during that period of time starts reducing. This is because we do not try to forcefully restrict our thoughts. Our mind unknowingly becomes calm and we enter the stage of meditation. Patience is the key to meditation.

Yoga and Meditation are both interrelated. Yoga mainly helps maintain a healthy body. A healthy mind rests in a healthy body and automatically calms the mind and helps to enter the stage of Meditation much more easily.

Practicing Yoga and Meditation:

Yoga and Meditation need a quiet environment to practice it. It is always better to choose a place with natural aeration and fresh air. Yoga Mat can be used for additional comfort. It is advisable to perform meditation when one is comfortable, perhaps a few hours after a meal. There is also a need for a brief warm-up before performing Yoga. One should sit straight and practice deep breathing. Focus on the body, mind as well as beyond and concentrate on the singular object.

Discussion:

It is found that the practice of Yoga and Meditation offers various benefits to its practitioners, they are as follows:

- 1. Reduces Stress:** Most of the students and teachers live a stressful life and thereby suffer from health issues. As Yoga benefits both body and mind, it can help reduce stress and promote relaxation. Regular practitioners of Yoga found stress free and they are better able to handle things when life becomes complex.
- 2. Recovers Memory and Concentration:** Yoga plays a vital role in the brain development of an individual and keeps one's brain healthy. It enhances skill and thereby improves human efficiency and the productivity level of practitioners.
- 3. Imparts Precise Breathing Techniques:** Breathing is a core element of Yogic Practice. It is essential for survival and our breathing style is directly related to our overall well-being. Proper breathing allows us to handle stress positively. The Yogic Breathing Technique is also known as pranayama. It refers to controlled breathing that matches the rhythm of the Yoga Posture. One must learn breathing techniques and practice Yoga to bring excellence to life.
- 4. Increases Self-confidence and Brings Inner Peace:** As Yoga inculcates a positive attitude among individuals and offers many health benefits, it boosts the self-confidence of a person.
- 5. Improves Flexibility, Balance and Posture:** Sitting continuously for study and excessive screen time may result in an improper posture of a person. This abnormal posturing in childhood can develop into major anatomical difficulties in adulthood. Regular Yogic Practices lead to correction of posture. It enhances flexibility and improves balance as it brings equilibrium to the full body.
- 6. Enhances Coping Skills:** The sedentary lifestyle of students and teachers develops physical abnormalities and it also exerts stressful conditions among them. Yogic practice

develops the skills for coping with physical and mental stress. It improves a person's effectiveness.

7. **Improves Self-control:** Practicing controlled breathing in Yoga inculcates the habit of self-control. Thus, Yogic Practitioners do not react indiscreetly or make hasty decisions even in an emotional state.
8. **Protects Self-esteem:** It is a proven fact that Yoga is a very good technique to increase and protect self-esteem. It teaches awareness of the body and relaxes us using Asanas. Yoga is all about being kind to oneself, not about being exceptional at something. Yoga helps heal depression and supports self-regulation.
9. **Reduces Violence in Schools and Colleges:** Violence in schools and colleges is a result of mental illness, feelings of loss, anger, loneliness and powerlessness among students. As the practice of Yoga addresses these issues, it helps reduce violence in schools and colleges. In addition, Yoga offers an internal locus of control to the practitioners.
10. **Boosts Immunity:** Yoga along with a nutritional diet and habit of sound sleep enhances the natural defense mechanism of our body. It ensures the optimal functioning of all our body organs which regulates blood flow and thereby boosts immunity.
11. **Fetches Peace of Mind:** Yoga and Peace of Mind are essentially related to each other. Yoga promotes peace of mind by regulating the nervous system and helping mindfulness.
12. **Reduces Anxiety:** Yoga can help in reducing anxiety by connecting with the mind, body and environment. Certain poses and breathing techniques help overcome negative feelings, it calms the mind and offers peace of mind.
13. **Inspires Self-love and Self-care:** Yoga enhances our personality from within rather than looking good from the outside. It teaches us how to love ourselves. Along with self-love, caring for self comes automatically.
14. **Decreases Absenteeism in Schools and Colleges:** Yogic practice-induced mental and physical health increase immunity and thereby reduces the incidences of illness among the students and it allows them to remain present in their schools and colleges regularly.
15. **Enhances Attention Span:** It is found that the group practice of Yoga significantly improves memory, concentration and thereby enhances the attention span of the practitioner.
16. **Increases Mental and Physical Wellness:** Yoga increases energy levels in the body and eliminates fatigue. Hence it is highly recommended to achieve optimal health for students at a growing age where more physical and mental energy is consumed.
17. **Decreases Headaches and Eye Strain:** Students continuously read books and also constantly use mobile phones. This causes strain in their eyes and headaches. Yoga exercises relieve headaches and cut down strain in the eyes. students can enjoy better vision and eye comfort by adopting Yogic practices.
18. **Increases Motivation and Productivity:** Yoga refreshes the body and mind. It brings in more vitality. Hence students practicing Yoga as a study break report higher levels of motivation and productivity.
19. **Better Quality Sleep:** Sleep deprivation can result in low academic performance along with many other symptoms. Yoga increases the discharge of melatonin, a hormone that manages sleep resulting in a better quality of sleep.

Suggestions:

1. Government should take initiatives to impart quality education, research and training related to Yoga and Meditation.
2. Teachers with in-depth knowledge of Yoga and Meditation should be appointed in each of the educational institutions.
3. Appropriate financial provisions should be made for the strengthening of Yoga and Meditation practices in the field of education
4. Aware people about Yoga and Meditation importance.

Conclusion:

Yoga and meditation are beautiful practices with a lot of personal benefits, especially in youth. Youth may imbibe a strong, healthy body and mind through Yoga, which are the essential components for moving forward in life with potential. Thus, students and teachers in schools and colleges should be mandatorily involved in Yogic and Meditational practices.

Acknowledgment:

Authors are thankful to the students and teachers who have shared their experiences, views and opinions on the benefits of practicing Yoga and Meditation.

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THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM



ISBN: 978-93-100-0564-6

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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EFFECTIVENESS OF VEDIC MATHEMATICS TECHNIQUES IN CLASSROOM TEACHING OF SECONDARY SCHOOL

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Abstract: *Many students develop a fear of mathematics in elementary school. Often, this leads to negative consequences for the students. It brings down their confidence, motivation, interest, and self-esteem because of the fear they have developed towards mathematics. Once students reach secondary school, their fear of the subject invariably increases. Thus, they refrain from studying mathematics. To prevent this, teachers must approach the subject in different ways, which create interest, and curiosity towards mathematics. The most common ways to make mathematics easy, improve the calculation of speed, and enhance their accuracy are through Abacus and Vedic Mathematics. Consistency and regular practice of mathematics are the only ways to remove fear among students and improve their mathematical problem-solving ability. Vedic mathematics is an ancient technique based on 16 sutras that helps to solve mathematical sums and problems in an easier way in less time compared to conventional mathematical teaching. With the help of Vedic mathematics mathematical concepts and formulas, could be easily memorized and used to enhance their speed, accuracy and apply them in real-life scenarios. In a pilot study, 60 students from VIII standard class were used to conduct the study. All students of standard VIII must study mathematics as it is an irrevocable part of the curriculum. For this study, the researcher used the experimental method, has used pre-testing and post-testing techniques. The findings of the study lead to conclude technique of Vedic mathematics is more efficient than the conventional method of teaching Mathematics to secondary school students.*

Keywords: *Vedic mathematics, Abacus, accuracy, speed of calculations.*

Introduction

The National Policy of Education (NPE-1986) stated “Mathematics could be deliberated as a method to direct a child to evolve his intellectual capacity, to develop his rationality, and to coherent logically”. “All of us do not have equal talent but all of us have an equal opportunity to develop our talents”- APJ Abdul Kalam, so is Vedic Mathematics techniques, master of all calculations, the word Vedic is derived from Veda meaning powerhouse of knowledge. It was initiated by Swami Bharati Tirthaji in the year 1918. Based on 16 sutras helping in all branches of mathematics like Calculus, Geometry, Arithmetic etc. Vedic Maths provides logical thinking of calculations making it simple and getting correct results. Vedic mathematics is based on fundamental and basic principles. The main role of the teacher is to develop this type of thinking for that teacher himself or herself must be well versed with the Vedic mathematics techniques which can create interest towards the subject in the classroom teaching. Vedic mathematics manifold spiritual, metaphysical, psychic, psychological, ethical, philosophical, scientific attitude etc.

Need of the Study

There seemed to be a knowledge gap in using these Vedic Mathematics Techniques in this modern era of electronic gadgets, even small calculations are done using calculators and instead of training the brain logically; we train it mechanically. So, there was a need to adapt these techniques in the teachers who address the nation through young minds. So teachers themselves must be cleared with the techniques of Vedic mathematics. By imbibing Vedic mathematics techniques in their classroom teaching, teachers bring in change among the students. Vedic mathematics curbs the fear of mathematics among students, in turn, develops interest, improves accuracy, and mathematical calculation speed.

The following points can lead to the need for the research problem.

1. Vedic mathematics technique leads to a logical approach to solving mathematics.
2. Vedic mathematics technique is the key to bringing diverse change in solving calculation and speed of mathematical problems which marks as significant.
3. Vedic mathematics techniques will remove fear and bring about interest among students in solving higher-order thinking problems.
4. Vedic mathematics techniques in classroom teaching with smart calculation will be useful to reduce the time of normal calculation.

Statement of the Problem

The research was undertaken with the purpose of reducing fear and developing interest in mathematics, especially among students. The statement of research was "Effectiveness of Vedic Mathematics techniques in classroom teaching of secondary schools." The study was done with a motive to enhance the accuracy and speed of students in solving mathematical operations in a simple way that is faster. This would increase their performance in the subject as well as these techniques will be useful in many ways when students appear for competitive exams to score better.

Variables of the Study: The Variables in the present study are as follows:

Independent variables: Vedic mathematics, Classroom teaching

Dependent variables: Students achievement

Variables uncontrolled: Interest and attitude.

Variables controlled: Time and classroom conditions.

Operational Definitions of the Terms

Effectiveness:

In the study, effectiveness is described as a significant mean difference of a group over the other group on the posttest in terms of student achievement in Vedic mathematics techniques imparted in the classroom.

Vedic mathematics techniques:

Solving mathematical problems easily with the help of some sutras, specifically based on the book Vedic Mathematics, authored by Sri Bharati Krishna Tirath Maharaja (1884-1960) of Govardhan Peetha, Puri (India).

Classroom teaching:

This term will be used in this study to refer to the teaching using normal textbook-based methods for teachers.

Secondary school:

In this research secondary school refers to state board schools of std 8 to 10.

The Objectives of the Study

The following objectives have been formulated:

1. To create a positive attitude towards Vedic mathematics among students.
2. To create awareness about the significance of Vedic Mathematics among students.
3. To analyze the mathematical calculation speed of the students.
4. To compare the means, and score on the achievement in mathematics of the two groups of the students on the pretest.
5. To compare the means scores on the achievement in mathematics of the two groups of students on the posttest.

The Hypotheses of the Study

Based on the objectives of the study, the researcher has formulated null hypotheses. The researcher will test this hypothesis using statistics and either accept or reject the hypotheses to obtain findings for the research study.

1. The Vedic mathematics technique does not have a significant effect on the accuracy level of the pretest and post-test scores among secondary students.
2. The Vedic Mathematics technique does not have a significant effect on the speed of calculation of the pretest and post-test scores among secondary students.

Research Questions:

1. Vedic mathematics improves the speed of mathematical calculations.
2. Vedic mathematics improves accuracy level.

Review of Related Literature

Studies conducted in India on Vedic mathematics:

S.G. Dhani, School of Mathematics TIFR, November (1993)," Myths and Reality of Vedic Mathematics" mentioned Vedic mathematics over the years as the belief of being from ancient scriptures. Several people also started research in Vedic mathematics from this article.

S.G. Dhani mentioned Vedic mathematics is well appreciated in other countries and even taught in some schools of the UK and also insisted on how useful the techniques of Vedic Mathematics are especially in upcoming generations. Attitudes to both mathematics and history say it's high time to introduce Vedic mathematics techniques and create awareness. Bharadwaj s, Kashyap s, Shukla. A, July (2012) In Mathematical Journal of Interdisciplinary Science "A Novel Approach for Optimization in Mathematical Calculation Using Vedic Mathematics Techniques" mentioned that all the calculations and the ability to study this calculation using special formulas can lead to reducing the time for solving the problem and the accuracy is also tested. Mrs. Sahaja jiji. JJT University Rajasthan in March (2013), AMIERJ mentioned Vedic mathematics is an important part of life and can be taken as a task for magical methods of fast calculation by using simple rules which can improve confidence. K Krishna Prasad January (2016) , IJMIE, "An Empirical Study On Role Of Vedic Mathematics In Improving The Speed Of Basic Mathematical Operations" quoted that Vedic mathematics is an Indian ancient system of operation can be used for BPO, FDA, SDA, IBPS exams where it is necessary for Calculation, reasoning etc. and also mentioned above Kenneth William, Andrew Nicholas and Jeremy pickle who extended the lecture in different places of London from the introductory book of Bharati Krishna Tirthaji.

Dhara R Joshi, August (2017), "Vedic Mathematics in Modern Era" mentioned the effectiveness of Vedic Mathematics helps in speed and accuracy also can overcome the fear

that can impact positive attitude for the development of different mental abilities for UPSC, GPSC, CET, JEE etc. Ajay Shukla, R.P. Shukla and Ajay Pratap Singh in the International Journal of Education Of Applied Social Science August (2017) based on a "Comparative Study Of Effectiveness Of Teaching Mathematics Through Conventional And Vedic Mathematics Approach" stated that Vedic Mathematics is Highly Effective compared to the normal approach of calculation the achievements in mathematics can be ruled out to overcome knowledge gap.

W.B. Vasantha Kandaswamy, Florentine Samarandache (2006) based on "Vedic Mathematics of Fuzzy Analysis" believed that Vedic mathematics had some strong sense of moves and makes mathematics easy. Findings believe that it may spoil student-teacher relationships but the sutras of Swami Bharathi Thirthji showed the power of extraordinary techniques. Dr Smitha. S in International Journal Of Scientific Research And Management "Strengthening Critical Thinking Skills Of Prospective Teachers Through Applications Of Vedic Mathematics". mentions that a personal skill and competency need to be developed for teachers in this 21st century that imparts critical thinking through Vedic mathematics techniques in teachers' education.

Studies Conducted in Abroad on Vedic mathematics:

Kenneth Williams (1991) - The native of formulas of mathematics lacks calculations with its techniques can be useful for the coming generation so it is important to adapt to the techniques of Vedic Mathematics in order to solve the problem in a simple and defeating manner. Kenneth R Williams (2003) "The system of Vedic mathematics -A comparison" stated that Vedic mathematics improves mind and agility also brings creative faculty. Kenneth Williams (2009) "Statistics and Vedic mathematics", The Crowning Gem - Inspiration Book VK 2013 by extending Swami Tirthji mentioning that the methods are simple and easy to understand and one needs to practice a lot to mastery of Vedic Mathematics that features simplicity directness and reproducibility. James Glover October (2013) "The Psychology Of Vedic Mathematics" consider it as a delightful activity with a mental process that is natural open minded with the help of sutras which provides different way of solving problems with some elements of spirituality that manifold to develop interest.

Research Design:

In the present study, the experimental research method was used because research framed the effectiveness of Vedic mathematics of the experimental group. A pre-test and a post-test were conducted among a group of 60 students of class VIII, before and after introducing the Vedic Mathematics technique. The experiment lasted for two weeks, including the preparation time. The time and score of the students were recorded and analyzed on the same day as the data collection. The researcher taught the students a new technique of solving problems and gave them sufficient practice to learn and imbibe it. Before and after the teaching, the researcher gave the students a pre-test and a post-test, each with questions of the same difficulty level that could be completed in 15 minutes. The researcher compared the time and accuracy of the students using the traditional method and the Vedic mathematics method. The results for accuracy and time of submission to check the speed of calculation were recorded for each test and each technique. The students were enthusiastic about learning Vedic Mathematics and attended all the classes. Initially students took some time to sense the technique in the first two days, but then they appreciated it and

wanted to learn more. They also asked for other techniques that could simplify and accelerate other mathematical operations. The researcher modified the sessions based on the students' requirements. For instance, some students required more practice and clarification at a lower speed, while some required additional sheets to work on. By the end of the training program, 83.33% of the students had enhanced their performance considerably.

Sample of the Study:

An experimental and control group of 60 students of standard VIII (English Medium) were used to conduct this study.

Analysis of Data:

The following statistical techniques were used for analyzing the data.

Descriptive statistics of Performance for the Total Sample.

The following table shows the measures of central tendency namely mean, median, mode, and measures of variability namely standard deviation of performance for the total score of the sample.

Table 1.1 Descriptive Statistics of Performance

Test	Sample Size	Mean	Median	Mode	S.D
Pre-Test	60	6.95	7.5	8	2.100
Post Test	60	8.32	9	10	1.678

Descriptive statistics of time taken for the total sample.

The following table shows the measures of central tendency namely mean, median, mode, and measures of variability namely standard deviation of time taken for the total score of the sample.

Table 1.2 Descriptive Statistics of Time Taken

Test	Sample Size	Mean	Median	Mode	S.D
Pre Test	60	12.643	13.225	15	2.223
Post Test	60	6.013	5.4	8.3	2.869

Testing of Hypothesis 1

The Vedic mathematics technique does not have a significant effect on the accuracy level of the pre-test and post-test scores among secondary students.

The statistical technique used to test this hypothesis was the t-test.

The following table shows the significance of the difference in the performance of the students.

for solving the sums in the pre-test and post-test.

Table 1.3 Descriptive Statistics of Performance

Test	Sample Size	Mean	S.D	T ratio	L.O.S
Pre Test	60	6.95	2.100		
Post Test	60	8.32	1.678	6.5539	2.001

1. H_0 hypothesis

Since the $p\text{-value} < \alpha$, H_0 is rejected.

The After-population's average is not equal to the Before population's average.

In other words, the sample difference between the averages of After and Before is big enough to be statistically significant.

2. P-value

The $p\text{-value}$ equals $1.532\text{e-}8$, ($P(x \leq 6.5539) = 1$). It means that the chance of type I error (rejecting a correct H_0) is small: $1.532\text{e-}8$ (0.0000015%). The smaller the $p\text{-value}$ the more it supports H_1 .

3. Test statistic

The test statistic T equals 6.5539, which is not in the 95% region of acceptance: $[-2.001, 2.001]$.

The 95% confidence interval of After Minus Before is: $[0.9494, 1.7839]$.

4. Effect size

The observed effect size d is large, 0.85. This indicates that the magnitude of the difference between the average of the differences and the expected average of the differences is large.

Testing of Hypothesis 2

The Vedic Mathematics technique does not have a significant effect on the speed of calculation of the pretest and post-test scores among secondary students.

The following table shows the significance of the difference in the Time taken by the students. for solving the sums in the pre-test and post-test.

Table 1.4 Descriptive Statistics of Time Taken

Test	Sample Size	Mean	S.D	T ratio	L.O.S
Pre Test	60	6.95	2.100		
Post Test	60	8.32	1.678	-14.6198	2.001

1. H_0 hypothesis

Since the $p\text{-value} < \alpha$, H_0 is rejected.

The After-population's average is not equal to the Before population's average. In other words, the sample difference between the averages of After and Before is big enough to be statistically significant.

2. P-value

The $p\text{-value}$ equals $2.826\text{e-}21$, ($P(x \leq -14.6198) = 1.413\text{e-}21$). It means that the chance of type I error (rejecting a correct H_0) is small: $2.826\text{e-}21$ ($2.8\text{e-}19\%$). The smaller the $p\text{-value}$ the more it supports H_1 .

3. Test statistic

The test statistic T equals -14.6198, which is not in the 95% region of acceptance: $[-2.001, 2.001]$. The 95% confidence interval of After Minus Before is: $[-7.538, -5.723]$.

4. Effect size

The observed effect size d is large, 1.89. This indicates that the magnitude of the difference between the average of the differences and the expected average of the differences is large.

Scope and Delimitations of the Study:

1. The study was confined to Mathematics Subjects only.
2. The study was delimited to the Thane District only.
3. The study was delimited to the Secondary Section class only.
4. The study was delimited to English Medium Students only.

Significance of the Study:

Number plays a fundamental role in mathematics and Vedic Mathematics can demonstrate this to some extent, even if the use of electronic gadgets distracts the student's mental calculation ability. Vedic mathematics is essential for any competitive exams and effective in the teaching-learning process; the unique sutras in Vedic mathematics and extraordinary techniques that can assist in understanding concepts of the study of multiplication, square, square roots, cube, and cube roots play a part in any calculations. Vedic mathematics delivers answers in one-step calculation.

Discussion

Post-test scores and time taken by the students clearly reveal that Vedic Mathematics technique was more beneficial, easy to understand and led to a greater extent speed of solving problems.

Major Findings of the study

The Vedic Mathematics technique enhanced the students' problem-solving skills significantly. They could solve more problems correctly and with fewer errors than using standard methods. The Vedic Mathematics technique boosted the students' problem-solving speed significantly. They could solve square and square root problems quicker than using the traditional method.

Suggestions**The teacher can use the Vedic Mathematics Techniques as it helps to:**

- Overcome the fear of Mathematics.
- Save time by doing calculations faster and easier. This is especially useful for exams and competitions that have time limits.
- Reduce errors by using fewer steps to solve problems.
- Master computational skills by using mental methods and reduce the reliance on devices like calculators, computers etc.
- Enhance the mind, mental ability, cognitive ability, intelligence, and brain development by increasing visualization and concentration abilities. This is one of the main reasons why mathematics is included in the school curriculum.
- Simplify difficult and complex mathematical operations with easy techniques.
- Preserve and use the rich heritage of Vedic Mathematics in India. Why make the students struggle with long and complicated calculations when we have the most amazing technique to make life easier for them.

Conclusion

Vedic Mathematics can be learned from a young age with basic knowledge of multiplication table. It helps to use both the left and the right brain hemisphere. The left brain handles language and logic, while the right brain handles vision and intuition. This improves memory and concentration. By doing calculations mentally without a pen or paper, you also focus better and develop concentration skills. Vedic Mathematics is a set of 'tricks' that makes solving mathematical calculations easy. It is a unique technique based on simple

principles and rules that can solve any kind of mathematical problem orally. Using Vedic Math more often can surely make the subject more interesting for children who usually fear it. Still, there is a vast scope for further research on various different techniques of Vedic mathematics

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"SOCEN - 2023"

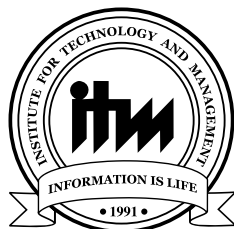
International Research Conference on
the theme

Social and Environmental Sustainability - A Management Perspective (SOCEN'23)

Dates: 4th, 5th, & 6th October 2023
Kharghar, Navi Mumbai

Organised by

ITM BUSINESS SCHOOL KHARGHAR
NAVI MUMBAI



Published by **ITM Business School**

25 & 26 Institutional Area, Sector - 4, Kharghar (E), Navi Mumbai 410 210

ISBN : 978-93-5967-434-6

Message from the Convenor

The concept of sustainability has pervaded the world, and society at large. Numerous authors have written on the topic, each expressing unique ideas of where sustainability might lead society and how it can help entities. Among the various dimensions of sustainability (Human, social, economic and environmental) social sustainability has not been discussed much (Eizenberg and Jabareen 2017). The social dimension is key to the concept of sustainability as it emphasizes on the well-being of humans (Janker 2020). On the other hand environmental sustainability has become the pressing need of the hour.

Keeping in view the importance of Social and environmental sustainability in today's world, ITM Business School, Kharghar organized three days International Research Conference "SOCEN-2023" on 4-6th October, 2023. This conference seeks to bring ideas and thoughts on social and environmental sustainability from a management perspective to create a better tomorrow.

The conference was great success witnessing 110 papers from India and overseas. Renowned researchers from across the globe shared their insights as key note speakers. These included :

Dr Paurav Shukla : University of Southampton, UK

Dr Sunil Sahadev : University of Brighton, UK

Dr Stephen Wilkinson : UNOWD, Dubai

Dr Festus Victor Bekun: Istanbul University, Turkey

Dr Narasingha Das : Lebanese American University, Lebanon

Dr Avik Sinha : MDI Gurgaon

Prof P.J Mathew : Chief Mentor

The conference proceedings consists of abstracts and papers of all three dates. My best wishes to the participants and happy reading.

Dr Sangeeta Trott

Convenor

Message from the Director

SOCEN is an expression of the fact that the earth is common to all, and we need to plan and act on preserving it for our future generations! This theme of our conferences propelled researchers to probe deeper into social and environmental sustainability and create awareness and a sense of care for nature which has always been generous to mankind.

I extend my heartfelt congratulations to Dr Sangeeta Trott and the team on the successful publication of the conference proceedings for SOCEN 23. This marks a significant milestone for our institute and showcases the culmination of the hard work and dedication put forth by all involved in the Research Department team and is a testament to the institute's commitment to excellence. The conference witnessed 110 papers that were presented in the three days by students, academicians and corporates. The proceedings encapsulate cutting-edge research, innovative ideas, and diverse perspectives presented during the conference. Thanks to all the guests from academia and corporate who made remarkable references on how we can save the planet from further plunder.

I encourage everyone to spread the word about the publication and to explore the contents of the proceedings. Thank you, Researchers, for your outstanding contributions, and we look forward to celebrating many more successes together in the future.

Wishing all the best and happy reading.

Regards

Dr Lakshmi Mohan

Pro Vice Chancellor- ITM Skills University

Director- ITM Business School

Message from the Dean

It is my pleasure to congratulate all participants of the conference hosted by ITM Business School, ITM Skills University, Kharghar. The conference brought together scholars, researchers, and industry practitioners from diverse fields to engage in interdisciplinary dialogue and exchange of ideas. The theme of the conference was Social and Environmental Sustainability - A Management Perspective which reflects our commitment to addressing pressing challenges and advancing knowledge in the field of sustainability and green economy. Through a series of keynote presentations, panel discussions, and paper presentations, we had the opportunity to explore innovative approaches, share best practices, and collaborate on solutions to some of the most pressing issues of society. I am particularly excited about the breadth and depth of topics that are covered in the conference proceedings. From cutting-edge research in sustainability to transformative initiatives in social empowerment, the diversity of perspectives represented in this forum underscores the richness and dynamism of our academic community. I would like to congratulate the conference organizers, committee members, and all those who have contributed to the planning and execution of this event. Special compliment to the team for bringing out this conference proceeding. The organizing committee's hard work and dedication have been instrumental in ensuring the success of this conference and the publishing of this conference proceedings and I appreciate your efforts. It is through such scholarly interactions of all of you that we could collectively advance our understanding of complex issues and drive positive change in our respective fields. I wish you all had a stimulating and productive conference experience. May this proceeding here be marked by fruitful insights and meaningful future research that will continue to inspire you and the intellectual community at large.

Best wishes!!!

Dr. Sarit Prava Das

Dean Academics

INTERNATIONAL RESEARCH CONFERENCE SOCEN 2023

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Analysis of Work Life Balance Among Teachers in Self Financing Degree Colleges of Mumbai University

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Abstract

Work-life balance among teachers is a critical aspect to enhance teacher effectiveness and satisfaction in the context of student learning. It has been observed that good quality of work life balance results into the wellness of the faculty and also improved student behaviour. The present study investigated the quality of work-life balance among Mumbai University affiliated Self-Financing Degree College teachers serving in different academic stream across universality and colleges. The purpose of present study is to highlight the necessity of adopting work-life-balance policies for teachers teaching at degree college level. Various factors like designation of the teachers, their nature of appointment, the academic stream in which they are teaching and the nature of their serving institution will be considered for study.

Keywords: Work Life Balance, Professional Life, Personal Life, Self-Financing Degree College, Mumbai University.

Introduction:

With globalisation in the World, the working environment has changed worldwide and it is necessary to adopt work life balance(WLB) strategies in such environment. In every organisation human resource plays a vital role for employees in maintaining their work life balance.

There are two aspects of Work Life Balance such as career development and the family caring. With the growth and development in educational, technology and social standards, the role of teachers have undergone a change where they find it difficult to maintain balance between their professional and personal life.

The present study investigated the quality of work-life balance among Mumbai University affiliated Self Financing Degree College teachers serving in different academic stream across universality and colleges. The purpose of present study is to highlight the necessity of adopting work-life-balance policies for teachers teaching at degree college level.

Objectives:

- 1) To study the level of Work Life Balance among different Teachers of Self Financing Degree College.
- 2) To identify the various factors that influences Work Life Balance.
- 3) To find out the stress level and its impact on the performance at job and discharging the family and social commitments.

Review of Literature:

Dr. Meena Rajiv: This study focuses on the work-life balance argues faced by faculty members in self-financed engineering colleges affiliated with Mumbai University. It identifies the factors affecting work-life balance and suggests remedies for improvement.

Dr. Aniket Patel: This study reveals the relationship between use of technology and work-life balance among college professors in self-financing colleges affiliated with Mumbai University. It investigates the extent to which technology is blessing or curse for work-life balance.

Dr. Shalini Desai: This case study studies the work-life balance experiences of college teachers in self-financing colleges affiliated with Mumbai University. It enquires the role of workload, institutional support, and personal preferences in achieving a healthy balance.

Dr. Rahul Khanna: This exploratory study researches the link between work-related stress, exhaustion, and work-life balance among self-financing college teachers of Mumbai University. It discovers the contributing factors and proposes approaches for managing stress.

Dr. Priya Gupta: This comparative study examines the impact of gender on work-life balance among university teachers, specifically comparing Mumbai University and Pune University. It observes how gender roles and institutional differences influence work-life balance outcomes.

Research Methodology:

For conducting this study primary data will be collected from 50 teachers teaching at degree levels at the academic and professional courses in private sector. The data was collected to understand their working hours, commuting time, household commitments, financial implications and the challenges to fulfil expectations of family members.

Data Analysis:

The data was analysed using Percentage Analysis.

Findings:

- 1) 50% of the Respondents are from Unaided Colleges, 31.2% from Autonomous Colleges and 18.8% from University.
- 2) 87.5% Respondents are Assistant Professors, 6.3% Professors and 6.2% from Other Category.
- 3) 56.3% Respondents were on Permanent Position, 37.5% are on Temporary Position and 6.2% are Visiting Faculty.
- 4) Out of Total Respondents 50% are Approved Staff and 50% are Unapproved Staff.
- 5) 62.4% of the Respondents are in the Income Range of 1lakh to 5lakh, 18.8% are from Income Range of 5lakh to 10lakh and remaining 18.8% are from 10lakh and above Income Group.
- 6) 43.8% respondents are from age group of 41-50 years, 37.4% from age group of 31-40 years and balance 18.8% from 21-30 age group.
- 7) 56.3% of the respondents are female and 43.7% are males.
- 8) 87.5% respondents are married and 12.5% are unmarried.
- 9) 56.3% respondents are having working spouse whereas 43.7% respondents do not have working spouse.
- 10) Highest Number of Dependents in family are 6 and lowest number of dependents is 1.
- 11) 56.3% of the Respondents belongs to Nuclear Family and balance 43.7% belongs to Joint Family.

- 12) 25% of the respondents are working for 5 Hours daily whereas 75% of the respondents are working between 6 hours to 8 hours.
- 13) 62.5% of the respondents are getting Leaves as per University Rules whereas 37.5% are not getting leaves as per University Rules.
- 14) 10% of the respondents have Teaching workload of 15 to 20 lectures per week whereas 85% of the respondents have 21 to 30 lectures per week and 5% of the respondents have flexible workload.
- 15) 81.3% of the respondents are not doing any part time work whereas 18.7% of the respondents are doing part time work.
- 16) 56.3% of the respondents replied that various kind of training increase their backlog of work and 43.7% replied that due to training it is not increasing their backlog of work.
- 17) 62.5% of the respondents reacted that they do not get Me time whereas 37.5% of the respondents reacted that they are getting Me time.
- 18) 81.3% of the respondents felt that the designation of a teacher affect their quality of work life balance whereas 18.7% of the respondents felt that their designation do not affect their quality of work life balance.
- 19) 68.8% of the respondents replied that their gender affect quality of work life balance whereas 31.2% of the respondents replied that their gender affect quality of work life balance.
- 20) 68.8% of the respondents are satisfied with their family life and self life ,18.8% are dissatisfied with their family and self life,6.3% of the respondents are Highly Satisfied and Highly Dissatisfied with their family and self life.
- 21) 75% of the respondents are satisfied with their Job and Flexible Environment whereas 12.5% of the respondents are highly dissatisfied .
- 22) 93.8% of the respondents are aware about work life balance and 6.3% of the respondents are unaware about work life balance.
- 23) 75% of the respondents are able to meet Household Commitments and 25% are not able to meet Household Commitments.

Suggestions:

- 1) Things of irrelevant nature should be avoided.
- 2) As we are social human being, do meditation when ever get time and spend time with nature and family.
- 3) Prioritize your health.
- 4) Government Authorities have same rules of approved teachers by UGC.
- 5) Provide healthy environment for work.
- 6) Each one have to learn and implement the balance mechanism.
- 7) All colleges should provide leaves to their employees as per University Norms.

- 8) All colleges should follow Working Hours and Work Load as per University Norms.
- 9) Minimum training programmes to be arranged by Colleges.
- 10) Authority responsibility relationship should be properly defined.

Conclusion:

The Present study reveals that Work Culture available in Colleges have it's impact on Work Life Balance of Teachers at large. In changing scenario, teachers have so many assignments with teaching workload, research and extension activities that work pressures are laying negative impact on their professional as well as personal life. Hence policy makers, educational institutions and the teachers themselves need to take care of this aspect.

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Sustainable Volunteering among Generation Z: An Attitudinal Survey

¹Sandeep Bhanot, ²Dr. Arjita Jain,

THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM



ISBN: 978-93-100-0564-6

EDITOR

DR. EKNATH MUNDHE

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

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This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

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Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

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KUNDALINI AND CHAKRAS: INVESTIGATING THE ENERGY CENTERS AND THEIR SIGNIFICANCE IN THE PATH OF ENLIGHTENMENT

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Abstract: Human body consist of seven chakras and each chakra has its significance role in human life therefore it is necessary to understand the role of each chakra in our life so in this present study we have considered the seven chakras and their significance and also studied how the imbalance of this chakras leads to various diseases and we have focussed on the importance of meditation and yoga in balancing this 7 Chakras and making human life Joyful and Peaceful.

Keywords: Chakras, Human Body, Meditation, Yoga

Introduction

In 21st Century where we all human beings are exposed to excessive use of smart phones and social media because of which thought pollution is increasing and we are losing emotional connect in our day to day relations therefore feeling of loneliness and various diseases are on rise. In this regard it is necessary to study the importance of yoga and meditation in balancing all the seven chakras of human body we have focussed on investigating on Kundalini, the energy centres and their significance in the path of enlightenment.

Objectives of the study

- 1) To understand the Kundalini Energy.
- 2) To identify the significance of seven chakras in human life.
- 3) To discover the significance of Yoga and Meditation in balancing seven Chakras.

Research methodology

The data is collected from Secondary Sources like Newspapers, Articles and websites.

Discussion

1.1 What is Kundalini?

Human body is like a machine. As a Machine requires energy to run it, human body also requires energy to perform various functions and the energy which is required to perform all the functions of human body lies in the upper and lower halves of the body. This divine force or consciousness is called as the *Kundalini Shakti*. When this *Kundalini Shakti* is stimulated and rises within us, then our entire life becomes happy and joyful.

1.2 What are chakras?

Human body consist of 1,72,000 *nadis* and this nadis have 109 nerve centres out of which nine centres are important, and even in those nine, seven centres are of primary importance where the seven Chakras are situated.

1.3 What are the seven *chakras* and where are they located in the body?

- The first *chakra* is at the base of the spine, at beginning of the anus and is called The Root Chakra(*Muladhara*).
- Just above that is the next *chakra* which is called The Sacral Chakra(*Svadhishthana*).
- The third *chakra* is just above the navel and is called The Solar Plexus Chakra (*Manipura*).
- Above that is the Heart Chakra (*Anahata chakra*) which is in the center of the chest
- Then comes the throat *chakra* called *Visuddha*.
- Above that is the *chakra* in-between the eyebrows called The Third Eye Chakra(*Ajna*)
- The last *chakra* is on top of the head called The Crown Chakra (*Sahasrara*).

1.4 Significance of Chakras in Human Life:

- 1) The Root Chakra connects our mind, body and soul with the earth. It gives us the feeling of being close to the earth.
- 2) The Sacral Chakra is associated with the lymphatic system and is responsible for expressing emotions.
- 3) The Solar Plexus Chakra is associated with Self-Confidence, Self-discipline and wisdom.
- 4) The Heart Chakra is responsible for emotional healing and sound mental health.
- 5) The Throat Chakra is responsible for expressing the Truth and sharing your opinion with others.
- 6) The Third Eye Chakra is responsible for garnering information about yourself and beyond the materialistic world.
- 7) The Crown Chakra is responsible for the direct connection with the almighty and conscious energy. Balancing this chakra will help us in balancing our other chakras and gaining insight into ourself.

connect with the panchtattva of nature by practicing meditation and yoga on daily basis which will help in balancing chakras and will create a positive Aura. A person with positive Aura will spread positive energy in the environment which will improve our physical, mental and spiritual health.

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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STATUS OF AYURVEDIC HEALTH TOURISM IN INDIA

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Abstract: *Ayurveda is considered as the oldest form of medicine that was originated and nurtured in the Indian subcontinent for centuries. Being an interesting feature of tourist attractions, today, India is emerging as an important health tourism destination because it has several pull factors like excellent Ayurvedic treatment at low cost, easy accessibility to Ayurvedic medicine, and Ayurvedic treatment centers with scenic locations for excellent holidays. National and international acceptance of Ayurvedic healing has widened the boundaries and prospects of Ayurvedic health tourism. With this background, the present paper attempts to understand the concept of Ayurveda, the scope for health tourism owing to Ayurveda and suggests measures for the growth of Ayurvedic tourism based on both primary and secondary data.*

Keywords: *Ayurvedic, Tourism, Status, India, Health.*

Introduction

Tourism and its influences on livelihood are a very old phenomenon. Tourism provides a number of opportunities to the people who are remotely located. The host region gains multiple benefits from tourism services in the form of money and other developmental aspects. Today, tourism has become an important policy tool dedicated to the change, development and reconstruction of physical and sociocultural environments and thus, as an industry, it defines and influences not only physical landscapes, land use and planning but also social structures, local cultures and other regional and local economies (Saarinen J., 2008). Tourism is classified into various types including religious tourism, heritage tourism, historical tourism, adventure tourism, ecotourism, agro tourism, health tourism etc.

Health tourism has mainly advanced in the last three decades (Kaspar, 1990; Garcia-Altes, 2005; Reisman, 2010) and includes a variety of key participants such as advisers, healthcare providers, insurance companies, information websites and media services (Neil et al. 1015). Individuals seeking alternative medicine therapy look for low-cost procedures for complicated surgeries such as heart, cosmetics and knee replacement which are provided by Ayurveda at destinations like Thailand, Singapore, India and Taiwan (Ye, Qiu and Yuen, 2011), Malaysia (Musa, Thiru Moorthi, and Doshi, 2012). Also, nowadays, instead of seeking long-haul destinations, tourists prefer shorter trips and well-known destinations. It is expected that by 2030, health tourism will represent 31% of international tourism (UNWTO 2013).

Health tourism refers to travelling to other countries to obtain medical, dental and surgical treatment¹. Or the practice of Travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, Health care travel and medical care travel². Health tourism refers to travelling to other countries to obtain medical, dental and surgical treatment¹. Or the practice of Travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, Health care travel and medical care travel². Health tourism refers to travelling to other countries to

obtain medical, dental and surgical treatment¹. Or the practice of travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, health care travel and medical care travel².

In recent times, India has emerged as a popular destination for health tourism and marketing. Ayurveda as a part of it has brought a new definition to vacationing in India. The reasons for this are that it comprises low medical cost as compared to other countries, use of non-toxic, harmless herbs resources, etc. Also, the waiting time for treatment in India is much lower as compared to other countries (Murlidhar, S. and Kartikey, P. 2016). The Make in India initiative of the Indian government, including Ayurveda is a part of the 'Wellness' industry. However, India has not yet achieved its full potential in the field of Ayurvedic health tourism. With this background, the present paper attempts to understand the current scenario of Ayurvedic health tourism in India and provides feasible suggestions to cope with the situation.

Objectives

The present study aims to understand the status of Ayurvedic health tourism in India which has been achieved with the help of the following objectives

1. To understand the concept of Ayurveda.
2. To recognize the scope for health tourism owing to Ayurveda.
3. To give suggestions for the development of health tourism on account of Ayurveda.

Methodology

The present research is of a theoretical nature and is based on both primary and secondary data sources. The secondary sources include government publications, survey reports, research papers and news articles, while the primary information was obtained by conducting interviews with tour organizers, Ayurvedic treatment centers and Ayurvedic health tourists.

Discussion

The study on Ayurveda health tourism has revealed that Ayurveda is one of the well-accepted medical practices in India. An average of 83% of the respondents agreed that Ayurvedic health tourism has an optimistic future. They are hopeful that, the process of globalization and GATT agreement will play an important role in the development and spread of this sector. A favorable visa policy adopted by the Indian government will definitely serve the purpose. A majority of the respondents have emphasized the need for the commercialization of Ayurvedic health tourism. As per many respondents, propagation of information on the advantages of Ayurveda, and effective advertising of Ayurvedic medicine with allied products and health care centers is needed. Respondents are also of the view that the medical researchers should ensure effective treatment even at the last stage of the disease which provides immediate relief to the patient. According to 38% of the respondents, an inclusive approach is essential for the development of Ayurvedic health tourism, which means aspects such as infrastructural development, support from the government, standardization of health-related services, favorable policies for allocation and extension of Indian Visas etc.

A Glimpse of Ayurveda

Ayurveda is one of the popular traditional streams of medicine that has continued and grown for centuries and continues to be even today. Evolved over two-plus millennia, Ayurveda is one of the accepted medical systems. It includes Yoga, Meditation, Pranayama, special nutrition, herbal medicines, reflexology, cathartics etc. Ayurvedic preparation hinges on complex herbal compounds, minerals, and metallic substances. It has also included some surgical techniques.

According to Ayurveda, there are three primary energies in the body viz. Vata, Pitta and Kapha. Each of these three doshas has its own distinctive abilities and a disproportion in any of these can result in different health problems. Studies also revealed that suppression of natural urges is considered unhealthy and may lead to illness.

Ayurveda is categorized into eight branches which are together known as ‘Ashtanga Ayurveda’. The meaning of word ‘Ashtanga’ is eight parts or branches including Kaya Chikitsa (Internal Medicine), Baala Chikitsa (Paediatrics treatment), Damstra Chikitsa (Toxicology), Shalya Chikitsa (Surgery), Jara Chikitsa (Geriatrics), Graha Chikitsa (Psychiatry) and Vrishya Chikitsa (Aphrodisiac therapy), Urdhyanga Chikitsa (treatment of eyes, nose, and throat, head related diseases). With the vast knowledge of natural medicine, this alternative medicine structure will be sustained in the future. Several avenues are yet to be explored by the experts, scholars, researchers and medical practitioners in the field of Ayurveda which will help to keep this traditional medicine system alive and contribute to its growth. Nonetheless, it is because of the inadequate literary evidence and lack of awareness among the masses about the basic principles of Ayurveda, that the knowledge of Ayurveda has not been properly disseminated and reached some of the countries in the world.

Advantages of Ayurvedic health treatment

1. **Weight management:** This relates to Body Mass Index (BMI) and depends upon particular body weight, and lifestyle to maintain the desired body weight. Ayurveda provides an efficient weight management process by suggesting a suitable diet, exercise and helpful practices.
2. **Healthy skin:** Ayurvedic oil massage not only deeply moisturizes but also gives glowing skin.
3. **Stress management:** Stress is ubiquitous. Ayurveda offers Yoga practice to reduce stress levels with physical benefits and mental benefits. Often it is advised to devise specific Yoga practices to reduce and prevent stress.
4. **Body cleansing:** Ayurveda offers an assured process of body cleansing by suggesting a detox diet and several other natural methods of cleansing.
5. **Manage blood pressure:** Ayurveda offers home remedies that help to regulate blood pressure and a healthy heart.
6. **Prevent immunity disorder:** Ayurveda promotes a nutritious diet, appropriate exercise and sound sleep with the regular practice of Yoga, Pranayama and Meditation. All these methods help boost immunity.
7. **Chronic pain:** Chronic pain is associated with several physical and mental health conditions like depression, lack of sound sleep, social isolation, overuse of medicines etc. Yoga, Meditation, Deep breathing techniques, progressive muscle relaxation and cognitive behavioral therapy offered by Ayurveda help to reduce chronic pain.

- 8. Gastrointestinal Problems:** This refers to problems in the digestive system and its treatment is important for maintaining good health as it plays a significant role in the absorption and circulation of nutrients and the elimination of toxins and wastes from the body. Ayurveda suggests preventive care and curative medicine to cope with gastric issues.

Benefits of Ayurvedic health tourism

There is numerous Ayurvedic health care centers spread across the country that offer health treatment services including *Panchakarma*, *Shirodhara*, *virechana*, *vaman*, *basti*, *nasyam treatment*, *raktmokshan*, *abhyanga*, *Kati vasti* etc. Most of these centers play an important role in developing the tourism industry that offers several benefits at individual, institutional and national levels as a whole. Some of these benefits are stated below.

1. Ayurvedic health tourism is one of the ways to generate foreign exchange.
2. Employment and job opportunities offered by Ayurvedic health tourism may restrict brain drain.
3. Ayurvedic tourism boosts growth in Gross Domestic Product (GDP) and helps in revenue generation due to the growth of national and international tourism.
4. After the pandemic of COVID-19, Ayurvedic practices have gained significance in the health and tourism industry with India's magnetic influence making it the most desirable destination for tourists across the globe.
5. Ayurvedic health tourism explores new technology.
6. People from other countries can get cheaper Ayurvedic treatment in India than they get in their own country.
7. Ayurvedic health tourism delivers effective and efficient medical services at low cost.
8. This healthcare system promotes the plantation of a variety of medicinal plants, resulting in many environmental benefits.
9. Ayurveda health tourism improves political friendship.
10. Promotion of Ayurvedic health tourism ensures development in infrastructural facilities, such as job and employment opportunities in various sectors, particularly in hotel logistics and transportation industry.

Suggestions

1. Ayurveda is one of the most commonly accepted health resources all through the world. However, it is lacking in commonalities in its different aspects. Thus, there is an utmost need to develop globally accepted standards in terms of guidelines and classifications, as well as integrate Ayurveda into the health system. This will enable one to compare the data on various facets of Ayurveda. Standardization of services should be ensured.
2. Most of the Ayurveda literature is available in Sanskrit and Hindi languages, which needs to be translated into at least major languages being spoken across the globe.
3. Research in Ayurveda should be strengthened to bring preciseness in diagnosis, treatment and recognition of medicinal effectiveness.
4. Enhancement of both preventive caring facilities and the production of curative medicine should be ensured in Ayurveda.
5. An entrepreneurial attitude should be developed among those involved in the field of Ayurveda.

6. A regular supply of input/raw materials for the production of Ayurvedic medicine should be ensured.
7. Traditional skills related to Ayurveda should be documented and preserved properly.
8. Quality control measures in the field of Ayurveda should be initiated.
9. Ayurveda treatment centers should be provided with basic infrastructure and facilities including land, water and electricity supply, loans on low-interest rates, concessions in medicinal sales tax, marketing facilities etc.
10. Indian brands in Ayurveda should be built abroad to strengthen the marketing of Ayurvedic medicines, devices and services.
11. Inter-sectorial coordination between the health and tourism sectors should be promoted.
12. Information on the advantages of Ayurveda should be disseminated by means of appropriate broadcasting technology.
13. A traveler's traveler-friendly scheme for receiving medical visas should be implemented in order to make the process of travel smoother across international borders.
14. A provision should be made to extend visas depending on the health condition of the traveler.
15. Governments should play a crucial role in the development of Ayurvedic health tourism.
16. Ayurvedic health tourism can be developed by adapting Public-private partnerships.

Conclusion

Ayurvedic health tourism is not new to India. In this country, it has been practiced since time immemorial. Nowadays it is gaining a lot of popularity as people are health-conscious and interested in seeking quality health services at low cost and without any side effects. Efforts are being made by the government of India, non-government organizations, and at the individual level to popularize Ayurvedic health tourism. The study revealed that, in spite of many efforts, Ayurvedic health tourism is not developed at its full potential. Thus, there is an utmost need for its popularization by using social media. Government and non-governmental organizations should make special efforts to utilize the country's full potential of Ayurvedic health tourism by adopting a policy of Public-private Partnership.

Limitations of the Study

Due to the paucity of sufficient data on Ayurvedic health tourism in India, the present study relies on the theoretical information obtained from secondary sources. It limits the use of suitable statistical and cartographic techniques in this paper.

Acknowledgment

Authors are highly grateful to the tour organizers and in charge of Ayurvedic health care centers for sharing their views, opinions and experiences on the present scenario of Ayurvedic health tourism in India.

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Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges



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Title	: Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges
Editor Name	: Dr. Lal Mervin Dharmasiri, Dr. Praveen G. Saptarshi, Prof. Dr. S. D. Shinde, Dr. F. M. Nadaf, Dr. Bhimashankar. M. Bhanje, Dr. Jyotiram More, Dr. Harish. B. Tipe Dr. Babalola Ayodele Samuel, Santosh P. Mane
Publishing Agency	: Jyotikiran Publication, Pune
Publisher Address	:Santosh Pandurang Mane Sr. No. 204, Sahajeevan Society, Bhekrinagar, Hadpsar, Pune-8 Mob- 8888454089 Email- jyotikiranpublicationpune@gmail.com
Printed By	:Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	:I st
ISBN	: 978-93-94819-34-4
Copyright	: © Santosh P Mane
Publication Date	: 15/06/2023

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AGRICULTURAL SUSTAINABILITY IN INDIA

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DOI- 10.5281/zenodo.8094068

Abstract

The rapid growth of population in India has put a heavy demand on food production and has compelled us to go for sustainable development of agriculture. Thus, there is an urgent need to shift from production-oriented to profit-oriented sustainable farming. The equilibrium between economic return and environmental concern within the context of efforts for sustainable agriculture can be achieved through cautious evaluation of input and output. It is quiet challenging; however, the efforts being made in this context should be balanced in a more practical way. Considering this fact, the present secondary data based study summarizes the necessity of sustainable agriculture and suggests the measures to be implemented.

Keywords: Agriculture, Development, Food Security, Sustainable, India

Introduction

Despite some remarkable achievements of international cooperation and national success stories of development, decades of development cooperation and nations' efforts have not resulted in the eradication of severe poverty from substantial parts of the world's population and the establishment of sustainable economic growth in the Global South (de Vries and Jochemsen, 2019). There is still no silver bullet for economic growth, let alone a recipe of how to pave the way for sustainable development. Interestingly, even though agriculture played a dominant role in almost all traditional economies, most of the developing countries have neglected agriculture in development as a key sector for sustainable development (Hwa 1989, Pingali et. al. 2019). Agricultural production in low-income countries is oftentimes characterized by slow production due to internal difficulties such as a limited skill base, and external difficulties such as the high vulnerability to instabilities of the often-primary commodities they export, high fluctuations in production, and high state dependency (ibid.). Moreover, agricultural land in developing countries often characterized by degraded natural resources and land-use conflicts (IPBES 2019). Agriculture has changed dramatically, especially since the end of the Second World War. Food and fibre productivity soared due to new technologies, mechanization, increased chemical use, specialization and government policies that favoured maximizing production. India also witnessed a change in the agriculture system after independence. We had the challenge to produce enough food for the growing population. Hence,

we went for green revolution by adopting high-yielding varieties, fertilizers, pesticides etc. This combination of high-yielding production technology has helped the country develop a food surplus (Nagar et al., 2013). Today, agriculture in India goes beyond just meeting the food requirement of the country. However, it plays an important role in the national economy and employs nearly half of the country's population. Green revolution has helped India transform its status from a food-deficit to a food-secure nation. However, today, the positive impacts of green revolution are getting saturated and its fallouts have become apparent in recent past.

Green revolution has truly increased agricultural production on a global level, but it has done so at the cost of the degradation of the environment and natural resources (Jouzi et al., 2017). Modern agricultural technologies aim at maximization of productivity/unit area/unit time and promote the cultivation of high-yielding varieties, hybrids or genetically modified plants with intensive use of fossil-fuel-based energy, synthetic chemical fertilizers, pesticides and irrigation water, which are leading to degradation of natural resource base, emergence of soil-nutrient disorders, soil and environmental degradation, loss of bio-diversity, development of new biotypes of pathogens and pests, chemical contamination of soil and water bodies and finally human and animal health hazards (Prasad and Gill, 2009). With this background, the present study attempts to find the need for sustainable agriculture in India and also suggests some measures to fulfil the same.

Materials and Methods

The present study is based on secondary data obtained from various sources viz. Government publications, research articles, reports of agencies, etc. Some empirical evidences have also been taken into consideration to arrive at the conclusion.

Results

Necessity for Agricultural Sustainability

Agriculture is the mainstay of India's national economy and the country is known as a global agricultural powerhouse. It is the world's largest producer of milk, pulses and spices and has a large area under wheat, rice and cotton. It is the second-largest producer of rice, wheat, cotton, tea, sugarcane, fruits, farm fish and vegetable. However, agriculture in India is facing numerous problems like loss of soil fertility, fragmentation of land holdings, uncertain and erratic rainfall at some places, outbreak of pests and diseases, low financial investment and rising input cost. Thus, the practice of sustainable agriculture in India is of great help to overcome these issues, as it restores and nourishes the soil and works in harmony with nature, conserves energy, protects and rejuvenates environmental resources, values bio-diversity, boosts food chain productivity, improves people's wellbeing and economic growth, provides resilience in the world of climate change and supports local communities for their socio-economic and overall development. Sustainable agriculture is good for people, the planet, and it is profitable.

Environmental Sustainability

Environmental sustainability includes making life choices that ensure an equal, if not better, way of life for future generations and it is aimed at improving the quality of human life without putting unnecessary strain on the earth's supporting systems. Environmental sustainability can be well understood by considering the status of following aspects:

Soil Fertility

Loss of soil fertility is one of the major problems that agriculture in India is facing today. Soil erosion due to surface runoff, deforestation, high wind velocity, over-irrigation, overgrazing, excess use of chemical fertilizers and pesticides are some of the causative factors of soil degradation and loss of its fertility. Sustainable agricultural practices, especially protecting environmental resources are of great help in this context.

Water Resources

Overuse of water resources in domestic, industrial and agricultural sector, contamination

of surface and groundwater due to improper disposal of sewage and industrial effluents, uneven distribution of water in many parts of the country etc. are some of the water-related issues that Indian agriculture is facing today. As sustainable agriculture ensures water conservation, it is desired.

Agricultural Biodiversity

Farmers in many parts of the country practice monoculture farming, which is a most disputable issue. This type of agriculture is responsible for the loss of biodiversity that leads to loss of soil efficiency. The practice of monoculture farming may result into the outburst of pests and diseases. Sustainable agriculture increases the variety of plants, animals and micro-organisms that enrich biodiversity and thereby improves the agricultural productivity.

Environmental Pollution

The overuse and inappropriate handling of chemicals in the form of fertilizers, pesticides, weedicides, fungicides and herbicides is one of the common problems of Indian agriculture, that contaminates air, water and soil. Priority given to the use of organic manure in sustainable agriculture is of great help to cope with the environmental pollution taking place in the agriculture sector.

Existing Landscape

Faulty agricultural practices and deforestation in rural parts of the country pose adverse effects on rural environment and it reduces the carrying capacity of soil resources. People from such areas tend to migrate towards urban zones in search of employment. Such a population cannot afford the cost of housing in cities and they prefer to reside in slums, causing nuisance in urban environment. Sustainable agriculture on the other hand creates a favourable environment for people in rural areas and decreases rural to urban migration.

Climate

Conventional agriculture is a significant contributor to the emission of greenhouse gases like carbon dioxide, methane, sulphur dioxide, nitrous oxide and so on. On the other hand, sustainable agriculture promotes the use of non-conventional energy resources and thus, plays an important role in global warming induced climate change mitigation by reducing the emission of greenhouse gases.

Economic Sustainability

Economic sustainability refers to the practices that support long-term economic growth without negativity impacting social, environmental and cultural aspects of the

community. Sustainable agriculture encourages justifiable economic practices to protect long-term profitability of agriculture.

Export-oriented policies

The government often promotes the export of agricultural produce so that farmers can get a reasonable price for their produce. However, it involves the hidden cost of transportation and maintenance. Instead, the agricultural produce if sold in the local market, will cut the expenditure on transportation and maintenance. It will result into the availability of agricultural produce to the local people at fair prices. Sustainable agriculture focuses on the needs and development of local people and helps in this context.

Agricultural Debt

Today, the cost of agricultural inputs viz. seeds, fertilizers, pesticides, wages, transportation etc. has increased noticeably. The application of advanced technology, particularly in case of irrigated agriculture could increase the yield. However, it has adversely affected the small and marginal farmers. Sustainable agriculture as an eco-friendly practice, could cut the input cost and free small and marginal farmers from the vicious cycle of debt.

Agricultural Risk

Fluctuations and frequent drop-downs in the prices of agriculture produce pose high risk of financial losses. If climatic conditions are favourable, farmers enjoy a bumper crop which leads to a decline in market prices. On the other hand, Meagre crop production during adverse climatic conditions reduces crop yield and thereby farmers' income, further it pushes them into the cobweb phenomenon. Sustainable agriculture stabilizes the prices of agricultural produce and assures good returns.

Employment

Today, a large segment of Indian population is dependent on agriculture for employment. However, as mechanization and modernization of agriculture have reduced the demand for skilled and unskilled laborers, it has now become essential to ensure the well-being of these unemployed people. Sustainable agriculture may accommodate some of such population by promoting labour-intensive activities.

Inclusiveness

The inclusive approach adopted in sustainable agriculture may yield holistic development of society. It may reduce rural poverty by finding suitable ways.

Political Support

Sustainable agriculture needs government support to succeed. Economic policies framed by

the government should cater to removing any or all obstacles faced by farmers in adoption of sustainable agriculture. One such obstacle is lack of finance, as Indian farmers are largely poor and do not have much savings to rely on. Hence, government can try to establish new institutions and strengthen existing institutions to provide easier financial options to the farmers for accepting the changes brought through sustainable agriculture. Another major obstacle is poor agricultural marketing. If government can strengthen the linkages in the marketing channels and build a well-connected marketing infrastructure, the benefits of sustainable agriculture can be enjoyed by both farmers as well as consumers; and the role of middlemen can be minimized.

Local acceptance

As science and technology is rapidly developed in the recent past, it has also been introduced in various sectors. However, the use of technology needs suitable knowledge and skills. In addition, due to the influence of religion, traditions and customs, people particularly in rural parts of the country are not ready to willingly accept the innovations in science and technology. As sustainable development promotes the use of locally developed technology in agriculture, it search for more attention.

Indigenous Skills and Knowledge

Indian farmers have been transferring their art and knowledge of crop cultivation from generations to generations. They are well aware of their environment, weather conditions, natural resources, local breeds, animal wealth and human resources. Thus, they have developed their own skills, knowledge and technology to be used in agriculture. Sustainable development of agriculture takes all these aspects into consideration.

Gender Equality

In agrarian community, it is often seen that; men are enjoying comparatively more economic benefits from family earnings. Sustainable agriculture promotes gender equality, equal share of burden and ensures equal economic benefits to the men and women, thereby it safeguards equal financial independence for men and women.

Food Security

Farmers in majority of the Indian states have adopted traditional methods of crop cultivation, resulting into the low agricultural productivity. In addition to this, lack of knowledge, prevalence of poverty, impact of religion and non-commercialization of agriculture

are also some of the reasons behind low agricultural production in the country. In India, priority has been given to the cash crops in commercialization of agriculture. Thus, the area under food crops has decreased. It has resulted into the lack of balanced diet available to the masses. Thus, it is essential to cultivate a variety of food crops to cope with this problem. Sustainable agriculture is one of the appropriate solutions for the same.

Participation

Diversity in religion and caste is one of the important characteristics of Indian population. People with good financial positions and those who belong to upper castes enjoy the benefits of agriculture. Small, marginal and low-caste farmers in the country are still away from the mainstream of development. The holistic development approach adopted in sustainable agriculture will be of great help in this context.

Suggestions

According to a study by the Council on Energy, Environment and Water (CEEW), less than 4 percent of Indian farmers have adopted sustainable agricultural practices and systems (Economic Times 2021). However, reversing these figures is not difficult, if we can adopt proactive measures and strategies that can launch sustainable agriculture as a best practice across India. Some of the suggestions are mentioned below.

Adaptation of Organic Farming

Organic farming was initiated as a part of a larger solution to the environmental sufferings caused by excess use of chemical fertilizers and pesticides. It has been developed as a response to the environmental harms caused by faulty agricultural practices. This type of farming has numerous ecological benefits. It avoids excessive use of chemical fertilizers and promotes the application of organic manure, reduce soil erosion and prevents nitrates from leaching into the ground. Organic farming improves soil health and recycles animal wastes.

Improvement in existing cropping patterns

Indian farmers give priority to the cultivation of a specific crop in a particular area. Crop diversification in such area will be of some help to produce a variety of food crops to provide a balanced diet to the masses. Priority should be given to wheat, rice, jowar, bajra, soybean, barley, peas, gram, oil seeds, ground nut, seasonal fruits, vegetables, and fodder crops while selecting the crops for sowing.

Adaptation of advanced farm practices

The innovations in science and technology plays an important role in the growth and development of agricultural system. It ensures improvement in agricultural production, generates employment, reduces poverty and promotes equitable and sustainable growth of agriculture. Adaptation of biotechnology, appropriate use of fertilizers and pesticides, selection of improved crop and livestock varieties, application of drip and sprinkler irrigation, adaptation of risk management practices, use of green energy resources are some of the measures with the help of which one can ensure the sustainable development of agriculture in India.

Improved Protection for Natural Resources

Natural resources like soil and water being used in the agricultural sector are losing their quality, either due to their over utilization or pollution. Soils are getting eroded due to faulty agricultural practices like deep ploughing, ploughing along the slope, over grazing, over irrigation and excessive use of chemicals in the form of synthetic fertilizers and pesticides. Surface and ground water resources are getting contaminated due to leachate. Resource protection by adopting suitable methods of conservation like reduce, reuse and recycle may help in this connection.

Enhancement of Resource Efficiency

Enhancement of resource efficiency stands for the efficient use of natural resources and the relationship between the natural raw materials or techno-economic materials and benefits gained from their use whether in production or consumption. The main aim of the enhancement of resource efficiency is to maximise the benefits of products or services while minimizing consumption and waste which may help in sustaining agricultural sector.

Strengthening research in agriculture

Agricultural research in India should be focused on adequate food production, food safety and security, energy needs, sustainable use of natural resources, educational, scientific and computer literacy as well as rural-urban interdependence.

Improvement in agro processing

As agro-processing refers to the set of techno-economic activities carried out for conservation and handling of agricultural produce and to make it usable as food, fibre, fuel or industrial raw material, it offers multiple benefits. Thus, the establishment of agro-processing industries should be given priority.

Discussion

Sustainable development of agriculture in India is possible through organic farming. selection of appropriate cropping pattern, adaptation of advanced farm practices, conservation of natural resources, improving resource efficiency, strengthening agricultural research, optimizing system to reduce post-harvest losses and improvement in food processing system

Acknowledgments

Authors are thankful to the administrators, planners and researchers working in the field of agriculture for sharing their views and opinions on the current scenario of Indian Agriculture.

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Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges



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Title	: Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges
Editor Name	: Dr. Lal Mervin Dharmasiri, Dr. Praveen G. Saptarshi, Prof. Dr. S. D. Shinde, Dr. F. M. Nadaf, Dr. Bhimashankar. M. Bhanje, Dr. Jyotiram More, Dr. Harish. B. Tipe Dr. Babalola Ayodele Samuel, Santosh P. Mane
Publishing Agency	: Jyotikiran Publication, Pune
Publisher Address	:Santosh Pandurang Mane Sr. No. 204, Sahajeevan Society, Bhekrinagar, Hadpsar, Pune-8 Mob- 8888454089 Email- jyotikiranpublicationpune@gmail.com
Printed By	:Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	:I st
ISBN	: 978-93-94819-34-4
Copyright	: © Santosh P Mane
Publication Date	: 15/06/2023

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POST COVID-19 ECONOMIC RECOVERY IN SAARC COUNTRIES

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DOI- 10.5281/zenodo.8123979

Abstract:

The Covid 19 pandemic of 2020 had a severe and drastic impact on the socio-economic development of SAARC nations. The economic growth and development suffered, with countries struggling from negative output, unemployment, poverty, healthcare challenges, labour migrations, reversing of SDG attainments, etc. Towards the end of 2021 onwards, the SAARC nations were able to make a gradual comeback to economic recovery on the back of growth of global trade, supportive macro-economic policies, resurgence of international tourism, and successful vaccination initiatives. However, the growth and economic recovery has remained fragile, imbalanced and uncertain. While India, Bangladesh and Maldives saw output and real GDP rise to near pre-pandemic levels, growth was more subdued in Bhutan and Nepal. On the other hand, Pakistan, Sri Lanka and Afghanistan had to deal with country specific economic and political crisis that negatively impacted their growth trajectories. The current study summarizes the post pandemic economic recovery of SAARC countries through study of secondary data available in the form of periodic reports, research articles, databases and other literature published by international organisations.

Keywords: Economic recovery, SAARC, Development, GDP growth, Covid 19, SDG

Introduction: The SAARC group of countries comprising of the South Asian nations of India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan, Maldives and Afghanistan was founded in 1985 in Dhaka, Bangladesh. Besides sharing a geographical identity as part of the South Asian region, and cultural and historical roots, defined by a rich ancient and medieval heritage giving way to British Colonialism in the 19th and 20th centuries, SAARC nations share similar economic features and challenges. They fall towards the middle and lower half of the economic development spectrum. Though all SAARC nations are considered as emerging and developing economies by IMF, (World Economic Outlook Database, April 2022), the SAARC nations of Afghanistan, Bangladesh, Bhutan and Nepal are included in the 'Least Developing countries' (as of December 2022) list by the Committee for Development Policy, United Nations, and UN DESA, whereas Afghanistan is also included in the list of 'Heavily indebted poor countries' (World Bank and IMF, World Economic Situation and prospects (WESP), 2022).

According to another classification by World Bank based on per capita GNI, most of the SAARC nations fall in the Lower Middle Income category except Afghanistan and Maldives which come under Low Income and Upper Middle Income category respectively. (See Table 1). This shared economic destiny presents similar challenges to the SAARC nations in terms of poverty, illiteracy, unemployment, energy needs, human development, etc. The Covid 19 pandemic that originated in Wuhan in China and spread throughout the world has had a particularly severe impact on SAARC nations. The already burdened healthcare infrastructure was tested to the extreme, whereas their economies struggled to withstand the global economic shocks arising from lockdowns, shutting down of factories, disruption in supply chain and trade and falling growth rates across the world. (World Development Report, 2022). The current study looks at the post-covid economic recovery in the SAARC countries. We discuss the economic fall-out of the pandemic on the SAARC nations and their post-covid recovery.

Table 1: Classification of SAARC Nations by World Bank on the basis of GNI Per Capita in Current USD.

Upper Middle Income (GNI: 4096 - 12695)	Lower Middle Income (GNI: 1046 – 4095)	Low Income (GNI: < 1045)
Maldives	India	Afghanistan
	Pakistan	
	Bangladesh	
	Sri Lanka	
	Nepal	
	Bhutan	

Extracted from World Bank Data accessed from World Population Review (2023).

<https://worldpopulationreview.com/country-rankings/saarc-countries>

Methodology: The study is based on secondary data gathered from periodic reports, and literature published by international institutions like Department of Economic and Social Affairs, United Nations, UN DESA, World Bank, International Monetary Fund, SAARC Chamber of Commerce and Industry, UNCTAD, WEF, etc. Study reports, articles and databases from various sources have been studied for the purpose of research.

General overview of SAARC Economy: The total population across the eight SAARC countries as of 2019 was upwards of 1.7 billion comprising 21% of the world's total population whereas the combined area of SAARC states put together stands at 2 million sq. miles i.e. 3% of world's area. From the 1980s to 2008, South Asian countries experienced a higher GDP growth rate than the global average. During 1980-1999, the average growth rate in GDP was 5.4%, and from 2000-2008 it increased to an average of 6.8%. (Rajeev Jain and J. B. Singh, 2009). According to the data published by the SAARC Chamber of Commerce and Industry, the combined GDP of SAARC nations in 2017, was US\$ 3291.74 billion, with India's share being

US\$2597.49. As such, India plays a leading role in driving the economic growth in SAARC. According to the World Bank report in 2017, forecasting on the economic prospects in South Asia, it was one of the fastest growing regions in the world, with economic growth expected to accelerate from 7.1 percent in 2016 to 7.3 percent in 2017. The report further observed that South Asia remained 'resilient' amidst a 'turbulent' global economy. However, SAARC has not fully realised the potential available within the intra-SAARC trade and investment space. The intra – regional trade among SAARC nations as a percentage of their world trade has grown from 2.3% in 2007 to 5.37% in 2017 which stands in sharp contrast to other regional Blocs like ASEAN which has an intra- regional trade of 22.68%, whereas the EU and NAFTA boast of intra-regional trade of 60.38% and 40.27% respectively (SAARC Statistical Yearbook, Pg. 136, 2017). In terms of foreign investment, the share of SAARC countries in global FDI inflow in 2021 year was only 3.31% i.e. US\$ 52.417 billion with India's share being US\$ 44.735. (WESP, 2022) This pales in comparison with ASEAN, comprising of South – East Asian countries whose share of the global FDI inflows in the world was 11% in 2018-19 (pre-pandemic) and increased to 12% in 2020-21 (US\$172 billion) (UNCTAD)

Figure 2: Growth of Real GDP: South Asia*, US, China and India (Annual percentage change)**



Source: Data extracted from World Economic Situation and Prospects, 2023 (pg. 128)

1. In WESP, 2023 report 'South Asia' includes India, Pakistan, Bangladesh, Sri Lanka,

Nepal, Bhutan, Maldives, Afghanistan and Iran.

2. 2022 : Partly estimated; 2023 and 2024: Baseline scenario forecasts partly based on UN DESA World economic Forecasting Model.

Economic impact of Covid 19 on SAARC countries:

The South Asian countries were severely impacted by the pandemic and its economic spillover with the region experiencing GDP contraction. World Economic Situation and Prospects (mid 2021, pg. 21) report notes that *'the economic growth in 2021 will be insufficient to undo the 6.7% loss in GDP per capita in the previous year.'* All countries in the region saw a spike in the number of infections of Covid 19. India was one of the hardest hit countries, experiencing a devastating second wave of Covid in the early months of 2021 which was attributed to the B.1.1.7 Variant of Covid 19 and a third wave in 2022 triggered by the Omicron variant. The economic fall-out was severe and devastating for the region with increasing number of households collapsing into poverty. The pandemic resulted in shutting down of businesses, job losses, overburdened health care infrastructure, growing inequality gaps, and increasing poverty, cumulatively contributing towards reversing the SDG achievements. The developing economies also had to struggle with inflation, poor health infrastructure, unemployment, inadequate access to vaccines and overall economic distress. The pandemic has directly affected the realisation of the following SDG goals: Goal 1. End poverty in all its forms everywhere, Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture, Goal 3. Ensure healthy lives and promote well-being for all at all ages, Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, Goal 5. Achieve gender equality and empower all women and girls, Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation besides have an indirect impact on the attainment of other SDG goals.

The impact of the pandemic was particularly severe in case of informal employment comprising of low skilled and unskilled workers. In South Asia, more than 70% (74.7%) of the total employment is in the informal

sector. (World Economic Situation and Prospects, 2022) Also, out of the total women employed, a majority of them work in the informal sector. This section of the society was most adversely impacted as they are usually devoid of labour welfare provisions like job security and social security benefits. Vulnerable groups including women, low skilled workers and youth were the major victims of Covid 19 related unemployment. The closure of contact intensive sectors of the economy, shut down of schools and places of employment and continued lockdowns had a disproportionate impact on women. This lead to increase in poverty and reversing of the SDG achievements in the areas of gender equality, health care access to women, girls' education, employment of women and non-discrimination.

Discussion:

Post Covid 19 recovery of SAARC economies:

The post Covid 19 economic recovery for the world including SAARC nations was uncertain, fragile and imbalanced. While developed countries in general particularly USA and China were already on the path of recovery by mid-2021, the situation was far more dire and uncertain for several countries in South Asia, Sub-Saharan Africa, Latin America and the Caribbean. While manufacturing-based economies recovered quickly on the back of increased demand for electronic equipment, medical supplies and other manufactured products, trade in services was would recover more slowly. Trade in services would pick up speed and attain pre – pandemic levels only in 2022 when the total services trade grew by over 17% in the second quarter on 2022 compared to the same time period in 2021. Fear of international travel, emerging variants of Covid 19 and phased uplifting of sanctions affected the travel and tourism sector dependent economies (and island states) such as Maldives, Sri Lanka and Nepal. The recovery was further complicated by the disparity in vaccine availability across countries and regions. The World Economic Situation Report (2022) by the United Nations noted that while there was a contraction of 3.4% in the world economy in 2020, it expanded by 5.5 % in 2021 heading towards a recovery. The economic growth has been projected to decelerate from an estimated 3% in 2022 to only 1.9% in 2023 and pick up momentum in 2024 but at a reduced rate of 2.5%. (WESP, 2023). The recovery was also impacted by the uneven vaccination rates in different parts of the globe during the initial days of the vaccine roll out. While USA, UK and European Union reported a

vaccination rate of 68.2, 67.1 and 28.9 per 100 people in early 2021 respectively, rate of doses administered in India was 10.0 per 100 people during the same period. (WESP, Mid -2021, pg. 2). However, the vaccination efforts have been vastly improved since then, and by December 2021, 64.2% of adults in India had been fully vaccinated and 89.4% had received their first dose. In October 2021, India attained a milestone of administering 1 million Covid 19 Vaccine doses. By December 2022, around 65% of the population in South Asia was fully vaccinated. (WESP 2023, Pg. 30)

By January 2021, merchandise trade had recovered surpassing the pre-pandemic levels. Trade in goods and services which was projected to increase by 9.4% in 2021 and 5.7% in 2022, increased by 11% in 2021 surpassing expectations (WESP, 2022). From 2022 onwards, the trade in services, which had initially been slow to recover, experienced rapid growth. International tourism, also registered a strong rebound driven by “improved economic conditions, pent-up demand, and the gradual lifting of pandemic-related restrictions.” (WESP, mid 2023). United Nations World Tourism Organization (UNWTO) had projected the total revenues from international tourism to reach \$1.2 trillion to \$1.3 trillion in 2022, a significant increase of 60% to 70 % compared to the figures in 2021 but still below the \$1.8 trillion recorded in 2019. (WESP 2023) While Tourism in Maldives had recovered to pre pandemic levels by 2022, India and Nepal also witnessed gradual growth in number of tourist arrivals. In South Asia, the average GDP in 2023 is projected to be 18.4% above its 2019 levels. The GDP output growth of the region has expanded by 7.5% in 2021 whereas it is projected to moderate from 5.6% in 2022 to 4.7% in 2023 and revert to 5.8% in 2024 according to WESP, Mid 2023.

In 2023, the average regional consumer price inflation in South Asia is expected to be 11%, and it is projected to decrease to 9.4% in 2024. While inflation rates are expected to remain at high levels in Pakistan, Sri Lanka, Bangladesh and Afghanistan due to various country specific factors, India's inflation rate has fallen from 7.8% in April 2022 to 7.0 % in August 2022 and further declined to 5.7% in December 2022 due to timely and adequate policies by the Government and the Reserve Bank of India. (PIB, 31 JAN 2023). Central Banks in South Asia, have already started adopting monetary measures to bring inflation under control. The WESP 2023 notes that food

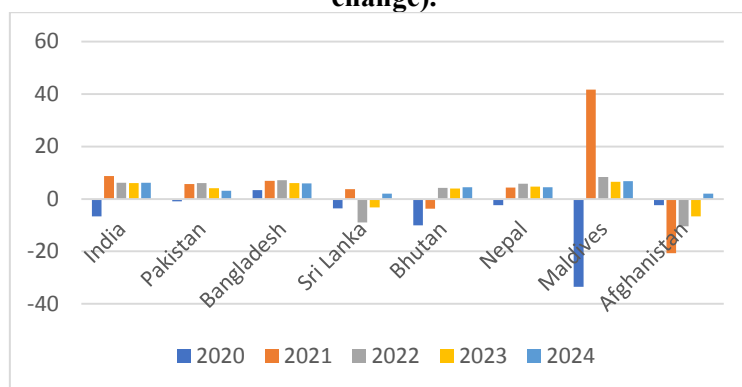
insecurity has increased in the South Asian countries of Bangladesh, Pakistan, Afghanistan and Sri Lanka owing to extreme climate events, damage to agricultural crops and livestock losses. To support its agricultural sector, Bangladesh has implemented several measures including reducing rice import tariffs, increasing fertilizer subsidies, and allocating more funds to the sector in its budget whereas Pakistan has used targeted subsidies and increased social protection to counter high prices. (WESP 2023)

Debt servicing was another major concern for several developing countries across the world including Sri Lanka, Maldives and Bhutan. In 2019, debt servicing accounted more than 45% of Government revenue for Sri Lanka whereas the figures were 30% for Maldives and 10 % for Bhutan. However these figures have ballooned to nearly 80% for Sri Lanka, 40% for Maldives and around 25% for Bhutan. (data extracted from graph in WESP 2023, Pg.50, Fig II.12). The G20 Debt Service Suspension Initiative (DSSI) was established in May 2020 in response to the COVID-19 pandemic. The G20 Debt Service Suspension Initiative aimed to provide relief to 73 low and lower-middle income countries by suspending their debt service payments to official bilateral creditors for a limited time, upon request. The initiative was supposed to help the countries concentrate their economic resources in tackling the pandemic and helping the vulnerable populations. However, the four South Asian countries that participated in this initiative – Afghanistan, Maldives, Nepal and Pakistan did not receive sufficient relief. On an average, relief accounted for less than 20% of debt service obligations or approximately 1.6% of GDP. (WESP 2022) As a percentage of GDP, gross external financing needs for Bangladesh, Pakistan, and Nepal was approximately 9%, 10.5% and 14% respectively whereas, it was around 22% for Sri Lanka in 2022. This figure includes current account deficit, short term external debt and amortization of long term external debt. (Data extracted from graph in WESP 2023, Pg 51, Fig II.13). When unsustainable levels of debt forces Governments to adopt austerity measures and implement cuts in public expenditure like health care and other benefits, the whole exercise inadvertently ends up affecting the vulnerable groups including women, children, disabled, low skilled and unskilled workers the most. It would adversely impact human development, increase poverty and inequality and push back sustainable

development. According to one study quoted in WESP 2022, the debt servicing payments for the 48 of the Vulnerable Twenty Group countries would reach 68.9 billion \$ in 2024. This grouping of 58 countries systematically vulnerable to climate change formed in 2015 includes all SAARC nations except India. Here, developed countries and groups such as IMF, World Bank, etc. should take active steps to mitigate the challenges faced by developing and distressed nations by enabling access to low-cost financing

through effective debt relief initiatives. The developing nations will face a crisis of choice in allocating their resources between debt refinancing, development needs, fighting climate change and SDG goals. The World Bank has setup two initiatives, namely, Global Shield Financing Facility and Global Shield Against Climate Risks that provide financial assistance to vulnerable countries to recover from climate risks and natural disasters.

Figure 3: Graph showing Real GDP growth of India, Bangladesh, Pakistan, Nepal, Sri Lanka, Maldives, Bhutan and Afghanistan for the years 2020, 2021, 2022 and 2023* (Annual percentage change).



Data extracted from World Economic Situation and Prospects, 2023

2022: Partly estimated; 2023, 2024 : Baseline scenario forecasts based partly on UN DESA forecasting model.

India: Recovering from a negative real GDP growth of -6.6% in 2020, India's real GDP expanded by 8.7% in 2021 and was estimated to grow at 6.2% in 2022 and expected to maintain strong growth at 6.0% in 2023, and further increase by 6.2% in 2024 owing to strong domestic demand. (WESP, 2023). The WESP Report, 2022 notes that while India is experiencing economic recovery due to several reasons such as improved vaccination coverage, ending of lockdown restrictions, restarting of economic activity, supportive macro-economic and fiscal policies, growth in exports, and stronger external position, what is required is attaining a - 'robust, sustained and inclusive growth.' Investments and exports could be negatively impacted by a combination of rising interest rates and a worldwide economic slowdown.

India's prudent efforts at battling covid especially during the second wave during the early months of 2021 has been commended at international level including WEF. Being a medical supplies and pharmaceuticals manufacturing hub, India was able to provide

critical medical supplies, equipment and assistance to more than 150 countries since the beginning of the pandemic. As part of Vaccine Maitri programme, till November 29th, 2021, India has provided 94 countries and 2 UN entities with a total of 723.435 lakh doses of the COVID vaccine through grants, commercial exports, or the COVAX initiative. (PIB, 07 Dec 2021) Overall, India has recovered quickly from the economic setback of the pandemic. However, challenges remain in terms of poverty alleviation and attaining inclusive and equitable growth. In a recent statement in June 2023, while releasing the Financial Stability Report, RBI Governor Shaktikanta Das reiterated that India's economy has made a strong recovery post covid and was among the fastest growing economies in the world. The director of Assocham (Associated Chambers of Commerce & Industry of India), Mr. Deepak Sood, in an article in The Hindu BusinessLine noted that Relaxation in FDI norms, increase in private investment, increase in hiring, strong capital expenditure spending by the Government and Government support like Emergency Credit Line Guarantee Scheme (ECLGS) through Covid – 19 financial relief package that supported the service sector of the country, has created business confidence and led to a better than expected recovery post pandemic.

Bangladesh: Bangladesh, one of the stronger economies in SAARC witnessed a real GDP growth of 6.9% in 2021 at US\$416.26 billion due to prudent economic policies, robust demographic dividend, ready-made garment (RMG) exports, remittance inflows, and stable macroeconomic conditions. The GDP of Bangladesh grew at 3.4% in 2020 and 6.9% in 2021 and is estimated to have grown by 7.2% in 2022 and is projected to grow by 6.0% in 2023 and 5.9% in 2024. It is interesting to note that among the SAARC nations, Bangladesh was the only one to avoid negative GDP growth rate in 2020 (WESP, 2023). By the first half of 2021 itself, Bangladesh's economy has started recovering on the back of increase in export and strong remittance inflows along with strong vaccination efforts, recovery of labour market, service sector growth and accelerating public investment. Industrial sector output including apparel production, manufacturing and pharmaceuticals recovered in 2021.

Sri Lanka: Sri Lanka's economy experienced a negative real GDP growth of -3.6% in 2020 and recovered to a growth of 3.7% in 2021. In early 2022, Sri Lanka suffered the one of the worst economic and political crisis in its history. The country defaulted on its debt for the first time in its history in May 2022 as it struggled to make interest payments on its sovereign bonds. During the time of default in April 2022, it had a massive debt pile towering more than \$50 billion and would later require a rescue package from the IMF and credit line extension from India. It's GDP growth contracted by -9% in 2022 and it is expected to maintain a similar negative growth of another -3.2% in 2023 and grow by 2% in 2024. (WESP, 2023) Its major challenges include food shortages, dwindling foreign reserves and sovereign debt risks along with political instability, and external financing constraints. IMF has agreed to lend Sri Lanka \$3 billion in addition to \$700 million support from World Bank. In addition to poor monetary and fiscal policies, unsustainable borrowing, excessive spending on large scale infrastructure projects, and the poorly conceived transition to organic farming, one of the causes for the economic crisis was Covid 19 pandemic and its spill-over effects on the Sri Lankan economy.

Maldives: Tourism sector constitutes almost one third of the GDP of Maldives. The impact of Covid 19 pandemic on international tourism was devastating. Maldives saw its economy nose dive in 2020 with a negative real GDP growth of -

33.5%. As a small island state dependent on tourism, the pandemic exposed its economic vulnerabilities, thereby threatening livelihoods, increasing food insecurity and weakening fiscal position. However, the economy of Maldives has recovered sharply on the back of sustained recovery in international tourism complemented with a successful nationwide vaccination campaign, which has led to growth of its real GDP by 41.7% in 2021. The tourism arrivals in Maldives in 2021 was 1.3 million and in 2022 was 1.68 million almost matching the pre-pandemic levels whereas the economic growth in real terms was estimated to be 12.2% (y-on-y) in 2022. Maldives' GDP growth in 2022 was estimated at 8.4% and it is projected to grow by 6.5% in 2023 and 6.8% in 2024. (WESP 2023). Limited structural diversification and heavy dependence on tourism remain two challenges for Maldives.

Pakistan: The Pakistani economy, already on shaky grounds in 2019, suffered a severe blow from the economic disruptions of the pandemic. The GDP that was growing by 3.1% in 2019, contracted by -0.9% in 2020. The twin challenges of fiscal and current account deficit had forced Pakistan to seek Extended Fund Facility (EFF) programme with the International Monetary Fund (IMF) in July 2019. But the economy recovered post pandemic with the real GDP growing by 5.7% in 2020 and 6.0% in 2021. In WESP, 2023 report, it was projected to grow by 4.1% and 3.1% in 2023 and 2024 respectively. The nation suffered from catastrophic floods, high inflation, and impacts of structural weaknesses, tight monetary stance and global economic conditions in 2022. Very recently, in June 2023, Pakistan needed another IMF bailout of \$3bn Stand-By Arrangement (SBA), as it faced an acute balance of payment crisis amid depleting foreign exchange reserves.

Nepal: Tourism and remittances form an important part of Nepal's economy along with agriculture. Nepal's economy was badly hit by the pandemic with the real GDP growth contracting to -2.4% in 2020. The real GDP of the country expanded by 4.3% in 2021 and was estimated to grow by 5.8% in 2022 and the further projected to grow by 4.7% in 2023 and 4.4% in 2024. The post pandemic recovery in Nepal has been decent with current account deficit narrowing in FY23 and increase in foreign exchange reserves. A major challenge for Nepal is to counter the adverse effects of global warming and climate change. In September 2021, Nepal adopted the Green,

Resilient and Inclusive Development (GRIP) approach, a long term vision focusing on Nepal's recovery from the economic crisis of Covid 19 pandemic with support from international institutional partners and developed nations through investments in sustainable development areas viz: sustainable tourism, renewable energy, biodiversity conservation, climate-smart agriculture, and inclusion of women, vulnerable and marginalised communities etc.

Bhutan: The tiny land surrounded country of Bhutan also experienced the adverse effects of Covid 19 as its economic growth deaccelerated from 5.8% growth in 2019 to -10.1% negative growth in 2020. Labour shortage owing to the pandemic-imposed lockdown, closing of borders and lower external demand affected agriculture, construction and export sector in addition to tourism. India's assistance in medical donations and supply of essential goods has been of tremendous help to Bhutan. The nation that measures Gross National Happiness is considered a success story as the country has been able to reduce poverty and improve human development indicators. The real GDP growth of Bhutan contracted by -3.7% in 2021 and is estimated to have recovered to 4.2% in 2021. It is further projected to grow by 4.0% and 4.5% in 2023 and 2024 respectively.

Afghanistan: Afghanistan's real GDP growth contracted to -2.4% in 2020 before worsening to -20.7% in 2021 when the armed insurgent group Taliban took over Kabul in August 2021, overthrowing the elected government. The overall situation in Afghanistan kept on deteriorating throughout the year that was marred by chaos and violence. The new Government formed by the insurgents passed regressive policies resisting women from education and participating in workforce. This coupled with decline of international aid and lack of access to offshore assets deteriorated the already precarious situation in Afghanistan. The GDP is estimated to have contracted by -10.4% in 2022 and is expected to contract by -6.6% in 2023.

The world economy, having recovered from the covid 19 setback and moving towards full recovery in 2021 struggled to maintain the momentum in later years due to several reasons like lingering effects of Covid 19, Ukraine-Russia war leading to soaring food and energy prices, high inflation and tightening global financial conditions. According to estimates and projections from UN DESA, global economy is projected to experience a slowdown in growth

from 3.1% in 2022 to 2.3% in 2023 and maintain a momentum of 2.5% in 2024 as compared to the 2000-2019 average growth rate of 3.1% in the global economy (WESP mid-2023, Pg.2). The above observation by WESP suggests that complete and sustainable recovery to pre – covid levels is still not completely realised. Outlier events like the Russia-Ukraine War and the Banking Sector crisis in United States and Europe in early 2023 (though contained by quick actions by the US and Swiss Governments and financial regulators that restrained it from having spill-over effects) could easily dent the post covid recovery.

Conclusion:

The impact of the Covid 19 pandemic has been particularly drastic for SAARC nations, who were already struggling with socio-economic, political, environmental, and developmental issues. The pandemic adversely impacted the growth trajectory of SAARC economies while exposing the structural weaknesses in the economy and presenting challenges in the form of inclusive healthcare, employment, economic development and sustainable growth. Large elements of the population in South Asia are still struggling with socio-economic problems that exuberated during the pandemic. Labour market recovery has been slow and inclusive growth remains elusive. Though SAARC nations witnessed momentum in economic recovery from 2021, supported by remittance inflows, broader mobility and supportive macroeconomic policies, the recovery has remained fragile and laden with risks. The challenges remain in the form of socio-economic difficulties faced by large section of populations, rise in poverty rate and inequality, setbacks in education attainment and health care due to the pandemic and macro-economic factors like inflation and debt. Global monetary tightening, tighter monetary policy, supply chain disruptions, slowing global demand, increased commodity prices etc. are expected to adversely impact the economic growth of the region in 2023. While the employment situation in India has improved by 2022 with unemployment reducing to pre – pandemic levels, Pakistan, Afghanistan and Sri Lanka experienced significant growth in unemployment due to country-specific issues.

While some of the SAARC economies have been able to recover and reach pre-pandemic levels of growth, viz India, Bangladesh, Maldives etc. others are still battling multiple challenges on their way to restoring economic development. However, these problems cannot be cited as an excuse to stray away from achieving SDGs.

Rather, it is imperative for these South Asian economies to devise strategies and come up with measures that will help them overcome the challenges and also achieve the targets set for them. Increasing intra-regional trade flows can be one of the starting points of co-operation for SAARC countries, which will reduce trade costs, provide access to new markets, attract FDI, and help in overall growth and development. In addition, these nations can devise a regional plan which contributes to overall environmental conservation and protection, thereby adhering to the global call for sustainability. The rebuilding efforts necessitated in the wake of the pandemic can prove to be an opportunity for SAARC as a regional Bloc to gain relevance as the member nations help and support one other in facing the common economic and social challenges.

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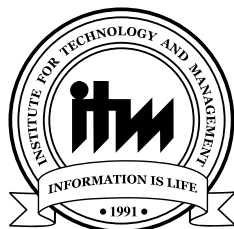
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ISBN : 978-93-5967-434-6

Message from the Convenor

The concept of sustainability has pervaded the world, and society at large. Numerous authors have written on the topic, each expressing unique ideas of where sustainability might lead society and how it can help entities. Among the various dimensions of sustainability (Human, social, economic and environmental) social sustainability has not been discussed much (Eizenberg and Jabareen 2017). The social dimension is key to the concept of sustainability as it emphasizes on the well-being of humans (Janker 2020). On the other hand environmental sustainability has become the pressing need of the hour.

Keeping in view the importance of Social and environmental sustainability in today's world, ITM Business School, Kharghar organized three days International Research Conference "SOCEN-2023" on 4-6th October, 2023. This conference seeks to bring ideas and thoughts on social and environmental sustainability from a management perspective to create a better tomorrow.

The conference was great success witnessing 110 papers from India and overseas. Renowned researchers from across the globe shared their insights as key note speakers. These included :

Dr Paurav Shukla : University of Southampton, UK

Dr Sunil Sahadev : University of Brighton, UK

Dr Stephen Wilkinson : UNOWD, Dubai

Dr Festus Victor Bekun: Istanbul University, Turkey

Dr Narasingha Das : Lebanese American University, Lebanon

Dr Avik Sinha : MDI Gurgaon

Prof P.J Mathew : Chief Mentor

The conference proceedings consists of abstracts and papers of all three dates. My best wishes to the participants and happy reading.

Dr Sangeeta Trott

Convenor

Message from the Director

SOCEN is an expression of the fact that the earth is common to all, and we need to plan and act on preserving it for our future generations! This theme of our conferences propelled researchers to probe deeper into social and environmental sustainability and create awareness and a sense of care for nature which has always been generous to mankind.

I extend my heartfelt congratulations to Dr Sangeeta Trott and the team on the successful publication of the conference proceedings for SOCEN 23. This marks a significant milestone for our institute and showcases the culmination of the hard work and dedication put forth by all involved in the Research Department team and is a testament to the institute's commitment to excellence. The conference witnessed 110 papers that were presented in the three days by students, academicians and corporates. The proceedings encapsulate cutting-edge research, innovative ideas, and diverse perspectives presented during the conference. Thanks to all the guests from academia and corporate who made remarkable references on how we can save the planet from further plunder.

I encourage everyone to spread the word about the publication and to explore the contents of the proceedings. Thank you, Researchers, for your outstanding contributions, and we look forward to celebrating many more successes together in the future.

Wishing all the best and happy reading.

Regards

Dr Lakshmi Mohan

Pro Vice Chancellor- ITM Skills University

Director- ITM Business School

Message from the Dean

It is my pleasure to congratulate all participants of the conference hosted by ITM Business School, ITM Skills University, Kharghar. The conference brought together scholars, researchers, and industry practitioners from diverse fields to engage in interdisciplinary dialogue and exchange of ideas. The theme of the conference was Social and Environmental Sustainability - A Management Perspective which reflects our commitment to addressing pressing challenges and advancing knowledge in the field of sustainability and green economy. Through a series of keynote presentations, panel discussions, and paper presentations, we had the opportunity to explore innovative approaches, share best practices, and collaborate on solutions to some of the most pressing issues of society. I am particularly excited about the breadth and depth of topics that are covered in the conference proceedings. From cutting-edge research in sustainability to transformative initiatives in social empowerment, the diversity of perspectives represented in this forum underscores the richness and dynamism of our academic community. I would like to congratulate the conference organizers, committee members, and all those who have contributed to the planning and execution of this event. Special compliment to the team for bringing out this conference proceeding. The organizing committee's hard work and dedication have been instrumental in ensuring the success of this conference and the publishing of this conference proceedings and I appreciate your efforts. It is through such scholarly interactions of all of you that we could collectively advance our understanding of complex issues and drive positive change in our respective fields. I wish you all had a stimulating and productive conference experience. May this proceeding here be marked by fruitful insights and meaningful future research that will continue to inspire you and the intellectual community at large.

Best wishes!!!

Dr. Sarit Prava Das

Dean Academics

INTERNATIONAL RESEARCH CONFERENCE SOCEN 2023

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Analysis of Work Life Balance Among Teachers in Self Financing Degree Colleges of Mumbai University

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Abstract

Work-life balance among teachers is a critical aspect to enhance teacher effectiveness and satisfaction in the context of student learning. It has been observed that good quality of work life balance results into the wellness of the faculty and also improved student behaviour. The present study investigated the quality of work-life balance among Mumbai University affiliated Self-Financing Degree College teachers serving in different academic stream across universality and colleges. The purpose of present study is to highlight the necessity of adopting work-life-balance policies for teachers teaching at degree college level. Various factors like designation of the teachers, their nature of appointment, the academic stream in which they are teaching and the nature of their serving institution will be considered for study.

Keywords: Work Life Balance, Professional Life, Personal Life, Self-Financing Degree College, Mumbai University.

Introduction:

With globalisation in the World, the working environment has changed worldwide and it is necessary to adopt work life balance(WLB) strategies in such environment. In every organisation human resource plays a vital role for employees in maintaining their work life balance.

There are two aspects of Work Life Balance such as career development and the family caring. With the growth and development in educational, technology and social standards, the role of teachers have undergone a change where they find it difficult to maintain balance between their professional and personal life.

The present study investigated the quality of work-life balance among Mumbai University affiliated Self Financing Degree College teachers serving in different academic stream across universality and colleges. The purpose of present study is to highlight the necessity of adopting work-life-balance policies for teachers teaching at degree college level.

Objectives:

- 1) To study the level of Work Life Balance among different Teachers of Self Financing Degree College.
- 2) To identify the various factors that influences Work Life Balance.
- 3) To find out the stress level and its impact on the performance at job and discharging the family and social commitments.

Review of Literature:

Dr. Meena Rajiv: This study focuses on the work-life balance argues faced by faculty members in self-financed engineering colleges affiliated with Mumbai University. It identifies the factors affecting work-life balance and suggests remedies for improvement.

Dr. Aniket Patel: This study reveals the relationship between use of technology and work-life balance among college professors in self-financing colleges affiliated with Mumbai University. It investigates the extent to which technology is blessing or curse for work-life balance.

Dr. Shalini Desai: This case study studies the work-life balance experiences of college teachers in self-financing colleges affiliated with Mumbai University. It enquires the role of workload, institutional support, and personal preferences in achieving a healthy balance.

Dr. Rahul Khanna: This exploratory study researches the link between work-related stress, exhaustion, and work-life balance among self-financing college teachers of Mumbai University. It discovers the contributing factors and proposes approaches for managing stress.

Dr. Priya Gupta: This comparative study examines the impact of gender on work-life balance among university teachers, specifically comparing Mumbai University and Pune University. It observes how gender roles and institutional differences influence work-life balance outcomes.

Research Methodology:

For conducting this study primary data will be collected from 50 teachers teaching at degree levels at the academic and professional courses in private sector. The data was collected to understand their working hours, commuting time, household commitments, financial implications and the challenges to fulfil expectations of family members.

Data Analysis:

The data was analysed using Percentage Analysis.

Findings:

- 1) 50% of the Respondents are from Unaided Colleges, 31.2% from Autonomous Colleges and 18.8% from University.
- 2) 87.5% Respondents are Assistant Professors, 6.3% Professors and 6.2% from Other Category.
- 3) 56.3% Respondents were on Permanent Position, 37.5% are on Temporary Position and 6.2% are Visiting Faculty.
- 4) Out of Total Respondents 50% are Approved Staff and 50% are Unapproved Staff.
- 5) 62.4% of the Respondents are in the Income Range of 1lakh to 5lakh, 18.8% are from Income Range of 5lakh to 10lakh and remaining 18.8% are from 10lakh and above Income Group.
- 6) 43.8% respondents are from age group of 41-50 years, 37.4% from age group of 31-40 years and balance 18.8% from 21-30 age group.
- 7) 56.3% of the respondents are female and 43.7% are males.
- 8) 87.5% respondents are married and 12.5% are unmarried.
- 9) 56.3% respondents are having working spouse whereas 43.7% respondents do not have working spouse.
- 10) Highest Number of Dependents in family are 6 and lowest number of dependents is 1.
- 11) 56.3% of the Respondents belongs to Nuclear Family and balance 43.7% belongs to Joint Family.

- 12) 25% of the respondents are working for 5 Hours daily whereas 75% of the respondents are working between 6 hours to 8 hours.
- 13) 62.5% of the respondents are getting Leaves as per University Rules whereas 37.5% are not getting leaves as per University Rules.
- 14) 10% of the respondents have Teaching workload of 15 to 20 lectures per week whereas 85% of the respondents have 21 to 30 lectures per week and 5% of the respondents have flexible workload.
- 15) 81.3% of the respondents are not doing any part time work whereas 18.7% of the respondents are doing part time work.
- 16) 56.3% of the respondents replied that various kind of training increase their backlog of work and 43.7% replied that due to training it is not increasing their backlog of work.
- 17) 62.5% of the respondents reacted that they do not get Me time whereas 37.5% of the respondents reacted that they are getting Me time.
- 18) 81.3% of the respondents felt that the designation of a teacher affect their quality of work life balance whereas 18.7% of the respondents felt that their designation do not affect their quality of work life balance.
- 19) 68.8% of the respondents replied that their gender affect quality of work life balance whereas 31.2% of the respondents replied that their gender affect quality of work life balance.
- 20) 68.8% of the respondents are satisfied with their family life and self life ,18.8% are dissatisfied with their family and self life,6.3% of the respondents are Highly Satisfied and Highly Dissatisfied with their family and self life.
- 21) 75% of the respondents are satisfied with their Job and Flexible Environment whereas 12.5% of the respondents are highly dissatisfied .
- 22) 93.8% of the respondents are aware about work life balance and 6.3% of the respondents are unaware about work life balance.
- 23) 75% of the respondents are able to meet Household Commitments and 25% are not able to meet Household Commitments.

Suggestions:

- 1) Things of irrelevant nature should be avoided.
- 2) As we are social human being, do meditation when ever get time and spend time with nature and family.
- 3) Prioritize your health.
- 4) Government Authorities have same rules of approved teachers by UGC.
- 5) Provide healthy environment for work.
- 6) Each one have to learn and implement the balance mechanism.
- 7) All colleges should provide leaves to their employees as per University Norms.

- 8) All colleges should follow Working Hours and Work Load as per University Norms.
- 9) Minimum training programmes to be arranged by Colleges.
- 10) Authority responsibility relationship should be properly defined.

Conclusion:

The Present study reveals that Work Culture available in Colleges have it's impact on Work Life Balance of Teachers at large. In changing scenario, teachers have so many assignments with teaching workload, research and extension activities that work pressures are laying negative impact on their professional as well as personal life. Hence policy makers, educational institutions and the teachers themselves need to take care of this aspect.

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Sustainable Volunteering among Generation Z: An Attitudinal Survey

¹Sandeep Bhanot, ²Dr. Arjita Jain,

THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM



ISBN: 978-93-100-0564-6

EDITOR

DR. EKNATH MUNDHE

THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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KUNDALINI AND CHAKRAS: INVESTIGATING THE ENERGY CENTERS AND THEIR SIGNIFICANCE IN THE PATH OF ENLIGHTENMENT

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Abstract: Human body consist of seven chakras and each chakra has its significance role in human life therefore it is necessary to understand the role of each chakra in our life so in this present study we have considered the seven chakras and their significance and also studied how the imbalance of this chakras leads to various diseases and we have focussed on the importance of meditation and yoga in balancing this 7 Chakras and making human life Joyful and Peaceful.

Keywords: Chakras, Human Body, Meditation, Yoga

Introduction

In 21st Century where we all human beings are exposed to excessive use of smart phones and social media because of which thought pollution is increasing and we are losing emotional connect in our day to day relations therefore feeling of loneliness and various diseases are on rise. In this regard it is necessary to study the importance of yoga and meditation in balancing all the seven chakras of human body we have focussed on investigating on Kundalini, the energy centres and their significance in the path of enlightenment.

Objectives of the study

- 1) To understand the Kundalini Energy.
- 2) To identify the significance of seven chakras in human life.
- 3) To discover the significance of Yoga and Meditation in balancing seven Chakras.

Research methodology

The data is collected from Secondary Sources like Newspapers, Articles and websites.

Discussion

1.1 What is Kundalini?

Human body is like a machine. As a Machine requires energy to run it, human body also requires energy to perform various functions and the energy which is required to perform all the functions of human body lies in the upper and lower halves of the body. This divine force or consciousness is called as the *Kundalini Shakti*. When this *Kundalini Shakti* is stimulated and rises within us, then our entire life becomes happy and joyful.

1.2 What are chakras?

Human body consist of 1,72,000 *nadis* and this nadis have 109 nerve centres out of which nine centres are important, and even in those nine, seven centres are of primary importance where the seven Chakras are situated.

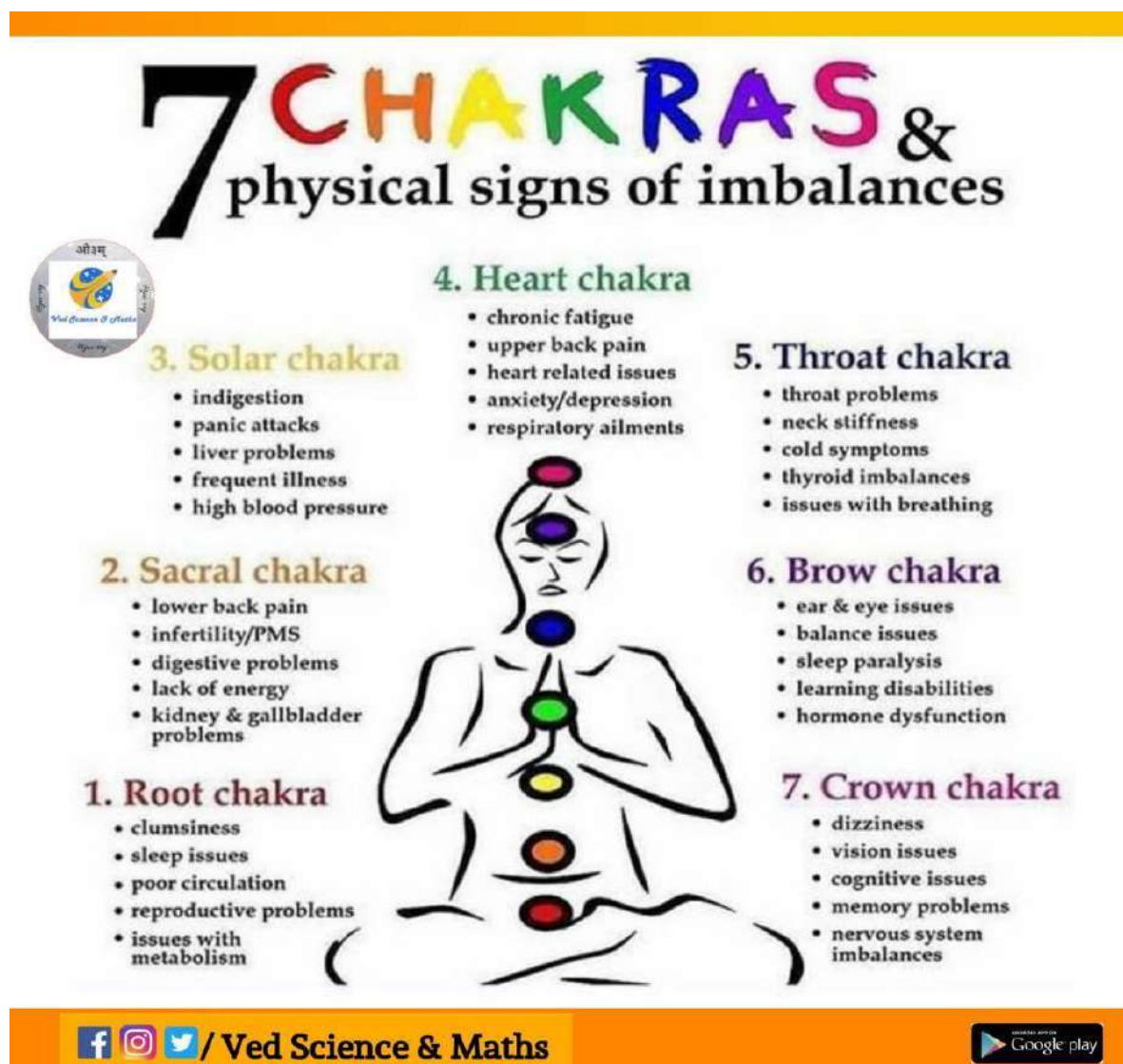
1.3 What are the seven *chakras* and where are they located in the body?

- The first *chakra* is at the base of the spine, at beginning of the anus and is called The Root Chakra(*Muladhara*).
- Just above that is the next *chakra* which is called The Sacral Chakra(*Svadhishthana*).
- The third *chakra* is just above the navel and is called The Solar Plexus Chakra (*Manipura*).
- Above that is the Heart Chakra (*Anahata chakra*) which is in the center of the chest
- Then comes the throat *chakra* called *Visuddha*.
- Above that is the *chakra* in-between the eyebrows called The Third Eye Chakra(*Ajna*)
- The last *chakra* is on top of the head called The Crown Chakra (*Sahasrara*).

1.4 Significance of Chakras in Human Life:

- 1) The Root Chakra connects our mind, body and soul with the earth. It gives us the feeling of being close to the earth.
- 2) The Sacral Chakra is associated with the lymphatic system and is responsible for expressing emotions.
- 3) The Solar Plexus Chakra is associated with Self-Confidence, Self-discipline and wisdom.
- 4) The Heart Chakra is responsible for emotional healing and sound mental health.
- 5) The Throat Chakra is responsible for expressing the Truth and sharing your opinion with others.
- 6) The Third Eye Chakra is responsible for garnering information about yourself and beyond the materialistic world.
- 7) The Crown Chakra is responsible for the direct connection with the almighty and conscious energy. Balancing this chakra will help us in balancing our other chakras and gaining insight into ourself.

1.5 Seven Chakras and Physical Signs of Imbalances



Findings

- 1) We have understood the importance of seven chakras and their role in human body.
- 2) In case if this chakra gets blocked due to any reason then it leads to various diseases.

Suggestions

- 1) One should daily practice Yoga and Meditation which will help in balancing the seven chakras.
- 2) Use of Smart phone and social media should be minimised.
- 3) Connect to the panchtattva of nature.
- 4) Build Social Relations and spent quality time with family.

Conclusion

In 21st Century where Internet has changed it's speed from 4G to 5G, human life is also not an exception. It has also undergone a drastic change which has increased thought pollution, tension, anxiety and feeling of loneliness which further have negative effect on our chakras due to which certain diseases are increasing. To overcome this problems one should

connect with the panchtattva of nature by practicing meditation and yoga on daily basis which will help in balancing chakras and will create a positive Aura. A person with positive Aura will spread positive energy in the environment which will improve our physical, mental and spiritual health.

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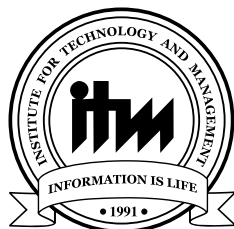
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Published by **ITM Business School**

25 & 26 Institutional Area, Sector - 4, Kharghar (E), Navi Mumbai 410 210

ISBN : 978-93-5967-434-6

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Management of E-Waste in India: SWOT Analysis

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Abstract

As electronic waste or e-waste poses many environmental and human health hazards, generation of it has become a major cause of concern in the majority of the developed and developing countries on the planet including India. Ironically, the constituents of e-waste can be valuable, but at the same time, some of them are toxic in nature. Unfortunately, the efforts being taken for E-waste management in India have many limitations, that must be recognized and addressed properly. This can be done by implementing suitable methods of e-waste collection, segregation and disposal. Steps taken to conduct an appropriate awareness campaign for e-waste management may serve the purpose. With this background, the present paper highlights the status of e-waste generation in India and provides possible suggestions for efficient e-waste management by adopting a technique of SWOT Analysis. As there is a paucity of data on e-waste generation and its management, the study is based on some reports, publications, research articles and information available in newspapers. The paper suggests that the framing of suitable policies and their rigorous execution with the supportive legislature will prove to be helpful to cope with the issues related to e-waste management in India.

Keywords: E-waste, Management, India, SWOT, Analysis.

Introduction

Waste or E-waste WEEE refers to electrical or electronic items that have been discarded, are surplus, obsolete, or have broken. (CPCB, 2008). Electronic waste (also known as e-waste) or waste from electrical and electronic equipment (WEEE) (Kahhat et al., 2008) comprises primarily of equipment used in data processing, communication, entertainment, and commerce (Liu et al., 2006). It is growing rapidly due to the increasing use of electronic products globally (Dwivedy and Mittal, 2010). The amount of "e-waste" or electronic garbage in India has now become a big issue. E-waste disposal is a rising global environmental and public health concern, since electronic waste has become the world's fastest increasing portion of the formal municipal waste stream. (Dahl R., 2002). Most waste electrical gadgets in India are held in houses since individuals do not know how to dispose of them. This piling up e- waste is extremely complex in nature, but it is also a rich source of metals like gold, silver, and copper, all of which may be collected and recycled. So, e-waste trade and recycling alliances provide employment to many groups of people (Baud et. al. 2001). The usage of electronic components is increasing due to decreased prices and growing usage of internet advancements in Information and Communications Technology (Nnorom and Osibanjo, 2008a; 2007). More than half of the globally generated e-waste is exported for recycling mainly in Asian countries like China and India due to the cheap labour (Ha et al., 2009). With this view, as the management of e-waste in India has now become a cause of concern, the present paper attempts to examine e-waste management by adopting the reliable technique called SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of e-waste management.

THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM



ISBN: 978-93-100-0564-6

EDITOR

DR. EKNATH MUNDHE

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ROLE OF YOGA AND MEDITATION IN EDUCATION

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Abstract: *Education these days is becoming challenging due to increasing competition, heavy syllabi, introduction of new teaching-learning practices, use of advanced teaching aids and learning devices. This situation leads to high stress levels among students and teachers. Considering this fact, the present paper attempts to understand the role of Yoga and Meditation in the field of education. The paper utilizes secondary information available in various modes. Discussions held with students and teachers are also considered while writing this paper. The study reveals that, in spite of numerous advantages of Yoga and Meditation in education, these are still neglected. It is found that there is an urgent need to popularize these practices among students and teachers.*

Keywords: *Yoga, Meditation, Education, Stress, India.*

Introduction:

Day by day education is becoming a challenging task in the environment we live in. Electronic devices and gadgets like Android Phones and laptops, we use in our daily life made us habituated with the speed as well as rapid and recurrent changes in activities. This is one of the key causes of increasing stress levels among people, particularly in the student and teacher community. Students come to schools and colleges where the most common methods of learning are listening, writing, speaking and reading to cope with the competition. The use of electronic gadgets like laptops, touchscreen monitors and laboratory equipment's for smoothening the teaching-learning activity needs new skills which creates stressful conditions among the students. In addition, excessive demands and too high expectations that are often put on students, result in rising stress levels and create unease among them. Most of the time, difficulties in meeting the expectations of teachers and parents are a cause of stress among students. Simultaneously, those same parents and teachers also remain under stressful conditions. We teach children the subject matter while no one teaches them how to breathe properly and thus reduce stress. Yoga is a breathing technique that is of great help in bringing down stress levels in an individual. Yoga is meant to help people achieve a level of mental tranquillity where they can fully manage their reactions to both positive and negative external stimuli and responses are moderate in intensity (Telles S., et. al. 2000). Yoga is a great way to stay healthy and enhance one's personality. In one study, it is found that a 4-week program of Yogasanas and Meditation lowers the aggressive behaviour of students (Iniew Sumanna, 1998). Thus, the practices of Yoga and Meditation are useful for both, an individual and for a stress-free society. Yoga is a way of life that emphasizes peace, balance, and bliss. (Nagendra H.R. and Nagarathna R. 1977). Having a healthy mind is a key to person's overall health and well-being. A healthy mind impacts your thoughts, feelings, behaviours, and responses and involves emotional, psychological, and social well-being. Along with Yogic Practice, Meditation, being part of Yoga, is the seventh limb of Ashtanga Yoga (Tamini L. K. 1961). While, Restraint, Observance, Posture, Breath control, Abstraction, Concentration,

Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges



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Title	: Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges
Editor Name	: Dr. Lal Mervin Dharmasiri, Dr. Praveen G. Saptarshi, Prof. Dr. S. D. Shinde, Dr. F. M. Nadaf, Dr. Bhimashankar. M. Bhanje, Dr. Jyotiram More, Dr. Harish. B. Tipe Dr. Babalola Ayodele Samuel, Santosh P. Mane
Publishing Agency	: Jyotikiran Publication, Pune
Publisher Address	:Santosh Pandurang Mane Sr. No. 204, Sahajeevan Society, Bhekrinagar, Hadpsar, Pune-8 Mob- 8888454089 Email- jyotikiranpublicationpune@gmail.com
Printed By	:Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	:I st
ISBN	: 978-93-94819-34-4
Copyright	: © Santosh P Mane
Publication Date	: 15/06/2023

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AGRICULTURAL SUSTAINABILITY IN INDIA

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DOI- 10.5281/zenodo.8094068

Abstract

The rapid growth of population in India has put a heavy demand on food production and has compelled us to go for sustainable development of agriculture. Thus, there is an urgent need to shift from production-oriented to profit-oriented sustainable farming. The equilibrium between economic return and environmental concern within the context of efforts for sustainable agriculture can be achieved through cautious evaluation of input and output. It is quiet challenging; however, the efforts being made in this context should be balanced in a more practical way. Considering this fact, the present secondary data based study summarizes the necessity of sustainable agriculture and suggests the measures to be implemented.

Keywords: Agriculture, Development, Food Security, Sustainable, India

Introduction

Despite some remarkable achievements of international cooperation and national success stories of development, decades of development cooperation and nations' efforts have not resulted in the eradication of severe poverty from substantial parts of the world's population and the establishment of sustainable economic growth in the Global South (de Vries and Jochemsen, 2019). There is still no silver bullet for economic growth, let alone a recipe of how to pave the way for sustainable development. Interestingly, even though agriculture played a dominant role in almost all traditional economies, most of the developing countries have neglected agriculture in development as a key sector for sustainable development (Hwa 1989, Pingali et. al. 2019). Agricultural production in low-income countries is oftentimes characterized by slow production due to internal difficulties such as a limited skill base, and external difficulties such as the high vulnerability to instabilities of the often-primary commodities they export, high fluctuations in production, and high state dependency (ibid.). Moreover, agricultural land in developing countries often characterized by degraded natural resources and land-use conflicts (IPBES 2019). Agriculture has changed dramatically, especially since the end of the Second World War. Food and fibre productivity soared due to new technologies, mechanization, increased chemical use, specialization and government policies that favoured maximizing production. India also witnessed a change in the agriculture system after independence. We had the challenge to produce enough food for the growing population. Hence,

we went for green revolution by adopting high-yielding varieties, fertilizers, pesticides etc. This combination of high-yielding production technology has helped the country develop a food surplus (Nagar et al., 2013). Today, agriculture in India goes beyond just meeting the food requirement of the country. However, it plays an important role in the national economy and employs nearly half of the country's population. Green revolution has helped India transform its status from a food-deficit to a food-secure nation. However, today, the positive impacts of green revolution are getting saturated and its fallouts have become apparent in recent past.

Green revolution has truly increased agricultural production on a global level, but it has done so at the cost of the degradation of the environment and natural resources (Jouzi et al., 2017). Modern agricultural technologies aim at maximization of productivity/unit area/unit time and promote the cultivation of high-yielding varieties, hybrids or genetically modified plants with intensive use of fossil-fuel-based energy, synthetic chemical fertilizers, pesticides and irrigation water, which are leading to degradation of natural resource base, emergence of soil-nutrient disorders, soil and environmental degradation, loss of bio-diversity, development of new biotypes of pathogens and pests, chemical contamination of soil and water bodies and finally human and animal health hazards (Prasad and Gill, 2009). With this background, the present study attempts to find the need for sustainable agriculture in India and also suggests some measures to fulfil the same.

Materials and Methods

The present study is based on secondary data obtained from various sources viz. Government publications, research articles, reports of agencies, etc. Some empirical evidences have also been taken into consideration to arrive at the conclusion.

Results

Necessity for Agricultural Sustainability

Agriculture is the mainstay of India's national economy and the country is known as a global agricultural powerhouse. It is the world's largest producer of milk, pulses and spices and has a large area under wheat, rice and cotton. It is the second-largest producer of rice, wheat, cotton, tea, sugarcane, fruits, farm fish and vegetable. However, agriculture in India is facing numerous problems like loss of soil fertility, fragmentation of land holdings, uncertain and erratic rainfall at some places, outbreak of pests and diseases, low financial investment and rising input cost. Thus, the practice of sustainable agriculture in India is of great help to overcome these issues, as it restores and nourishes the soil and works in harmony with nature, conserves energy, protects and rejuvenates environmental resources, values bio-diversity, boosts food chain productivity, improves people's wellbeing and economic growth, provides resilience in the world of climate change and supports local communities for their socio-economic and overall development. Sustainable agriculture is good for people, the planet, and it is profitable.

Environmental Sustainability

Environmental sustainability includes making life choices that ensure an equal, if not better, way of life for future generations and it is aimed at improving the quality of human life without putting unnecessary strain on the earth's supporting systems. Environmental sustainability can be well understood by considering the status of following aspects:

Soil Fertility

Loss of soil fertility is one of the major problems that agriculture in India is facing today. Soil erosion due to surface runoff, deforestation, high wind velocity, over-irrigation, overgrazing, excess use of chemical fertilizers and pesticides are some of the causative factors of soil degradation and loss of its fertility. Sustainable agricultural practices, especially protecting environmental resources are of great help in this context.

Water Resources

Overuse of water resources in domestic, industrial and agricultural sector, contamination

of surface and groundwater due to improper disposal of sewage and industrial effluents, uneven distribution of water in many parts of the country etc. are some of the water-related issues that Indian agriculture is facing today. As sustainable agriculture ensures water conservation, it is desired.

Agricultural Biodiversity

Farmers in many parts of the country practice monoculture farming, which is a most disputable issue. This type of agriculture is responsible for the loss of biodiversity that leads to loss of soil efficiency. The practice of monoculture farming may result into the outburst of pests and diseases. Sustainable agriculture increases the variety of plants, animals and micro-organisms that enrich biodiversity and thereby improves the agricultural productivity.

Environmental Pollution

The overuse and inappropriate handling of chemicals in the form of fertilizers, pesticides, weedicides, fungicides and herbicides is one of the common problems of Indian agriculture, that contaminates air, water and soil. Priority given to the use of organic manure in sustainable agriculture is of great help to cope with the environmental pollution taking place in the agriculture sector.

Existing Landscape

Faulty agricultural practices and deforestation in rural parts of the country pose adverse effects on rural environment and it reduces the carrying capacity of soil resources. People from such areas tend to migrate towards urban zones in search of employment. Such a population cannot afford the cost of housing in cities and they prefer to reside in slums, causing nuisance in urban environment. Sustainable agriculture on the other hand creates a favourable environment for people in rural areas and decreases rural to urban migration.

Climate

Conventional agriculture is a significant contributor to the emission of greenhouse gases like carbon dioxide, methane, sulphur dioxide, nitrous oxide and so on. On the other hand, sustainable agriculture promotes the use of non-conventional energy resources and thus, plays an important role in global warming induced climate change mitigation by reducing the emission of greenhouse gases.

Economic Sustainability

Economic sustainability refers to the practices that support long-term economic growth without negativity impacting social, environmental and cultural aspects of the

community. Sustainable agriculture encourages justifiable economic practices to protect long-term profitability of agriculture.

Export-oriented policies

The government often promotes the export of agricultural produce so that farmers can get a reasonable price for their produce. However, it involves the hidden cost of transportation and maintenance. Instead, the agricultural produce if sold in the local market, will cut the expenditure on transportation and maintenance. It will result into the availability of agricultural produce to the local people at fair prices. Sustainable agriculture focuses on the needs and development of local people and helps in this context.

Agricultural Debt

Today, the cost of agricultural inputs viz. seeds, fertilizers, pesticides, wages, transportation etc. has increased noticeably. The application of advanced technology, particularly in case of irrigated agriculture could increase the yield. However, it has adversely affected the small and marginal farmers. Sustainable agriculture as an eco-friendly practice, could cut the input cost and free small and marginal farmers from the vicious cycle of debt.

Agricultural Risk

Fluctuations and frequent drop-downs in the prices of agriculture produce pose high risk of financial losses. If climatic conditions are favourable, farmers enjoy a bumper crop which leads to a decline in market prices. On the other hand, Meagre crop production during adverse climatic conditions reduces crop yield and thereby farmers' income, further it pushes them into the cobweb phenomenon. Sustainable agriculture stabilizes the prices of agricultural produce and assures good returns.

Employment

Today, a large segment of Indian population is dependent on agriculture for employment. However, as mechanization and modernization of agriculture have reduced the demand for skilled and unskilled laborers, it has now become essential to ensure the well-being of these unemployed people. Sustainable agriculture may accommodate some of such population by promoting labour-intensive activities.

Inclusiveness

The inclusive approach adopted in sustainable agriculture may yield holistic development of society. It may reduce rural poverty by finding suitable ways.

Political Support

Sustainable agriculture needs government support to succeed. Economic policies framed by

the government should cater to removing any or all obstacles faced by farmers in adoption of sustainable agriculture. One such obstacle is lack of finance, as Indian farmers are largely poor and do not have much savings to rely on. Hence, government can try to establish new institutions and strengthen existing institutions to provide easier financial options to the farmers for accepting the changes brought through sustainable agriculture. Another major obstacle is poor agricultural marketing. If government can strengthen the linkages in the marketing channels and build a well-connected marketing infrastructure, the benefits of sustainable agriculture can be enjoyed by both farmers as well as consumers; and the role of middlemen can be minimized.

Local acceptance

As science and technology is rapidly developed in the recent past, it has also been introduced in various sectors. However, the use of technology needs suitable knowledge and skills. In addition, due to the influence of religion, traditions and customs, people particularly in rural parts of the country are not ready to willingly accept the innovations in science and technology. As sustainable development promotes the use of locally developed technology in agriculture, it search for more attention.

Indigenous Skills and Knowledge

Indian farmers have been transferring their art and knowledge of crop cultivation from generations to generations. They are well aware of their environment, weather conditions, natural resources, local breeds, animal wealth and human resources. Thus, they have developed their own skills, knowledge and technology to be used in agriculture. Sustainable development of agriculture takes all these aspects into consideration.

Gender Equality

In agrarian community, it is often seen that; men are enjoying comparatively more economic benefits from family earnings. Sustainable agriculture promotes gender equality, equal share of burden and ensures equal economic benefits to the men and women, thereby it safeguards equal financial independence for men and women.

Food Security

Farmers in majority of the Indian states have adopted traditional methods of crop cultivation, resulting into the low agricultural productivity. In addition to this, lack of knowledge, prevalence of poverty, impact of religion and non-commercialization of agriculture

are also some of the reasons behind low agricultural production in the country. In India, priority has been given to the cash crops in commercialization of agriculture. Thus, the area under food crops has decreased. It has resulted into the lack of balanced diet available to the masses. Thus, it is essential to cultivate a variety of food crops to cope with this problem. Sustainable agriculture is one of the appropriate solutions for the same.

Participation

Diversity in religion and caste is one of the important characteristics of Indian population. People with good financial positions and those who belong to upper castes enjoy the benefits of agriculture. Small, marginal and low-caste farmers in the country are still away from the mainstream of development. The holistic development approach adopted in sustainable agriculture will be of great help in this context.

Suggestions

According to a study by the Council on Energy, Environment and Water (CEEW), less than 4 percent of Indian farmers have adopted sustainable agricultural practices and systems (Economic Times 2021). However, reversing these figures is not difficult, if we can adopt proactive measures and strategies that can launch sustainable agriculture as a best practice across India. Some of the suggestions are mentioned below.

Adaptation of Organic Farming

Organic farming was initiated as a part of a larger solution to the environmental sufferings caused by excess use of chemical fertilizers and pesticides. It has been developed as a response to the environmental harms caused by faulty agricultural practices. This type of farming has numerous ecological benefits. It avoids excessive use of chemical fertilizers and promotes the application of organic manure, reduce soil erosion and prevents nitrates from leaching into the ground. Organic farming improves soil health and recycles animal wastes.

Improvement in existing cropping patterns

Indian farmers give priority to the cultivation of a specific crop in a particular area. Crop diversification in such area will be of some help to produce a variety of food crops to provide a balanced diet to the masses. Priority should be given to wheat, rice, jowar, bajra, soybean, barley, peas, gram, oil seeds, ground nut, seasonal fruits, vegetables, and fodder crops while selecting the crops for sowing.

Adaptation of advanced farm practices

The innovations in science and technology plays an important role in the growth and development of agricultural system. It ensures improvement in agricultural production, generates employment, reduces poverty and promotes equitable and sustainable growth of agriculture. Adaptation of biotechnology, appropriate use of fertilizers and pesticides, selection of improved crop and livestock varieties, application of drip and sprinkler irrigation, adaptation of risk management practices, use of green energy resources are some of the measures with the help of which one can ensure the sustainable development of agriculture in India.

Improved Protection for Natural Resources

Natural resources like soil and water being used in the agricultural sector are losing their quality, either due to their over utilization or pollution. Soils are getting eroded due to faulty agricultural practices like deep ploughing, ploughing along the slope, over grazing, over irrigation and excessive use of chemicals in the form of synthetic fertilizers and pesticides. Surface and ground water resources are getting contaminated due to leachate. Resource protection by adopting suitable methods of conservation like reduce, reuse and recycle may help in this connection.

Enhancement of Resource Efficiency

Enhancement of resource efficiency stands for the efficient use of natural resources and the relationship between the natural raw materials or techno-economic materials and benefits gained from their use whether in production or consumption. The main aim of the enhancement of resource efficiency is to maximise the benefits of products or services while minimizing consumption and waste which may help in sustaining agricultural sector.

Strengthening research in agriculture

Agricultural research in India should be focused on adequate food production, food safety and security, energy needs, sustainable use of natural resources, educational, scientific and computer literacy as well as rural-urban interdependence.

Improvement in agro processing

As agro-processing refers to the set of techno-economic activities carried out for conservation and handling of agricultural produce and to make it usable as food, fibre, fuel or industrial raw material, it offers multiple benefits. Thus, the establishment of agro-processing industries should be given priority.

Discussion

Sustainable development of agriculture in India is possible through organic farming. selection of appropriate cropping pattern, adaptation of advanced farm practices, conservation of natural resources, improving resource efficiency, strengthening agricultural research, optimizing system to reduce post-harvest losses and improvement in food processing system

Acknowledgments

Authors are thankful to the administrators, planners and researchers working in the field of agriculture for sharing their views and opinions on the current scenario of Indian Agriculture.

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Environmental, Industrialization, Management, Economics, Agriculture, Rural and Urban Development towards Sustainable Potential

Editors

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Sustainable Agriculture



**Book Chapter as
Per UGC Guideline**

Title	: Environmental, Industrialization, Management, Economics, Agriculture, Rural and Urban Development Towards Sustainable Potential
Editor Name	: Dr. Babalola, Ayodele Samuel, Riswan M, Dr. Prasanna Srinivas, Santosh P. Mane
Publishing Agency	: Fern International Publication Pune
Publisher Address	: Jyoti Kerappa Mane Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras , Malshiras, Solapur, 413107
Printed By	: Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	: I st
ISBN	: 978-81-959050-0-3
Copyright	: Jyoti Kerappa Mane
Publication Date	: 31/01/2023

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Mob- 8888454089

Email- fppune2003@gmail.com

Publication- Fern International Publication Pune

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E-Waste Management with Special Reference to India

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DOI-10.5281/zenodo.7631679

Abstract

Today, the generation of e-waste particularly in developed and developing countries has become a cause of concern due to its hazardous effects on human health and living organisms. India is not an exception to this. However, the management and treatment of e-waste in India have certain limitations. Thus the issue of E-waste has to be studied systematically. With this view, the present paper attempts to understand the present scenario of e-waste management in India. The paper is based on secondary data, which reveals that the e-waste generation in India varies from state to state and city to city. There are certain challenges to e-waste management in the country like lack of reliable data on e-waste generation and its management. The paper gives some suggestions for effective e-waste management and concludes that there is an urgent need for an in-depth investigation and assessment of present and future scenarios of e-waste management in India.

Key Words: Management, E-waste, Disposal, Recycling, India

Introduction

Today, the advancement in science and technology has brought spectacular developments in modern times that have enhanced the quality of our lives. At the same time, these have led to diverse problems of hazardous waste and other wastes generated from electric and electronic products. These harmful and other wastes pose a great threat to human well-being and the environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and the environment (GoI, 2011). Electronic waste (e-waste), that is, waste arising from end-of-life electronic products such as computers, mobile phones, LED bulbs, televisions, VCRs, stereos, copiers, and fax machines etc. is one of the fastest growing waste streams in the world today (Rama, M. et. Al., 2019). The annual global production of e-waste is estimated to surpass 50 million tons in 2020 (Baldé, C. P. et.al. 2017). E-waste in India is not only increasing in amount but also in its toxicity, the reason being the rapid growth in productivity and consumption in the electronics sector (Dwivedy and Mittal, 2010). About 50,000 tons of e-waste are imported to India each year (Manomaivibool, 2009). The electronic and electrical components manufacturing industries are the largest growing

sectors in India (Sepúlveda et al., 2010) producing 40,000 tons of e-waste itself every year (Sthiannopkao and Wong, 2013). Thus, the present research paper highlights the related issues and strategies to mitigate this emerging problem in India.

Objectives

1. To know about the current scenario of e-waste management in India
2. To provide suggestions on challenges in e-waste management

Materials and Methods

The present study is theoretical and is based on secondary sources of data viz. the government and private publications, research articles and reports.

E-waste and India

Today, e-waste has emerged as one of the serious environmental issues, which is related to public health matters. India is one of the major e-waste-producing countries in the world. It produces approximately 2 million tonnes of e-waste annually. In addition, it imports e-waste from developed countries around the world. Electronic gadgets, Computer and telecom devices, medical equipment's and electric equipment are the major sources of e-waste generation in India.

Table 1: Year-wise e-waste generation in India

Sr. No.	Year	E-waste generation (Million Metric Tonnes)
1	2015	1.97
2	2016	2.22
3	2017	2.53
4	2018	2.86
5	2019	3.23
Total		12.81

Source: CSE, 2020 compiled from The Global E-waste Statistics Partnership Table 1 reveals that, in the year 2015, India's e-waste production was 1.97 Million Metric Tonnes (MMT). It increased to 2.22 MMTs in 2016 and 2.53 MMT in 2017. This rising trend of e-waste generation continued in 218 and 2019 also. E-waste generation in these years was 2.86 MMT and 3.23 MMT and E-waste formally collected 30 kt , appx 1% collection rate. The yearly growth in e-waste generation was approximately 13 percent.

Table 2: Percentage contribution by states to annual e-waste generation

Sr. No.	State	% Contribution
1	Maharashtra	13.9
2	Tamil Nadu	9.1
3	Andhra Pradesh	8.7
4	Uttar Pradesh	7.1
5	Waste Bengal	6.9
6	Delhi	6.7
7	Karnataka	6.2
8	Gujarat	6.1
9	Madhya Pradesh	5.3
10	All other states	30.0
Total		100.00

Source: Electrical and Electronics manufacturing in India, ASSOCHAM & NEC Technologies, 2018
E-waste generation in India shows a state-wise variation (Table 2). In 2018, Maharashtra was the most industrialized state which generated 13.9% e-waste followed by the states of Tamil Nadu and

Andhra Pradesh (9.1% and 8.7% respectively). Uttar Pradesh generated 7.1% e-waste of the total e-waste generated in the country, while each of the states viz. West Bengal, Delhi, Karnataka, Gujarat and Madhya Pradesh generated more than 5% e-waste in 2018.

Table 3: Major e-waste generating cities in India

Sr. No.	City	e-waste generation in Metric Tonnes (MT)
1	Mumbai	96000
2	Delhi and NCR	85000
3	Bengaluru	57000
4	Chennai	47000
5	Pune	19000

Source: Vrushali P., Citizen Matters, Indian Cities Stare at a mountain of e-waste, with little Idea how to manage It, June 11, 2018

In 2018, Mumbai, Delhi and NCR, Bengaluru, Chennai and Pune were the top five e-waste-generating cities in the country (Table 3). Mumbai with its highest e-waste production in the country (96000 MT) ranked first followed by Delhi and NCR with its 85000 MT e-waste production. The city of Bengaluru generated around half (57000) of

the e-waste produced by Mumbai. Chennai generated 47000 MT of e-waste and Pune generated 19000 MT of e-waste.

Challenges before e-waste management in India

The major challenges of e-waste management found are as below

1. Unscientific handling of e-waste
2. More than 30% of the population resides in urban areas which substantially contributes to e-waste generation.

3. Scattered sources of e-waste generation make e-waste management problematic.
4. Lack of skilled and unskilled workforce needed for e-waste collection, handling and disposal.
5. Adoption of improper methods of e-waste disposal by industries.
6. Financial constraints in the field of e-waste management.
7. Weaknesses of e-waste producing industries,
8. Negligence of e-waste handling and managing institutions.
9. Implementation of unsuitable and improper technology for e-waste generation
10. Vague implementation of e-waste generation and prohibition laws.
11. Paucity and improper installation of e-waste collection bins
12. Unfocused mechanism of e-waste collection

Challenges to policymakers

1. Lack of e-waste generation, prohibition and management laws in the recent scenario.
2. Dearth of advanced methods of e-waste management
3. Absence of separate e-waste management and disposal department in local government bodies.
4. Inefficiency of the waste segregation system
5. Lack of positive attitude towards cleanliness among the citizens.
6. The unavailability of dependable data on e-waste generation is a major obstacle for policymakers ready to design an e-waste management strategy and to an industry wishing to take rational investment decisions.
7. Only a small amount of the e-waste finds its way to recyclers due to the absence of a well-organized take-back scheme for consumers.
8. It is because of the lack of harmless e-waste recycling mechanisms available in the informal sector, that there is a reliance on formal sectors, which poses risks to human health.
9. lack of infrastructures facilities, financial and policy supports also present challenges in e-waste management.

Suggestions

1. There should be a separate e-waste management department in urban local government bodies.
2. Local government bodies should collaborate with industries for collecting, transporting and processing e-waste material.
3. E-waste management targets should be achieved phase-wise and systematically.

4. Standard and proven methods for e-waste management should be adopted.
5. There should be a strict vigilance on unorganized sectors.
6. Privatization of the Recycling and reuse industry should be made. Jobs in this industry involve collection, processing, reuse, remanufacturing and more.
7. Awareness campaigning has to be created through formal and informal education systems. Mass media and social media can be used effectively.
8. Privatization and commercialization of e-waste recycling should be made.
9. Workshops on e-waste handling and management should be conducted.
10. Government should provide financial assistance in the form of incentives and subsidies to the e-waste recycling plants.

Conclusion:

The generation of a large amount of e-waste in various states and cities in India has made the problem of solid waste disposal and management more complex. Lack of reliable data, unavailability of proper disposal methods and shortage of knowledge about e-waste disposal are some of the obstacles in e-waste management. Thus, there is an urgent need for a thorough investigation and assessment of present and future scenarios of e-waste management. Quantification, characterization, qualitative analysis, evaluation of disposal practices and assessment of environmental impacts of e-waste management has become the need of the hour today. Use of suitable and standard methods of e-waste collection, transportation, treatment, storage, recovery and disposal need to be recognized and adopted considering the amount and quantity of e-waste. Public Private Partnership in recycling and disposal of e-waste is essential. Production of low waste-generating electronic gadgets, equipment's and instruments should be encouraged. Minimal use of toxic material should be used in electronic devices. Thus, a collective approach from national and international bodies, including public awareness, is crucial to managing e-waste,

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10. Vrushali P., (2018), Citizen Matters, Indian Cities Stare at a mountain of e-waste, with little Idea how to manage It, June 11, 2018.

ISBN: 978-81-959050-4-1

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Govt. Regd. No. UDYAM-MH-32-0072613
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Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

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Publisher Address

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Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
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Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

Copyright: Jyoti K. Mane

Publication Date: 20/10/2023

Price: 1000

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Green Energy for Emerging India: Potential, Policies and Challenges

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Abstract

Today, India is on the verge of transitioning from conventional energy resources to sustainable growth powered by green energy resources. Green energy will be the source of next phase of India's growth. The present paper attempts to understand the potential and challenges in the adaptation of green energy resources in the light of various policies framed by the Government of India in order to attain its NDC commitments. The study is based on secondary sources of data viz. publications and reports by international and national bodies. A few research papers were also referred to obtain the information. It is observed that India's attainment of Net Zero emissions depends on its successful harnessing of renewable energy resources; besides working towards improving fossil fuel efficiency, framing policies for utilisation of green energy, innovation in environment friendly technologies and bringing efficiency in the transportation of power supply. Towards this end, India has already formulated policies and undertaken a slew of measures such as the National Solar Mission, National Hydrogen Energy Mission, PM KUSUM etc. However, the challenges remain in terms of lack of research and development, land acquisition, inefficiencies in power distribution, the rapid growth of population, urbanization, industrialization, high dependence on fossil fuel based energy resources etc.

Keywords: Green Energy, India, Potentials, Policies, Challenges.

Introduction:

The challenge of global warming induced climate change has imposed a sense of urgency among the decision-makers across the world to adapt to a more sustainable model of growth and reduce dependence on fossil fuels. An important landmark demonstrating the collective intention to fight climate change and restrict the increase in

global average temperatures is the Paris Agreement adopted by 196 parties at the United Nations Climate Change Conference on 12th December 2015. Though India's energy use is less than world average on per capita basis, it is the world's third largest energy consuming country. (India Energy Outlook, 2021). In its Updated Nationally Determined Contribution (NDC) under Paris Agreement submitted in August 2022 to UNFCCC, India has stated its intention '*to adopt a climate friendly and cleaner path*' towards economic development. India has set ambitious and commendable targets such as, reducing emissions intensity of its GDP by 45% by 2030 from 2005 levels, achieving 50 percent cumulative electric power from non-fossil fuel based sources by 2030, restoring forest cover thereby creating an additional carbon sink of 2.5 to 3 billion tonnes by 2030, mobilising investments in development programmes towards sectors vulnerable to climate change, building capacities and technology transfer related to climate change. With this background, the present paper highlights the major policies and programs launched by the government to utilise the green energy resources at their optimum level.

Objectives:

The objective of the present paper is to study the potential and challenges in the adaptation of green energy sources in the light of various policies framed by the Government in its mission to attain the NDC commitments.

Data and Methodology:

The present study is based on the secondary information obtained from national and international reports including the reports published by the International Energy Agency and Ministry of New and Renewable Energy, India. Information available in research papers has also been taken into consideration. The paper is written in theoretical form.

Result and Discussion:

India's attainment of Net Zero emissions by 2070 depends on its successfully harnessing non-renewable energy sources including Wind energy, Solar power, Biomass, Hydropower, and Nuclear Power; besides adopting climate-friendly technologies, framing environment-friendly standards and regulations, working towards improving coal efficiency, and bringing efficiency in power supply. Towards this end, India has already formulated policies and undertaken a slew of measures such as the National Solar Mission, National Hydrogen Energy Mission, PM-KUSUM Scheme, National Bioenergy Programme, etc. However, the challenges remain in terms of investment financing, research and development, land acquisition, demands of a huge burgeoning population, urbanization, high dependence on coal, etc.

a. Solar energy: Solar power comprises 50.24% of the total potential for energy from renewable sources which is estimated at 14,90,727 MW as of 31st March 2022 (GoI, 2023). India being located in the tropical region is endowed with an abundance of solar energy. According to the Ministry of New and Renewable Energy, India's land area receives about 5000 trillion kWh of energy from the Sun per year. This comes to around 7,48,990 MW. The National Institute of Solar Energy (NISE) has estimated that 748 GW of energy can be produced from Solar PV modules by utilizing 3% of wasteland (Murthy

G. S., 2022). Solar energy can help in meeting the growing energy demand without harming the environment and is a clean, easy to maintain and sustainable method of generating power. (Sharma, et. al. 2012). The Development of Solar Parks and Ultra Mega Solar Parks Scheme that was started in December 2014 has been extended till 2026. Under this Scheme, the Central Government shares the financial burden of setting up solar parks with the states. A total of 50 solar parks across 12 states in the country have been sanctioned till now, with a total capacity of 37,990 MW. Out of these, 11 solar parks with an aggregate capacity of 8,521 MW have been completed, and 7 solar parks with an aggregate capacity of 3,985 MW have been partially completed. Financial Assistance through the VGF (Viability Gap Funding) Scheme up to specified limits is provided for Solar PV Power Projects. In order to promote rooftop solar usage, the Solar Rooftop Subsidy Scheme has been launched where a 30% subsidy for installation is provided to states in general categories, and a subsidy up to 70 % is provided by the Central government in case of states in special categories. In order to develop high-efficiency solar PV manufacturing through cutting-edge technology, a Production Linked Incentive (PLI) Scheme for the National Programme on High-Efficiency Solar PV Modules has been formulated with an outlay of Rs. 24000 crores. Under Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyaan (PM-KUSUM), small farmers, co-operatives, panchayats, etc. are assisted in setting up solar energy-based power plants up to 2MW and standalone solar agricultural pumps. As of 30 Sept 2023, a total of 137.95 MW installed solar capacity has been achieved under this program, and 262,873 standalone solar pumps have been installed. The International Solar Alliance is an inter-governmental grouping of countries that lie between the Tropic of Cancer and the Tropic of Capricorn. The initiative first proposed by the Indian Prime Minister, in November 2015 aims at harnessing solar energy for growth, replacing carbon-intensive fossil fuels, and ensuring energy security. As of June 30, 2023, India has commissioned solar projects with a total capacity of 70.10 GW which includes 57.22 GW from ground-mounted solar projects, 10.37 GW from rooftop solar projects, and 2.51 GW from off-grid solar projects. (Ministry of New and Renewable Energy, 2023). Some of the challenges faced in the successful harnessing of solar power are land procurement, the decline in wastelands in recent decades, regulatory bottlenecks, and multiple approvals required, (India Energy Outlook, 2021)

b. Wind energy: Along with solar, wind power is an important source of green and renewable energy in India. Of the total renewable power generation potential as of 31 March 2022, the wind power potential is 46.66% at 6,95,509 MW (120m hub height). (Energy Statistics India, 2023). The National Institute of Wind Energy (NIWE) has identified the eight windy states that can realise most of this potential- Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, and Telangana. In terms of the cumulative installed capacity of wind energy, India ranks fourth in the world. Several policies offering fiscal and financial incentives have been formulated by the Government to encourage wind power projects such as Accelerated Depreciation benefits; concessional custom duty exemption on certain components of

wind electric generators, Generation Based Incentive (GBI) Scheme, etc. The National Institute of Wind Energy, Chennai provides support in the form of wind resource assessment and identification of potential sites. Offshore wind turbines are a comparatively new development in this sector with the first offshore turbine built in Denmark in 1991. India has a vast coastline of 7600km which offers tremendous potential to harness the wind power through offshore turbines. The National Offshore Wind Energy Policy has been notified by the Government to ensure offshore wind energy development in the country.

c. Hydropower: Hydropower is clean, renewable, and a low-carbon source of energy. In the year 2022-23, energy from India's hydroelectric power plants accounted for 12.5% of the total power generated in the country. (Powell Lydia et. al. 2023). According to the STEPS scenario projection by IEA outlined in India Energy outlook in 2021, 'modern bioenergy, solar, wind and hydropower could meet a quarter of India's total energy demands in 2040' with hydropower witnessing capacity doubling to about 100GW in 2040. (India Energy Outlook, 2021). According to the Small Hydro Database of July 2016 compiled by the Hydro and Renewable Energy Department (HRED), there is an estimated potential for power generation of 21133 MW across 7133 sites in the country from small and mini hydel projects. The major challenges in large hydropower projects are related to land acquisition, resettlement, and rehabilitation (India Energy Outlook, 2021). Environmental and social costs, deforestation, and loss of biodiversity are some of the other challenges associated with large-scale hydropower projects. (Powell Lydia et. al. 2023). However, small hydropower projects are more environmentally friendly and do not cause deforestation and displacement. Hydropower can contribute significantly to power system flexibility as compared to other energy sources.

d. Bioenergy: Traditional bio-mass mostly used in rural areas in the form of fuel wood, straw, dung, charcoal, etc, is inefficient, unhealthy, and harmful to the environment. Modern bioenergy technologies can help to convert surplus biomass, bagasse, organic waste, agricultural residues, forest industries residues, and other waste into energy with a minimum negative impact on the environment while avoiding emissions. It is estimated that 130 Mtoe of energy can be generated from sustainable organic waste streams. (India Energy Outlook, 2021). A National Bioenergy Programme has been formulated by the Ministry of New and Renewable Energy for the period April 2021 to March 2025 with an outlay of Rs. 858 Crores to realise the energy potential of biofuels and biomass. Under this scheme, support and financial assistance for setting up biogas, Bio CNG plants, and other Waste to Energy projects is provided. The National Biofuels Policy, of 2018 targets 'bioethanol blending in gasoline of up to 10% in 2022 and 20% in 2030' (India Energy Outlook, 2021). The policy also envisages setting up 12 new biorefineries across the country with an investment of around Rs. 10000 Crore by Oil Marketing Companies. Some of the challenges in the adoption of bioenergy are supply chain uncertainties, high upfront costs and financing required, and use of bio-mass for non-energy purposes like fodder for animals, as manure, fuel for households in rural areas, etc.

e. Hydrocarbon: Green hydrogen produced using renewable energy can help India

reduce its carbon emissions and attain its NDC commitments. It has the potential to replace fossil fuels in transportation, shipping, steel manufacturing, fertilizer production, petroleum refining, etc., and provide energy security. The National Green Hydrogen Mission has been implemented by the Government of India to enable the production, usage, and export of Green Hydrogen. It aims to replace fossil fuels with renewable fuels and feedstocks to produce hydrogen. Currently, most of the hydrogen consumed is generated from fossil fuel-based sources and is referred to as Grey Hydrogen. The National Green Hydrogen Mission aims to create capabilities to generate at least 5 MMT of Green Hydrogen per annum by 2030 with the potential to reach production to 10MMT with the growth of export markets. The various initiatives under this mission include facilitating the building of infrastructure and supply chains for storage and delivery of green hydrogen, reducing input and capital costs to increase cost-competitiveness, achieving scale and low costs, providing financial incentive mechanisms, creating a robust standard and regulations framework, R & D, etc.

f. Nuclear Power: Nuclear energy is a low-carbon, releases less carbon emission, and economically viable source of energy. Currently, there are 23 operational nuclear power reactors in India with an installed capacity of 7480MWe. This capacity is proposed to be increased to 22,480 MWe by 2031, with nuclear power accounting for nearly 9% of India's electricity by 2047. (World Nuclear Association, June 2023). Nuclear Power will form a significant part of India's energy basket as it aims to achieve its NDC goals and move away from fossil fuels.

g. Other Policies: Other technologies and policies towards encouraging green energy and realizing the NDC commitments include the Green Energy Corridors Initiative that was launched in 2015-16 to synchronize and facilitate the integration of energy produced from renewable sources with India's national grid system, better energy efficiency and fuel quality standards for passenger cars through Bharat Stage VI, Faster Adoption and Manufacturing of Electric Vehicles (FAME) II in 2019 to encourage EV adoption, constructing supercritical coal plants with higher efficiencies, promoting Clean Coal technologies, stricter pollution emissions norms for thermal plants introduced in 2015, distribution of LED bulbs through Ujala Scheme etc.

Conclusion:

Being the most populous and developing country, India needs a huge supply of energy to develop economically and to improve the standard of living of its population. Though the country is blessed with a variety of green energy resources, it has not yet utilized its green resources up to their full potential. The government of India and the state governments are making an effort to increase the use of green energy resources by adopting suitable policies, providing financial support and encouraging environment friendly technologies. However, there is a wide scope for improvement in the development and utilization of green energy sources in India by overcoming inherent challenges and adopting appropriate measures.

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Implementation of National Education Policy - 2020 (Multidisciplinary Education)

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Editor

Dr. Pradeep Dighe

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**Advent
Publishing**

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Advent Publishing

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ISBN: 978-93-95369-26-8

First printing edition: February 2023

BD|#AP0250|826x1169|311p|

Cover design by Mr. Jyotiram Shinde

Printed in Republic of India

Published by Advent Publishing

007, Aspen, Building No 01,
Mohan Highlands, Badlapur East
Mumbai 421503 (MS) INDIA

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E-mail: info@adventpublishing.in

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PREFACE

Dear friends,

It gives us an immense privilege and pleasure to welcome you all at this SPPU sponsored National Workshop on “Implementation of National Education Policy 2020 under Multidisciplinary Education” on behalf of Loknete Dr. Balasaheb Vikhe Patil (Padma Bhushan Awardee) Pravara Rural Education Society’s Padmashri Vikhe Patil College of Arts, Science and Commerce Pravaranagar. In fact we had a very little span to organize such a big event. Moreover, our management and the College have taken sound efforts for organization of this workshop and lead to make available open platform for an academicians, researchers, scientists, industrialists and policymakers to sensitize and explore the major issues and challenges of NEP 2020 before the country.

This is high time to discuss the Implementation of the National Education Policy 2020. As all, we know that society is vibrant in nature. Teaching community has to change their mindset, education system, policy and planning accordingly. As our young nation strides towards development and advancing our potentiality inclusively, it becomes imperative to take inspiration from our ancient heritage and cultural values to transform the existing status quo with a modern and sustainable approach. In the present day, Indian educationists and reformers believe that to keep up and transform according to its social environment, a new modern education system is needed.

After Independence, several steps were taken by successive governments to decolonize the education system, including through the University Education Commission (1948-49), Secondary Education Commission (1952-53), and D.S. Kothari Commission (1964-66); the National Policy on Education 1968, 1986 and revised policy 1992. Former President of India Dr. APJ Abdul Kalam had emphasized the need for a value-based education that could be produced young age to make a culturally adapted citizenship and enable for transforming India into a prosperous, peaceful, secure, happy and developed nation. The NEP 2020 says recognizing the urgency of foundational learning, the shift from the 10+2 system to the 5+3+3+4 - with foundation, preparatory, middle, and secondary stages—will focus on a more holistic development of children. The emphasis on skills like analysis, critical thinking, conceptual clarity and co-curricular and vocational subjects will diversify their learning. Universal access at all levels of school education will be guaranteed, and drop out will be brought back into the education system. The multiple exit and re-entry system, credit transferability across the Universities, and multidisciplinary in the higher education system have provided flexibility to students. Internationalization of education will be facilitated through institutional collaborations, student and faculty exchange programmes. Such prompt measures will ultimately bridge the gap between industry and academia and harness our demographic dividend.

The mandatory teaching of an Indian language will protect and promote our linguistic and cultural diversity. India has thousands of languages and dialects, and each language has its significance and identity. India takes pride in this. But on the other hand, 196 languages in the country have been included in the list of endangered languages by UNESCO. The NEP 2020 emphasis on local languages will address these co-education system will pave the way for

addressing the pending demands of recognizing many languages under the Eighth Schedule of the Indian Constitution.

It is our responsibility to communicate this vision to the public so that the people whose lives are affected by our discoveries will understand and support to our research and educational missions under the NEP 2020. Technology has greatly shaped society and the environment, addressed many problems but also added new problems. The future of research should be bright one, full of great promise for making a significant difference in the quality of life on a global scale. Technology is the major cultural products of human history and all citizens, independently of their occupational 'needs', should be acquainted with them as elements of human culture. It is also important for economic well-being and from the perspective of a broadly based liberal education. There is the enticing prospect of novelty and better times ahead, but at the same time the concern of losing the good of the past.

So this is high time to discuss on the implementation of the National Education Policy 2020 among staff, academicians and policy makers. It is with these sentiments we take over as the organizers from Pravara group of institutions who for a last several decades has cleverly and effectively lead the educational trust organizing the National Workshop on "Implementation of National Education Policy 2020. In this context we have received more than 50 articles/research paper from the participants. We feel its overwhelming creative interest and well wishes from all of you. The deliberations to be held during the workshop will bring new insights and help the researchers in the various fields to implement the NEP 2020 under a multidisciplinary approach. We wish to express our gratitude to Hon'ble Chairman of our society Namadar Shri Radhakrishna Vikhe Patil for their moral support. We are grateful to the Savitribai Phule Pune University Pune and those who directly or indirectly boosted us to organize this event.

Thanking you,

Dr. Pradeep M. Dighe

Dr. Anil Kurhe-

Dr. Goraksh Pondhe -

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National Education Policy (NEP) 2020 of India: A Theoretical Analysis

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Introduction: Education policy refers to the rules and principles that govern the operation of education systems. The main aim of framing national education policy by governments in the world is to ensure the development of human resources of their country. With this view, governments all over the world have emphasized on framing and implementing new education policies. Formulation of education policies considers the factors like pedagogical methodologies, resource mobilization, curriculum content, and the possible impact of the policy on different groups.

Historical background of Education Policy of India:After independence, the Indian government has taken initiatives to solve the problem of illiteracy which was prevalent in the country. India's first education minister Maulana Abul Kamal Azad suggested that, the education system of our country should be under the control of the central government. He promoted a uniform education system throughout the country. In view of developing a suitable education system in the country, the union government of India established a university education commission in 1948-49, a secondary education commission in 1952-53 and in 1964-66 university grant commission and Kothari commission. In 1968 based on the recommendations from the Kothari commission report then Prime Minister of the country Indira Gandhi announced the first national education policy, which was called 'radical restructuring'. The major objective of this policy was to provide equal education opportunities to all for achieving the goals like national integration and cultural as well as economic development. This policy had a 'three language formula' (Regional language, Hindi and English) in secondary education and compulsory education for all children up to 14 years of age.

The second education policy in India was introduced in the year 1986 by Prime Minister Rajiv Gandhi. This policy has a major emphasis on the removal of disparities and equalising the opportunity of taking education to all sections of society including people belonging to SC and ST communities. Child centric approach in primary education had launched "Operation Blackboard" to improve primary school education. This was the major highlight of this policy. Based on Mahatma Gandhi's philosophy, the rural university model was created to promote socio-economic development in rural India.

National Policy on Education 1992 is the modification of national policy on education 1986. It was implemented by the P.V. Narasimha Rao government. The National Policy on Education 1992 stressed on promotion of development and strengthening national integration. This policy emphasized the need for greater transformation of the Indian educational system, with a focus on quality enhancement. The policy also stressed on developing moral values among students and bringing education closer to life. Further, fulfilling the goal of

universalization of primary education, District Primary Education Program (DPEP) was launched in 1994. In view of universalizing elementary education in a time-bound manner, the government of India launched *Sarva Shiksha Abhiyan* in 2000-2001. In 2009, the Government of India launched the Right to Education Act or The Right of Children to Free and Compulsory Education Act emphasizing free and compulsory education for children in the age group of 6 to 14 years.

New Education Policy, 2020: This is the third National education policy of India. The major objectives of this new education policy are to cater to the needs of a knowledge-based economy in the changing global scenario, enhance the quality of education promote innovation and research and ensure global access to the Indian educational system. Keeping these objectives for the overall development of the country, the government of India decided to change the education policy after 34 years. To formulate a new education policy, the government of India in 2017, constituted a committee under the chairmanship of K.Kasturirangan. The committee drafted the National Education Policy 2019. On July 2020, the Government of India approved the National Education Policy 2020. The Ministry of Human Resource Development has been renamed the Ministry of Education.

Pattern: In the new education Policy, the pattern of education is 5+3+3+4. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

Role of Education: As per the requirement of the 21st century, the aim of a quality university or college education must be to develop good, well-rounded and creative individuals. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement and productive contribution to society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

Gross Enrolment Ratio in Higher Education: Gross Enrolment of higher education to be raised to 50% by 2035 and 3.5 crore seats to be added in higher education. The target of increasing the gross enrollment ratio is to 50% by 2030.

Expenditure: The Center and State will work together to increase the public investment in the Education sector to reach 6% of GDP at the earliest, and reach 20% of all public expenditure over a period of 10 years.

Teacher-Student Ratio: The Teacher-Student ratio shall range from 1:10 to 1:20 depending on the program. The teaching duty shall allow time for interaction with the students, conducting research, and other university activities. Faculty will be appointed to individual

institutions and not be transferable across institutions, so that they may feel truly invested in, connected to, and committed to their institution and community.

Curriculum Policy: On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hour's daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early-grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

Statistics: Institutions equipped with vast, ubiquitous, prosperous, multi-disciplinary branches envisage a new Vision and Structure for Higher Education. The existing 800 universities and 40,000 colleges will be consolidated into about 15,000 excellent institutions.

Institutional restructuring and consolidation - The main thrust of this policy in higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges and HEI clusters, each of which will aim to have 3,000 or more students.

Model multidisciplinary colleges will be established across the country and also establishing at least one large high-quality multidisciplinary HEI in or close to every district.

All HEIs will move towards becoming large multidisciplinary institutions as

1. Research Intensive Universities (RUs)
2. Teaching Universities (TUs)
3. Autonomous Degree Granting Colleges (ACs)

RUs will largely focus on research; TUs while placing greater emphasis on teaching would also conduct significant research and ACs are large multidisciplinary institutions of higher learning primarily focused on undergraduate teaching.

By 2040, all higher education institutions shall become multidisciplinary institutions and shall have student enrollments in the thousands for optimal use of infrastructure and resources.

Higher Education Commission of India (HECI): Will be set up as a single overarching umbrella body for the entire higher education, excluding medical and legal education. HECI to have four independent verticals-

1. National Higher Education Regulatory Council (HEGC),
2. General Education Council (GEC) for standard setting.
3. Higher Education Grants Council (HEGC) for funding.
4. National Assessment and Accreditation Council (NAAC) for accreditation.

Public and private higher education institutions will be governed by the same set of norms for regulation, accreditation and academic standards.

Entry-Exit Points: The policy envisages broad-based, multi-disciplinary, holistic undergraduate education with flexible curricula, creative combinations of subjects, integration of vocational education and multiple entry and exit points with appropriate certification. UG education can be of 3 or 4 years with multiple exit options and appropriate certificates within this period.

Academic Credit Points: Academic bank of credits to be established to facilitate the transfer of credits.

Graded Autonomy: Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure the leadership of the highest quality and promote an institutional culture of excellence. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG (Board of Governance) by 2035.

Virtual Labs: Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPRAKHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG (Socio-economically Disadvantaged Groups) students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.

Globalization of Education: Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India. Indian universities will be encouraged to set up campuses in other countries, and similarly, the top 100 universities in the world will be permitted to operate in India.

National Research Foundation (NRF): The National Research Foundation will be created as an apex body for fostering a strong research culture and building research capacity across higher education. The present complex nomenclature of HEIs in the country as deemed to be university, affiliating university, affiliating technical university, the unitary university shall be replaced by the university. Undertaking the Ph. D. shall require either a master's degree or a 4 years bachelor's degree with research. The M. Phil program shall be discontinued.

Departments in languages literature, music, Philosophy, Indology, Arts, Dance, Theater, Education, Mathematics, Statistics, pure and applied sciences, sociology, economics, sports and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthen at HIEs across the country. The flexible and innovative curriculum shall emphasize offering credit-based courses and projects.

The undergraduate degree will be of either a 3 or 4-year duration with multiple exit options within this period. The 4-year program may also lead to a degree with research. HEIs will have the flexibility to offer different designs of master programs.

1. There may be a two-year program with research for those who have completed a 3-year bachelor program.
2. For students completing a four-year bachelor's program with research there could a one-year master's program.

There may be an integrated 5 years bachelor/master's program. Universities and colleges will be required to set up high-quality support centers. The requisite support to the students from the rural background and small towns including increasing hostel facilities as per requirement. Financial assistance to needy students shall be made available. The national scholarship portal will be expanded for this purpose.

Conclusion: The fundamental reform proposed by the National Education Policy (NEP) 2020 of India covers comprehensive dimensions of ensuring quality education in the coming years. The framework of this policy focuses on the holistic development of students, teachers, educators, policymakers and administrators working in the field of education. It offers a futuristic vision to transform the educational environment in India. The present study is a theoretical extension of the evolution of the Indian educational structure. Student centricity, multiple entries and exit points, variety of academic courses and language options came out as the key extracts from the policy documents of NEP 2020. The emphasis is laid on integrating ICT with the process of teaching-learning. It assures community development by imparting knowledge-based education to students in all classes of society. The experiential learning process is encouraged at all levels of education starting from primary to the level of post-graduation. This policy is a crucial revolution in the Indian educational ecosystem that must be executed incrementally to observe its effectiveness in the short run. Assuredly, the policy is innovative and meets the students' and teachers' demands at large, however, its inferences would vary from state to state. The policy is a comprehensive and open-minded opportunity while yet looking for methods to internationalize.

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Indian Council of
Social Science Research



Conference Proceedings

28th - 29th March 2023



NATIONAL CONFERENCE ON : ORGANIC FARMING **SILVER JUBILEE YEAR 2022-23**

ISBN No. -978-81-927305-7-8

Organized by
Department of Geography
Shirdi Sai Rural institute's
Arts, Science and Commerce College, Rahata
Tal-Rahata, Dist-Ahmednagar (423107)

Scanned with CamScanner

National Conference on
"ORGANIC FARMING"

28th -29th March 2023

Conference Proceeding

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Organic Farming for Sustainable Development

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Abstract

In an attempt to meet the growing food demand for rapidly increasing world population, agriculture sector is facing numerous challenges across the world. Though the conventional practice of agriculture is one of the widely accepted approaches due to its affordability and accessibility, it has some weaknesses. Sustainable agriculture through organic farming is one of the feasible alternatives to overcome these weaknesses. With this view, the present paper attempts to understand the concept of organic farming for sustainable development by understanding the principles, objectives, importance limitations and prospects of organic farming.

Keywords: Organic, Farming, Sustainable, Development, India

Introduction:

Today's world is full of artificial, manmade, synthetic as well as manufactured food and today, the word 'organic' has become mysteriously rare. Organic agricultural produce refers to the foods that are grown on soils with no artificial additives. It is completely cultivated by means of organic farming system which uses natural pest controls and manures consisting of organic materials derived from animals, human and crop residues which contain plant nutrients in complex organic forms and biological fertilizers from plants and animals instead of chemical alternatives. Organic farming has numerous ecological benefits over conventional farming, such as reduction in soil erosion, decrease in nitrate leach in surface water and groundwater, recycling of animal waste etc. Organic farming is an inclusive production management system that caters to the health of the agricultural ecosystem, including the environment, the biological cycle, and the soil. In short, organic farming neutralizes the environmental damage caused by conventional farming. Today, our planet is considerably damaged by pollution and the global warming induced climate change is fuelling the scope for organic farming. The potential of organic farming in replenishing environmental quality has made it the best alternative for farming, leading to the wide acceptance of organic farming across the world. With this background the present paper attempts to understand the concept of organic farming for sustainable development.

Organic Farming:

Organic farming is a safe and justifiable farming system that produces healthy crops without any of the environmental damages. It prohibits the application of artificially prepared chemical fertilizers and pesticides to develop a healthy, fertile soil with

appropriate water holding capacity. The focus of this type of agriculture is on growing variety of crops to enhance the richness of biodiversity. Thus, the farm remains biologically balanced, with a variety of helpful insects and other animals to act as natural predators for pests and a soil with ample microorganisms and earthworms. As the food produced in organic farming is free from the toxins, it has been in steadily rising demand all over the world. The avoidance of artificial chemicals means organic farming which minimizes health and pollution problems. Of the many goals of organic farming, the two widely accepted are:

- (i) To obtain toxin-free agricultural produce for long-term safety to human health, and
- (ii) To attain a closed nutrient cycle for restoration of negative soil nutrient balances.

Organic farming relies on "biologically driven nutrients" and helps accomplish a closed nutrient cycle, an important factor to attain sustainable agricultural development.

Principles of Organic Farming:

The four main principles of organic production are:

The Principle of Health: Organic farming should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

The Principle of Ecology: Organic farming should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

The Principle of Fairness: Organic farming should build on relationships that ensure fairness with regard to the common environment and life opportunities.

The Principle of Care: Organic farming should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment (I.F.O.A.M., 2005b).

Objectives of Organic Farming:

- To use natural and energy resources with responsibility.
- To preserve indigenous knowledge in seeds, crop varieties, and farming,
- To recognize the social and ecological impact of farming system
- To maintain biodiversity and protect animal welfare.
- To restrict all forms of pollutions that may result from agricultural practices.
- To use on farm resources as far as possible.
- To produce nutritious and good quality food.
- To maintain the local and regional ecological balance.
- To enhance biological cycles linking microorganisms, soil flora and fauna, plants
- and animals.
- To develop and maintain soil fertility in long-term.
- To help conserving basic natural resources viz. soil and water.

Sustainable Development:

Sustainable development is defined as a development in a direction that the present generation's needs are met without overexploitation of resources so that future generations' needs are not compromised (W.C.E.D., Brundtland Commission Report,

1987). Global development of humanity during the last decades has led to the increasingly undesirable effects of global warming induced climate changes and a variety of natural disasters, wars, political and socio-economic instability. Many anthropogenic activities have negatively impacted on the environment, endangering the survival of the future generations. These situations have specified changes in the behaviour aimed at more rational and efficient management of resources that will reduce pressure on resources and environmental impact. Such accountable behaviour will safeguard the long-term exploitation of resources, without jeopardizing future generations is considered within the concept of sustainable development.

The concept of sustainable development is based on the concept of holistic development. There are three components or dimensions of sustainable development, which includes social and economic development with the maintenance of environmental balance. It includes the need of redistribution of resources to ensure the quality of life for all. The crux of sustainable development derives from the triple bottom line concept, which implies the balance between three pillars of sustainability viz. socio-economic development and maintenance of environmental balance. The environmental sustainability focuses on maintaining the quality of the environment which is essential for conducting the economic activities and peoples' standard of living. The social sustainability strives to ensure human rights and equality, protection of cultural identity, respect for cultural, religious and racial diversity. Economic sustainability is necessary to maintain the natural, social and human capital essential for income and maintaining the standard of living. The total sustainable development can be achieved through maintaining a balance between all the three pillars, yet, the required condition is not easy to achieve, because in the process of achieving its goals each pillar of sustainability must respect the interests of other pillars not to bring them into imbalance.

Importance of Organic Farming:

Food produced in organic farming appeals to consumers as a healthy and ethical choice. In addition to money and ethics, organic farming has several environmental benefits.

- 1. Least contact with chemicals:** Use of chemicals in the form of fertilizers and pesticides results into numerous environmental issues like contamination of soil, water and air, loss of biodiversity in the soil, rise in soil toxicity etc. Sometimes these harmful chemicals stick around for longer time even for decades.
- 2. Supports Animal Health:** Organic farming creates healthy environment for birds and other natural predators to live happily on farms that assists in natural pest control.
- 3. Improvement in soil quality:** Healthy soils play an important role in the production of healthy food. Excess and frequent use of chemicals in the form of fertilizers and pesticides deteriorate soil quality. Thus, natural cultivation practices prove to be better than chemical soil management.
- 4. Decrease in soil erosion:** Application of organic manure instead of chemical fertilizers increases the texture and water holding capacity of soil and thereby reduces the potential erosion loss of soil.

5. Water Conservation: Organic farming helps keep water bodies clean by reducing polluted runoff. As the application of organic manure increases water holding capacity of soil, it reduces the requirement of water for irrigation and thereby conserves water.

6. Enrichment of Biodiversity: Application of chemicals in the form of artificial fertilizers, pesticides, weedicides, herbicides, insecticides etc. contaminate soils and increases its toxicity which results into the loss of soil biota consisting of useful micro-organisms like bacteria, fungi and algae. Organic farming safeguards biodiversity.

Organic Farming in India:

Ever increasing population as opposed to an ever-decreasing supply of living resources like food and water has made it necessary to increase agricultural production and stabilize it in a viable and feasible manner. The benefits of 'Green Revolution' credited to Dr. MS Swaminathan have now reached a plateau and with diminishing returns it has become necessary to devise alternate techniques. In addition, the excess use of fertilizers and artificial growth regulators has led to an issue called 'pollution'. The need of the hour is a natural balance between life and property for existence. Keeping in view the fact that fossil fuels are on their way of extinction and are non-renewable, organic, nature friendly ways of farming and agriculture has gained importance. (<https://www.farmingindia.in/organic-farming/>)

India produced around 2.75 million MT (2019-20) of certified organic products which includes all varieties of food products namely Oil Seeds, Sugar cane, Cereals & Millets, Cotton, Pulses, Aromatic & Medicinal Plants, Tea, Coffee, Fruits, Spices, Dry Fruits, Vegetables, Processed foods etc. The production is not limited to the edible sector but also produces organic cotton fiber, functional food products etc. Among different states Madhya Pradesh is the largest producer followed by Maharashtra, Karnataka, Uttar Pradesh and Rajasthan. In terms of commodities Oil seeds are the single largest category followed by Sugar crops, Cereals and Millets, Tea & Coffee, Fiber crops, fodder, Pulses, Medicinal/ Herbal and Aromatic plants and Spices & Condiments. The total volume of export during 2019-20 was 6.389 lakh MT. The organic food export realization was around INR 4,686 crore (689 million USD). Organic products are exported to USA, European Union, Canada, Switzerland, Australia, Japan, Israel, UAE, New Zealand, Vietnam etc. In terms of export value realization Processed foods including soya meal(45.87%) lead among the products followed by Oilseeds (13.25%), Plantation crop products such as Tea and Coffee(9.61%), Cereals and millets (8.19%), Spices and condiments (5.20%), Dry fruits (4.98%), Sugar(3.91), Medicinal plants(3.84%) and others.

(http://apeda.gov.in/apedawebsite/organic/Organic_Products.htm)

Limitations of Organic Farming:

The demand for organic products and subsequently organic farming has been reported to get increased all over the world. Despite of numerous advantages it offers in terms of preservation of natural resources, protection of environment, better food quality etc., a shift to organic farming still remains a big challenge in developing countries like India. Besides other drawbacks, government policies in regard of

promoting organic farming is one of the biggest challenges in India (Bhardwaj and Dhiman, 2019; Das et al., 2020). Organic food is more expensive because farmers do not get as much out of their land as conventional farmers. Also, other constraints like dearth of livestock; difficulty in soil nutrients management; low yield as well as failure in achieving the desired quality of the organic produce; lack of constancy in quality of the produce, organic pesticides are less effective in comparison to chemical pesticides; labour intensive process and thus high input cost, lack of finances or credits; insufficient infrastructure; inability to meet the export demand (like high price related to quality, paper related work is a complicated as well as time taking process and lack of proper economic amenities required for quality assessment both for input as well as organic produce which opens up the possibility for fake products in the market resulting in losses of trust and interest in the product among the consumers (Barik, 2017; Bhardwaj & Dhiman, 2019; Das et al., 2020).

Organic farming has a major disadvantage in that it produces low yield which in turn is balanced with the high price premium and low input cost involved in producing organic products. However, in India, organic produce does not offer a high price premium, thus decrease yield leads to lower profit if they are sold domestically. Other limiting factor is that a large number of farmers belongs to a marginal and small category and therefore, to support organic farming in a country like India, the government needs to invest to provide financial incentives to the farmers. There is a need to bring out more schemes wherein cooperation with non-government agencies, they should help in the certification process and provide special training to the farmers to enhance their knowledge and skills that are required for the production, processing and for the marketing strategy of organic products. Besides financial assistance, they need to be supported by extension programmes on how to use their own input resources instead of purchasing and relying on outside resources and also there is a need to encourage them in making associations and trade unions to improve their marketing efficiency (Barik, 2017; Das et al., 2020; Yadava and Komaraiah, 2021).

Prospects of Organic Farming in India:

India possesses large arable land. The net sown area in this country is 140.1 million hectares. Agriculture and its allied sectors viz. livestock, forestry, fisheries etc. is still the largest source of livelihood for Indians. Agriculture and its allied sectors have employed more than half of the total workforce in India. About 70 per cent of rural households still depend primarily on agriculture for their livelihood. As per the Agriculture Census of 2015–16, about 146 million farming families in India have operational landholdings for agriculture use. Around 85 per cent of these farmers are small and marginal, with landholdings of 2 ha or less. However, the share of agriculture and allied sectors in the gross domestic product of the country has declined from 18.2 per cent in 2014–15 to 16.5 per cent in 2019–20.

Organic farming is not new to India. Farmers in the country are cultivating their crops without using chemicals since the centuries. They are largely depend on cow dung, crop residues and composts since time immemorial. This is also synchronized with the Sustainable Development Goal 2 targeting 'end hunger, achieve food security

and improved nutrition and promote sustainable agriculture'. In fact, the organic and natural farming movement in India is still not become a mass movement. Only 2 per cent of net sown area in India is organically farmed. This fact itself reveals that, there is a large potential for the development of organic and natural farming in India. Hence with the widespread awareness and capacity building of the farmers in compliance with international standards, Indian organic farmers will shortly be strengthening their appropriate place in world agricultural trade.

Now the time has come to explore the current untapped domestic and international market for certified organic products. To fulfil this purpose, organic and natural agriculture must become a part of conventional agriculture. Efforts should also be taken to build demanding scientific data on the benefits of organic farming. Now it has become important to ensure promotion of organic and bio fertilizers instead of chemical fertilizers. In addition to this a farmer friendly and gainful certification policy should also be framed and implemented to encourage farmers to go for organic farming.

Conclusions:

Organic farming is an environment friendly method of crop cultivation with a huge potential for preventing environmental degradation. It is also helpful for improving socio-economic status of people. Today, organic food is gaining popularity among the health-conscious individuals and societies. It produces safe and healthy nutritious food with less contaminants. However, favouring and supporting the premium price of organic produce and providing accessibility to the marketplace would encourage the farmers to opt for organic farming. Besides, the advanced organic farming methods will help promote organic farming among marginal and small farmers by ensuring economic and eco-friendly agricultural produce. Consequently, adopting the indigenous technique of organic farming, providing better market facilities for organically grown agricultural produce, provision for financial assistance, enhancement of technical skills, education, organization of training programmes and workshops and implementation of awareness programs would bring more land under organic farming for profitable, healthy as well as sustainable agricultural production.

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THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM



ISBN: 978-93-100-0564-6

EDITOR

DR. EKNATH MUNDHE

THE WISDOM OF BHARAT: AN EXPLORATION OF THE INDIAN KNOWLEDGE SYSTEM

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Professor,

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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ROLE OF YOGA AND MEDITATION IN EDUCATION

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Abstract: *Education these days is becoming challenging due to increasing competition, heavy syllabi, introduction of new teaching-learning practices, use of advanced teaching aids and learning devices. This situation leads to high stress levels among students and teachers. Considering this fact, the present paper attempts to understand the role of Yoga and Meditation in the field of education. The paper utilizes secondary information available in various modes. Discussions held with students and teachers are also considered while writing this paper. The study reveals that, in spite of numerous advantages of Yoga and Meditation in education, these are still neglected. It is found that there is an urgent need to popularize these practices among students and teachers.*

Keywords: *Yoga, Meditation, Education, Stress, India.*

Introduction:

Day by day education is becoming a challenging task in the environment we live in. Electronic devices and gadgets like Android Phones and laptops, we use in our daily life made us habituated with the speed as well as rapid and recurrent changes in activities. This is one of the key causes of increasing stress levels among people, particularly in the student and teacher community. Students come to schools and colleges where the most common methods of learning are listening, writing, speaking and reading to cope with the competition. The use of electronic gadgets like laptops, touchscreen monitors and laboratory equipment's for smoothening the teaching-learning activity needs new skills which creates stressful conditions among the students. In addition, excessive demands and too high expectations that are often put on students, result in rising stress levels and create unease among them. Most of the time, difficulties in meeting the expectations of teachers and parents are a cause of stress among students. Simultaneously, those same parents and teachers also remain under stressful conditions. We teach children the subject matter while no one teaches them how to breathe properly and thus reduce stress. Yoga is a breathing technique that is of great help in bringing down stress levels in an individual. Yoga is meant to help people achieve a level of mental tranquillity where they can fully manage their reactions to both positive and negative external stimuli and responses are moderate in intensity (Telles S., et. al. 2000). Yoga is a great way to stay healthy and enhance one's personality. In one study, it is found that a 4-week program of Yogasanas and Meditation lowers the aggressive behaviour of students (Iniew Sumanna, 1998). Thus, the practices of Yoga and Meditation are useful for both, an individual and for a stress-free society. Yoga is a way of life that emphasizes peace, balance, and bliss. (Nagendra H.R. and Nagarathna R. 1977). Having a healthy mind is a key to person's overall health and well-being. A healthy mind impacts your thoughts, feelings, behaviours, and responses and involves emotional, psychological, and social well-being. Along with Yogic Practice, Meditation, being part of Yoga, is the seventh limb of Ashtanga Yoga (Tamini L. K. 1961). While, Restraint, Observance, Posture, Breath control, Abstraction, Concentration,

Meditation and Spiritual absorption are the eight components of Yoga while ahimsa, satya, asteya, brahmacharya, aparigraha, saucha, santosha, tapah, swadhyaya and Ishwar pranidhan are the basic principles (Siddappa Naragatti, and Yoga Therapist 2018). Yoga's methods of meditation, asanas, and pranayama have a beneficial impact on teenage stress management (Krejci Milada. 1994). It helps calm the mind. Both Yoga and Meditation are proven to be helpful in improving the performance of teachers and students. Students also experience rapid physical, intellectual, and social changes at different rates and at different times, while educational contexts and social expectations are expanding (Young et al., 2012). With this view in mind, the present study is aimed at understanding the role of Yoga and Meditation in education as a healthy way of living.

Objectives:

The study has been designed to achieve the following objectives:

1. To understand the concepts of Yoga and Meditation.
2. To know the status of Yoga and Meditation practices.
3. To recognize the Role of Yoga and Meditation in education.

Methodology:

The present work is carried out with two main sources. Initially, the information on Yoga and Meditation was gathered from secondary sources viz. private and government publications, research articles, books, newspapers and survey reports. Secondly, the effects of Yoga and Meditation on students and teachers were carried out by considering the experiences shared by them.

Concepts of Yoga and Meditation:

Yoga is primarily a spiritual discipline that harmonizes the mind and body via the application of an incredibly subtle science. It is an art, science and a way to live healthily. The word 'Yoga' is derived from the Sanskrit root 'Yuj', meaning 'to join' or 'to unite'. As per Yogic Scriptures, the practice of Yoga leads to the union of individual consciousness with that of universal consciousness i.e. union with the divine, indicating a perfect harmony between the mind and body. The aim of Yoga is self-realization, to overcome suffering that leads to a state of liberation. The practice of Yoga is to live with freedom in different walks of life. Health and peace should be the major objectives of Practicing Yoga. Being measured as an 'immortal cultural outcome' of the Indus-Saraswati Valley civilization, Yoga has proved itself to cater to both the material and spiritual upliftment of humanity. The essence of Yoga Sadhana is the practice of basic humanitarian values. The practice of Yoga is supposed to have started at the beginning of civilization. The Yogic Science has been around for a very long time. Now-a-days Yoga Education is being imparted by many institutions including universities and colleges. Today, practicing Yoga is considered to be of great help in improving flexibility, endurance, balance, physical strength and immunity. Academic institutions promote health benefits among the students and faculty through Yoga and Meditation.

Meditation is a practice in which an individual uses a technique of mindfulness that focuses the mind on a particular object, thought or activity to train attention and awareness and achieve a mentally clear and emotionally sound, calm as well as stable state. This wellness platform enormously contributes to forming a stress-free environment and healthy way of thinking and living.

Meditation is a technique to still the mind. But the act is not easy enough. The human mind keeps on traveling at a great speed with numerous thoughts coming and going at the same time. Meditation starts with letting our thoughts flow without any restrictions on them. Just be an observer and let the thoughts flow. Over a period of time, we observe that without controlling our thoughts, the flow of thoughts during that period of time starts reducing. This is because we do not try to forcefully restrict our thoughts. Our mind unknowingly becomes calm and we enter the stage of meditation. Patience is the key to meditation.

Yoga and Meditation are both interrelated. Yoga mainly helps maintain a healthy body. A healthy mind rests in a healthy body and automatically calms the mind and helps to enter the stage of Meditation much more easily.

Practicing Yoga and Meditation:

Yoga and Meditation need a quiet environment to practice it. It is always better to choose a place with natural aeration and fresh air. Yoga Mat can be used for additional comfort. It is advisable to perform meditation when one is comfortable, perhaps a few hours after a meal. There is also a need for a brief warm-up before performing Yoga. One should sit straight and practice deep breathing. Focus on the body, mind as well as beyond and concentrate on the singular object.

Discussion:

It is found that the practice of Yoga and Meditation offers various benefits to its practitioners, they are as follows:

- 1. Reduces Stress:** Most of the students and teachers live a stressful life and thereby suffer from health issues. As Yoga benefits both body and mind, it can help reduce stress and promote relaxation. Regular practitioners of Yoga found stress free and they are better able to handle things when life becomes complex.
- 2. Recovers Memory and Concentration:** Yoga plays a vital role in the brain development of an individual and keeps one's brain healthy. It enhances skill and thereby improves human efficiency and the productivity level of practitioners.
- 3. Imparts Precise Breathing Techniques:** Breathing is a core element of Yogic Practice. It is essential for survival and our breathing style is directly related to our overall well-being. Proper breathing allows us to handle stress positively. The Yogic Breathing Technique is also known as pranayama. It refers to controlled breathing that matches the rhythm of the Yoga Posture. One must learn breathing techniques and practice Yoga to bring excellence to life.
- 4. Increases Self-confidence and Brings Inner Peace:** As Yoga inculcates a positive attitude among individuals and offers many health benefits, it boosts the self-confidence of a person.
- 5. Improves Flexibility, Balance and Posture:** Sitting continuously for study and excessive screen time may result in an improper posture of a person. This abnormal posturing in childhood can develop into major anatomical difficulties in adulthood. Regular Yogic Practices lead to correction of posture. It enhances flexibility and improves balance as it brings equilibrium to the full body.
- 6. Enhances Coping Skills:** The sedentary lifestyle of students and teachers develops physical abnormalities and it also exerts stressful conditions among them. Yogic practice

develops the skills for coping with physical and mental stress. It improves a person's effectiveness.

7. **Improves Self-control:** Practicing controlled breathing in Yoga inculcates the habit of self-control. Thus, Yogic Practitioners do not react indiscreetly or make hasty decisions even in an emotional state.
8. **Protects Self-esteem:** It is a proven fact that Yoga is a very good technique to increase and protect self-esteem. It teaches awareness of the body and relaxes us using Asanas. Yoga is all about being kind to oneself, not about being exceptional at something. Yoga helps heal depression and supports self-regulation.
9. **Reduces Violence in Schools and Colleges:** Violence in schools and colleges is a result of mental illness, feelings of loss, anger, loneliness and powerlessness among students. As the practice of Yoga addresses these issues, it helps reduce violence in schools and colleges. In addition, Yoga offers an internal locus of control to the practitioners.
10. **Boosts Immunity:** Yoga along with a nutritional diet and habit of sound sleep enhances the natural defense mechanism of our body. It ensures the optimal functioning of all our body organs which regulates blood flow and thereby boosts immunity.
11. **Fetches Peace of Mind:** Yoga and Peace of Mind are essentially related to each other. Yoga promotes peace of mind by regulating the nervous system and helping mindfulness.
12. **Reduces Anxiety:** Yoga can help in reducing anxiety by connecting with the mind, body and environment. Certain poses and breathing techniques help overcome negative feelings, it calms the mind and offers peace of mind.
13. **Inspires Self-love and Self-care:** Yoga enhances our personality from within rather than looking good from the outside. It teaches us how to love ourselves. Along with self-love, caring for self comes automatically.
14. **Decreases Absenteeism in Schools and Colleges:** Yogic practice-induced mental and physical health increase immunity and thereby reduces the incidences of illness among the students and it allows them to remain present in their schools and colleges regularly.
15. **Enhances Attention Span:** It is found that the group practice of Yoga significantly improves memory, concentration and thereby enhances the attention span of the practitioner.
16. **Increases Mental and Physical Wellness:** Yoga increases energy levels in the body and eliminates fatigue. Hence it is highly recommended to achieve optimal health for students at a growing age where more physical and mental energy is consumed.
17. **Decreases Headaches and Eye Strain:** Students continuously read books and also constantly use mobile phones. This causes strain in their eyes and headaches. Yoga exercises relieve headaches and cut down strain in the eyes. students can enjoy better vision and eye comfort by adopting Yogic practices.
18. **Increases Motivation and Productivity:** Yoga refreshes the body and mind. It brings in more vitality. Hence students practicing Yoga as a study break report higher levels of motivation and productivity.
19. **Better Quality Sleep:** Sleep deprivation can result in low academic performance along with many other symptoms. Yoga increases the discharge of melatonin, a hormone that manages sleep resulting in a better quality of sleep.

Suggestions:

1. Government should take initiatives to impart quality education, research and training related to Yoga and Meditation.
2. Teachers with in-depth knowledge of Yoga and Meditation should be appointed in each of the educational institutions.
3. Appropriate financial provisions should be made for the strengthening of Yoga and Meditation practices in the field of education
4. Aware people about Yoga and Meditation importance.

Conclusion:

Yoga and meditation are beautiful practices with a lot of personal benefits, especially in youth. Youth may imbibe a strong, healthy body and mind through Yoga, which are the essential components for moving forward in life with potential. Thus, students and teachers in schools and colleges should be mandatorily involved in Yogic and Meditational practices.

Acknowledgment:

Authors are thankful to the students and teachers who have shared their experiences, views and opinions on the benefits of practicing Yoga and Meditation.

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WOMEN EMPOWERMENT AND GENDER EQUALITY TOWARD SUSTAINABLE DEVELOPMENT

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Title	: Women Empowerment and Gender Equality toward Sustainable Development
Editor Name	: Santosh P. Mane ,Dr. Babalola, Ayodele Samuel, Riswan M, Dr. Prasanna Srinivas
Publishing Agency	: Fern International Publication Pune
Publisher Address	: Jyoti Kerappa Mane Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras , Malshiras, Solapur, 413107 :Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of
Printed By	India, Near Laxminarayan Theatre, Swargate, Pune- 411009 Email- fppune2003@gmail.com
Edition Details	:I st
ISBN	: 978-81-959050-1-0
Copyright	: Jyoti Kerappa Mane
Publication Date	: 28/02/2023

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Published by –

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Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras, Solapur, 413107

Mob- 8888454089

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Publication- Fern International Publication Pune

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Schemes for Empowerment of Women in India

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DOI- 10.5281/zenodo.7701295

Abstract

The present paper attempts to understand the efforts taken by the government for women empowerment in India. It studies various government schemes framed and implemented for women empowerment. Based on secondary data obtained from various sources like government publications and research articles, this theoretical paper concludes that there is a dire need of framing suitable women empowerment schemes and their proper implementation. Reliable and detailed information on these schemes should be reached to needy women and their groups at its earliest. Government should support and monitor such schemes for their effective implementation. Individual and organizational participation in the implementation of such schemes is of great help.

Key Words: Women, Empowerment, Schemes, Government, India.

Introduction:

Women empowerment refers to increasing the spiritual, political, social, educational, gender, or economic strength of individuals and communities of women (Thakur S. and Naikoo, A. 2016). It is a multi-dimensional process that involves personal, social, psychological, economic, and political aspects (Panday, N. 2014). Women's empowerment is a new phrase in the vocabulary of gender literature. The phrase is used in two broad senses i.e., general, and specific. In a general sense, it refers to empowering women to be self-dependent by providing them access to all freedoms and opportunities, which they were denied in day-to-day because of their being women. In a specific sense, women's empowerment refers to enhancing their position in the power structure of society. The word women empowerment essentially means that women have the power or capacity to regulate their day-to-day lives in social, political and economic terms -a power which enables them to move from the periphery to the center stage (Mamanshetty S., 2018). The need for women empowerment arose because of the discrimination and male domination in Indian society since ancient times. Women are being suppressed by their family members and society for many reasons. They have been targeted for many types of violence and discriminatory practices by the male members in the family and society in India and other countries as well. Wrong and old practices for men in society from ancient times have taken the form of well-developed customs and traditions. There is a tradition of worshipping many female goddesses in India including giving honours to the women forms in the society like mothers, sister, daughters, wives and other female relatives or friends. But it does not mean that only respecting or honouring women can fulfil the need

for development in the country. It needs the empowerment of the rest half population of the country in every walk of life (Shireesha, E. 2021). With this background, the present study attempts to understand the schemes for women's empowerment in India.

Objectives:

The main aim of the present study is to understand the efforts taken by the government for women empowerment in India. This has been achieved with the help of following objectives:

1. To study the government schemes for women empowerment in India.
2. To provide useful suggestions for the effective implementation of women empowerment schemes in the country.

Materials and Methods

The present paper is descriptive in its nature. It utilizes the secondary data obtained from various sources like government publications, research articles and information available on social media.

Results and Discussions

The present study reveals that there are various schemes of state and central government being implemented for the empowerment of women in India. Some of the important schemes with their objectives with beneficiary selection criteria are given below:

1. Beti Bachao Beti Padhao Scheme

In view of addressing the concerns of gender discrimination and women empowerment in the country, the government of India introduced the Beti Bachao, Beti Padhao scheme in 2015 with an initial funding of Rs. 100 crores. The meaning of Beti Bachao, Beti Padhao is to 'Save the girl child, educate the girl child'. This scheme aims at educating citizens against gender bias and improving the effectiveness of welfare services for

girls. This scheme was introduced after the national census results for 2011 revealed a detraction of Child Sex Ratio and Sex Ratio at Birth. The child Sex Ratio is defined as the number of girls per 1,000 boys with 0-6 years age. This ratio has showcased a steady decline, from 945 in 1999 to 918 girls for every 1,000 boys in 2011. It was found that the Sex Ratio at Birth was the main factor behind this. Gender-biased sex-selective abortion and post-birth discrimination in neglecting the health, nutrition, educational and economic needs of the girl child were the main causes of the declining sex ratio in the country. It was observed that the socio-cultural and religious preference for boys was the basic cause of the declining sex ratio and this was the motive behind launching Beti Bachao, Beti Padhao Scheme for girls in the country.

The main objectives of this scheme are as follows:

1. To Improve the child-sex ratio
2. To ensure gender equality and women empowerment in the country
3. To prevent gender-biased, sex-selective abortions.
4. To ensure the survival, protection and fitness of girl child
5. To encourage education and participation of the girl child.

2. Mahila police Volunteers

Ministry of Women and Child Development in collaboration with the Ministry of Home Affairs has envisaged the engagement of Mahila Police Volunteers in the States and Union Territories who will act as a link between police and community to help victimised women. Chief Secretaries of States and Union Territories were instructed to adopt this inventiveness in their concerned States. During the financial year 2016-17, the state of Haryana adopted this scheme for the districts of Karnal and Mahendergarh. Thus, Haryana was the first state in the country to implement this scheme. This was followed by the sanction of proposals forwarded by the states of Andhra Pradesh, Jharkhand, Gujarat, Mizoram, Chhattisgarh, Karnataka and Madhya Pradesh for the implementation of the Mahila Police Volunteers scheme. In fact, this scheme is implemented by the central government. However, it should be implemented by state governments and Union Territories with substantial financial and administrative participation. The Central Women and Child Development Ministry actively pursue the State Governments and Union Territories administrations for the effective implementation of this Scheme.

3. Mahila Shakti Kendras (MSK)

Mahila Shakti Kendra Scheme was approved by the government for the period from 2017-18 to 2019-20. Empowerment of rural women through community participation was the main purpose of implementing this scheme in the country. The scheme is envisaged to be implemented at both national and state levels. Community engagement through College Student Volunteers is envisioned in 115 most backward districts as part of the Block Level initiatives. Student volunteers were instrumental in women's awareness of important government schemes, developmental programs and related social issues. District Level Centre for Women has also been envisaged for 640 districts to be covered in a phased manner, these centres served as a link between village, block and state levels in facilitating women-centric schemes. Under the Scheme, State Resource Centre for Women is provided for all States and Union Territories, District Level Centre for Women in 640 districts were to be covered in a phased manner (220 districts during 2017-18, 220 more in 2018-19 and the remaining 200 districts in 2019-20) and Block Level initiative to be focussed in 115 most backward districts covering 8 blocks in each district. The Scheme is implemented through the State Government and Union Territory Administration with a cost-sharing ratio of 60:40 between centre and states except for NE and Special Category States where funding ratio is 90:10.

4. Nari Shakti Puraskar

It is an annual award given by the Ministry of Women and Child Development of the Government of India to individual women or the institution or NGOs that are taking efforts for women empowerment in the country. It is the topmost civilian honor for women in India and is presented by the president of India on 8th March (International Women's Day) at Rashtrapati Bhavan in New Delhi. This award was introduced in the year 1999 as a Stree Shakti Puraskar, which was renamed and reorganised in the year 2015. This puraskar is being awarded in six institutional and two individual categories, which carry a cash prize of Rs. 2,00,000 and 1,00,000 rupees, respectively.

5. Nirbhaya

The Government of India has set up a special fund called the 'Nirbhaya Fund' for taking initiatives aimed at ensuring the safety and security of women in the country. An Authorized Committee of officers constituted under the Nirbhaya Framework assesses and recommends the proposals for providing financial support under Nirbhaya Fund in combination with the concerned Ministries, Departments, or Implementing Agencies. After

appraisal by the Committee, the concerned Ministries or Departments obtain approval from their respective and competent financial authorities to release funds and implement the approved projects or schemes directly or through States or Union Territories or Implementing Agencies. Under the Nirbhaya Fund, the “One Stop Centre Scheme” is being implemented across the country since 1st April 2015. One Stop Centre Scheme aims at facilitating women affected by violence with a range of integrated services under one roof such as Police facilitation, medical aid, providing legal and psycho-social counselling and temporary shelter. One Stop Centre Schemes are to be set up within a 2 km radius of the hospitals or medical facilities either in newly constructed buildings in an approved design or in pre-existing buildings. Under the scheme, one Stop Centres are being set up in all districts of the country.

6. Pradhan Mantri Matru Vandana Yojana (PMMVY):

Pradhan Mantri Matru Vandana Yojana is a Centrally Sponsored Conditional Cash Transfer Scheme, for its implementation across the country with effect from 1st January 2017. The maternity benefit under this scheme is available to all Pregnant Women and Lactating Mothers, excluding Pregnant Women and Lactating mothers, who are in regular employment with the Central Government or the State Governments or Public Sector Undertakings or those who are getting similar benefits under any law for the time being in force, for a first living child of the family. Under this scheme, financial support of Rs.5,000/- is provided to the eligible beneficiary in suitable instalments during pregnancy and lactation in response to an individual fulfilling certain nutrition and health-seeking conditions. The deserving and eligible beneficiary also receives the remaining cash incentive as per approved norms towards maternity benefits under Janani Suraksha Yojana after institutional delivery so that on an average, a woman gets financial assistance of rupees six thousand only.

7. Pradhan Mantri Ujjwala Yojana (PMUY):

Pradhan Mantri Ujjwala Yojana aims at protecting the health of women and children by providing them with clean cooking fuel viz. Liquefied Petroleum Gas, so that, they don't have to compromise their health in kitchens filled with smoke or walk in risky areas for the collection of firewood. This scheme was launched by the Hon'ble Prime Minister of India on 1st May 2016 in Uttar Pradesh at Ballia. Under this scheme, in all five crores connections of Liquefied Petroleum Gas were expected to be provided to Below Poverty Level families. Ensuring

the empowerment of women, particularly in the rural parts of the country, the connections are being issued in the name of women of the households.

8. Sakhi Niwas

Today, a substantial number of women are leaving their usual place of residence in search of jobs and employment opportunities in large cities and industrial clusters of the country. One of the crucial problems faced by these women is the dearth of safe and suitably located housing facilities. Considering this fact, the government of India thus introduced a scheme in 1972-73 of grant-in-aid for the construction of a new structure or the expansion of existing buildings for providing hostel facilities to working women in cities, towns and even in rural parts of the country where employment opportunities for women are available. Based on the study, the existing scheme has been revised to promote the availability of safe and suitably located accommodation facilities for working women who need to live far from their families due to perform their professional duties. The hostels constructed under this scheme for working women shall be made available to all working women without any discrepancy with respect to caste, creed, color, religion, material, and social status etc., subject to norms set under the scheme. Women under training for the job may also be conditionally lodged in such hostels. This scheme covers working women, who may be single, widowed, divorced, separated, or married but whose husband or immediate family does not reside in the same city, Women who are under training for a job provided the total training period does not exceed one year. This is only on the condition that there is a vacancy available after accommodating working women. The number of women under training for jobs should not exceed 30% of the total capacity. Girls up to the age of 18 years and boys up to the age of 5 years, accompanying working mothers will be provided accommodation, with their mothers.

9. Swadhar Greh (A Scheme for Women in Difficult Circumstances)

Swadhar Greh is a scheme implemented by the Ministry of Women and Child Development, Government of India, to provide short-stay accommodation facilities and rehabilitation services to women who are in difficult circumstances such as destitute, deserted by their husbands, failure, victims of natural disasters and women released from jail without family support. Swadhar Greh provides a supportive and protective environment to these women and offers a range of services such as shelter, food, clothing, and counselling services to help them regain their emotional strength and

financial independence. The scheme also offers skill development and training programs to women in view of enhancing their employability and provides legal aid and support services to help them address their legal issues. Swadhar Greh aims to promote self-reliance and empower women to live dignified life. This scheme is being implemented across the country through non-governmental and other organizations. Under the Scheme, Swadhar Greh will be made available in every district with a capacity of 30 women with the following objectives:

1. To cater to the fundamental need for food, clothing, shelter, medical treatment, and care of women in distress and who are without any socio-economic support.
2. To enable these women to recover their emotional strength that gets hindered due to their encounters with undesirable situations.
3. To support them with legal aid and guidance for enabling them to take steps for their readjustment in their own family and also in the society in which they live.
4. To do their economic and emotional rehabilitation.
5. To act as a foundation that comprehends and fulfils various requirements of women in distress.
6. To empower these women to start their life afresh with dignity.
7. The following strategies can be adopted to achieve the objectives of the scheme:
8. Temporary accommodation facilities with the provision of food, clothing, medical facilities etc.
9. Professional and skill gradation training for economic rehabilitation of these women
10. Counselling, awareness creation and behavioural training
11. Legal aid and Guidance
12. Counselling through mobile and telephone.

10. Women Helpline Scheme

The Scheme of Women Helpline is intended to provide 24-hour, immediate and emergency response to women affected by violence through referral, linking with appropriate authorities such as police, One Stop Centre, hospital and information about women-related government schemes and programs across the country through using a single number.

Suggestions

1. The details of women empowerment schemes should be reached up to needy women. It can be achieved through the effective use of electronic, print, and social media.

2. constant monitoring and unceasing financial assistance should be ensured for the effective implementation of women empowerment schemes.
3. Government should continuously monitor the implementation of these schemes.
4. Physical and mental health of women should be ensured by framing and implementing suitable women empowerment policies.
5. Strict implementation of the women-related legislature should be ensured.

Conclusion

The study concludes that the present status of Indian women is not as good as it should be. Thus, there is a dire need for framing and implementing various schemes and programs in favour of women's empowerment in India. Though there is a variety of women empowerment schemes available, the government, NGOs and individuals should ensure their effective implementation.

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ISBN: 978-93-100-0564-6

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**THE WISDOM OF BHARAT:
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ISBN: 978-93-100-0564-6



978-93-100-0564-6

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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STATUS OF AYURVEDIC HEALTH TOURISM IN INDIA

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Abstract: *Ayurveda is considered as the oldest form of medicine that was originated and nurtured in the Indian subcontinent for centuries. Being an interesting feature of tourist attractions, today, India is emerging as an important health tourism destination because it has several pull factors like excellent Ayurvedic treatment at low cost, easy accessibility to Ayurvedic medicine, and Ayurvedic treatment centers with scenic locations for excellent holidays. National and international acceptance of Ayurvedic healing has widened the boundaries and prospects of Ayurvedic health tourism. With this background, the present paper attempts to understand the concept of Ayurveda, the scope for health tourism owing to Ayurveda and suggests measures for the growth of Ayurvedic tourism based on both primary and secondary data.*

Keywords: *Ayurvedic, Tourism, Status, India, Health.*

Introduction

Tourism and its influences on livelihood are a very old phenomenon. Tourism provides a number of opportunities to the people who are remotely located. The host region gains multiple benefits from tourism services in the form of money and other developmental aspects. Today, tourism has become an important policy tool dedicated to the change, development and reconstruction of physical and sociocultural environments and thus, as an industry, it defines and influences not only physical landscapes, land use and planning but also social structures, local cultures and other regional and local economies (Saarinen J., 2008). Tourism is classified into various types including religious tourism, heritage tourism, historical tourism, adventure tourism, ecotourism, agro tourism, health tourism etc.

Health tourism has mainly advanced in the last three decades (Kaspar, 1990; Garcia-Altes, 2005; Reisman, 2010) and includes a variety of key participants such as advisers, healthcare providers, insurance companies, information websites and media services (Neil et al. 1015). Individuals seeking alternative medicine therapy look for low-cost procedures for complicated surgeries such as heart, cosmetics and knee replacement which are provided by Ayurveda at destinations like Thailand, Singapore, India and Taiwan (Ye, Qiu and Yuen, 2011), Malaysia (Musa, Thiru Moorthi, and Doshi, 2012). Also, nowadays, instead of seeking long-haul destinations, tourists prefer shorter trips and well-known destinations. It is expected that by 2030, health tourism will represent 31% of international tourism (UNWTO 2013).

Health tourism refers to travelling to other countries to obtain medical, dental and surgical treatment¹. Or the practice of Travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, Health care travel and medical care travel². Health tourism refers to travelling to other countries to obtain medical, dental and surgical treatment¹. Or the practice of Travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, Health care travel and medical care travel². Health tourism refers to travelling to other countries to

obtain medical, dental and surgical treatment¹. Or the practice of travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, health care travel and medical care travel².

In recent times, India has emerged as a popular destination for health tourism and marketing. Ayurveda as a part of it has brought a new definition to vacationing in India. The reasons for this are that it comprises low medical cost as compared to other countries, use of non-toxic, harmless herbs resources, etc. Also, the waiting time for treatment in India is much lower as compared to other countries (Murlidhar, S. and Kartikey, P. 2016). The Make in India initiative of the Indian government, including Ayurveda is a part of the 'Wellness' industry. However, India has not yet achieved its full potential in the field of Ayurvedic health tourism. With this background, the present paper attempts to understand the current scenario of Ayurvedic health tourism in India and provides feasible suggestions to cope with the situation.

Objectives

The present study aims to understand the status of Ayurvedic health tourism in India which has been achieved with the help of the following objectives

1. To understand the concept of Ayurveda.
2. To recognize the scope for health tourism owing to Ayurveda.
3. To give suggestions for the development of health tourism on account of Ayurveda.

Methodology

The present research is of a theoretical nature and is based on both primary and secondary data sources. The secondary sources include government publications, survey reports, research papers and news articles, while the primary information was obtained by conducting interviews with tour organizers, Ayurvedic treatment centers and Ayurvedic health tourists.

Discussion

The study on Ayurveda health tourism has revealed that Ayurveda is one of the well-accepted medical practices in India. An average of 83% of the respondents agreed that Ayurvedic health tourism has an optimistic future. They are hopeful that, the process of globalization and GATT agreement will play an important role in the development and spread of this sector. A favorable visa policy adopted by the Indian government will definitely serve the purpose. A majority of the respondents have emphasized the need for the commercialization of Ayurvedic health tourism. As per many respondents, propagation of information on the advantages of Ayurveda, and effective advertising of Ayurvedic medicine with allied products and health care centers is needed. Respondents are also of the view that the medical researchers should ensure effective treatment even at the last stage of the disease which provides immediate relief to the patient. According to 38% of the respondents, an inclusive approach is essential for the development of Ayurvedic health tourism, which means aspects such as infrastructural development, support from the government, standardization of health-related services, favorable policies for allocation and extension of Indian Visas etc.

A Glimpse of Ayurveda

Ayurveda is one of the popular traditional streams of medicine that has continued and grown for centuries and continues to be even today. Evolved over two-plus millennia, Ayurveda is one of the accepted medical systems. It includes Yoga, Meditation, Pranayama, special nutrition, herbal medicines, reflexology, cathartics etc. Ayurvedic preparation hinges on complex herbal compounds, minerals, and metallic substances. It has also included some surgical techniques.

According to Ayurveda, there are three primary energies in the body viz. Vata, Pitta and Kapha. Each of these three doshas has its own distinctive abilities and a disproportion in any of these can result in different health problems. Studies also revealed that suppression of natural urges is considered unhealthy and may lead to illness.

Ayurveda is categorized into eight branches which are together known as ‘Ashtanga Ayurveda’. The meaning of word ‘Ashtanga’ is eight parts or branches including Kaya Chikitsa (Internal Medicine), Baala Chikitsa (Paediatrics treatment), Damstra Chikitsa (Toxicology), Shalya Chikitsa (Surgery), Jara Chikitsa (Geriatrics), Graha Chikitsa (Psychiatry) and Vrishya Chikitsa (Aphrodisiac therapy), Urdhyanga Chikitsa (treatment of eyes, nose, and throat, head related diseases). With the vast knowledge of natural medicine, this alternative medicine structure will be sustained in the future. Several avenues are yet to be explored by the experts, scholars, researchers and medical practitioners in the field of Ayurveda which will help to keep this traditional medicine system alive and contribute to its growth. Nonetheless, it is because of the inadequate literary evidence and lack of awareness among the masses about the basic principles of Ayurveda, that the knowledge of Ayurveda has not been properly disseminated and reached some of the countries in the world.

Advantages of Ayurvedic health treatment

1. **Weight management:** This relates to Body Mass Index (BMI) and depends upon particular body weight, and lifestyle to maintain the desired body weight. Ayurveda provides an efficient weight management process by suggesting a suitable diet, exercise and helpful practices.
2. **Healthy skin:** Ayurvedic oil massage not only deeply moisturizes but also gives glowing skin.
3. **Stress management:** Stress is ubiquitous. Ayurveda offers Yoga practice to reduce stress levels with physical benefits and mental benefits. Often it is advised to devise specific Yoga practices to reduce and prevent stress.
4. **Body cleansing:** Ayurveda offers an assured process of body cleansing by suggesting a detox diet and several other natural methods of cleansing.
5. **Manage blood pressure:** Ayurveda offers home remedies that help to regulate blood pressure and a healthy heart.
6. **Prevent immunity disorder:** Ayurveda promotes a nutritious diet, appropriate exercise and sound sleep with the regular practice of Yoga, Pranayama and Meditation. All these methods help boost immunity.
7. **Chronic pain:** Chronic pain is associated with several physical and mental health conditions like depression, lack of sound sleep, social isolation, overuse of medicines etc. Yoga, Meditation, Deep breathing techniques, progressive muscle relaxation and cognitive behavioral therapy offered by Ayurveda help to reduce chronic pain.

- 8. Gastrointestinal Problems:** This refers to problems in the digestive system and its treatment is important for maintaining good health as it plays a significant role in the absorption and circulation of nutrients and the elimination of toxins and wastes from the body. Ayurveda suggests preventive care and curative medicine to cope with gastric issues.

Benefits of Ayurvedic health tourism

There is numerous Ayurvedic health care centers spread across the country that offer health treatment services including *Panchakarma*, *Shirodhara*, *virechana*, *vaman*, *basti*, *nasyam treatment*, *raktmokshan*, *abhyanga*, *Kati vasti* etc. Most of these centers play an important role in developing the tourism industry that offers several benefits at individual, institutional and national levels as a whole. Some of these benefits are stated below.

1. Ayurvedic health tourism is one of the ways to generate foreign exchange.
2. Employment and job opportunities offered by Ayurvedic health tourism may restrict brain drain.
3. Ayurvedic tourism boosts growth in Gross Domestic Product (GDP) and helps in revenue generation due to the growth of national and international tourism.
4. After the pandemic of COVID-19, Ayurvedic practices have gained significance in the health and tourism industry with India's magnetic influence making it the most desirable destination for tourists across the globe.
5. Ayurvedic health tourism explores new technology.
6. People from other countries can get cheaper Ayurvedic treatment in India than they get in their own country.
7. Ayurvedic health tourism delivers effective and efficient medical services at low cost.
8. This healthcare system promotes the plantation of a variety of medicinal plants, resulting in many environmental benefits.
9. Ayurveda health tourism improves political friendship.
10. Promotion of Ayurvedic health tourism ensures development in infrastructural facilities, such as job and employment opportunities in various sectors, particularly in hotel logistics and transportation industry.

Suggestions

1. Ayurveda is one of the most commonly accepted health resources all through the world. However, it is lacking in commonalities in its different aspects. Thus, there is an utmost need to develop globally accepted standards in terms of guidelines and classifications, as well as integrate Ayurveda into the health system. This will enable one to compare the data on various facets of Ayurveda. Standardization of services should be ensured.
2. Most of the Ayurveda literature is available in Sanskrit and Hindi languages, which needs to be translated into at least major languages being spoken across the globe.
3. Research in Ayurveda should be strengthened to bring preciseness in diagnosis, treatment and recognition of medicinal effectiveness.
4. Enhancement of both preventive caring facilities and the production of curative medicine should be ensured in Ayurveda.
5. An entrepreneurial attitude should be developed among those involved in the field of Ayurveda.

6. A regular supply of input/raw materials for the production of Ayurvedic medicine should be ensured.
7. Traditional skills related to Ayurveda should be documented and preserved properly.
8. Quality control measures in the field of Ayurveda should be initiated.
9. Ayurveda treatment centers should be provided with basic infrastructure and facilities including land, water and electricity supply, loans on low-interest rates, concessions in medicinal sales tax, marketing facilities etc.
10. Indian brands in Ayurveda should be built abroad to strengthen the marketing of Ayurvedic medicines, devices and services.
11. Inter-sectorial coordination between the health and tourism sectors should be promoted.
12. Information on the advantages of Ayurveda should be disseminated by means of appropriate broadcasting technology.
13. A traveler's traveler-friendly scheme for receiving medical visas should be implemented in order to make the process of travel smoother across international borders.
14. A provision should be made to extend visas depending on the health condition of the traveler.
15. Governments should play a crucial role in the development of Ayurvedic health tourism.
16. Ayurvedic health tourism can be developed by adapting Public-private partnerships.

Conclusion

Ayurvedic health tourism is not new to India. In this country, it has been practiced since time immemorial. Nowadays it is gaining a lot of popularity as people are health-conscious and interested in seeking quality health services at low cost and without any side effects. Efforts are being made by the government of India, non-government organizations, and at the individual level to popularize Ayurvedic health tourism. The study revealed that, in spite of many efforts, Ayurvedic health tourism is not developed at its full potential. Thus, there is an utmost need for its popularization by using social media. Government and non-governmental organizations should make special efforts to utilize the country's full potential of Ayurvedic health tourism by adopting a policy of Public-private Partnership.

Limitations of the Study

Due to the paucity of sufficient data on Ayurvedic health tourism in India, the present study relies on the theoretical information obtained from secondary sources. It limits the use of suitable statistical and cartographic techniques in this paper.

Acknowledgment

Authors are highly grateful to the tour organizers and in charge of Ayurvedic health care centers for sharing their views, opinions and experiences on the present scenario of Ayurvedic health tourism in India.

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ISBN: 978-81-959050-4-1

**NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS
SUSTAINABLE DEVELOPMENT**



Dr. Shantaram G. Baviskar
Dr. Manisha S. Pawar

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Fern International Publication Pune
Govt. Regd. No. UDYAM-MH-32-0072613
Malshiras, Dist-Solapur (MS), India
and
Sr.No.-48/60/1/3, Swapnapurti Niwas Yerwada Vasti, Vadgaon
Budruk, Pune, Pin-411041
Email- fppune2003@gmail.com



Price-750

Natural Sciences and Environmental Awareness towards Sustainable Development

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Fern International Publication Pune

Natural Sciences and Environmental Awareness towards Sustainable Development

Editors

Dr. Shantaram G. Baviskar, Dr. Manisha S. Pawar

Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

E-mail: fppune2003@gmail.com

Publisher Address

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras,
Solapur, 413107

Mob- 888454089

and

Amitsons Digital Copier, Pune Swargate

106, Paras Chamber, 1st Floor, Above Bank Of

India, Near Laxminarayan Theatre, Swargate, Pune- 411009

Mob-7058486065

Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
India, Near Laxminarayan Theatre,
Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

Copyright: Jyoti K. Mane

Publication Date: 20/10/2023

Price: 1000

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The Future of Agriculture in India

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Abstract

Agriculture in India is still providing a livelihood to the majority of the country's population and is the backbone of India's self-sufficiency in food grains. However, the last two decades have seen India go through a severe farming crisis and record lower-than-expected agricultural growth. Considering this fact, the present paper attempts to investigate the current scenario of Indian agriculture, the constraints of agricultural development and it also anticipate the decisive trends in the agricultural sector. The paper, based on both primary information and secondary data, reveals that, though efforts are being taken to improve the agricultural conditions in India, there is an urgent need to accept a holistic approach to the development of this sector.

Keywords: Future, India, Agriculture, Sustainable, Technology.

Introduction

Agriculture is a diverse sector and its major sub-sectors are crops, livestock, fishery and forestry (GoI, 2023 a). In India, the agricultural industry is significant (Saini P. et. al. 2022). It is the backbone of India's national economy and a mainstay of livelihood for the majority of households; thus, it can never be underrated. It is agriculture that feeds the country's population (Bethu, S. 2016). Though the contribution of agriculture to the gross domestic product has declined over decades, it shows remarkable growth. Nevertheless, agricultural production is still expected to increase so that the population of the country should be well nourished. The demand for agricultural produce has risen throughout time as the country's population has grown and the need for food security has increased (Biswas, S. 2022). The rapid growth of population and the rising purchasing capacity of individuals in the country have created a large demand for nutritious food. In addition, globalization has allowed the supply of agricultural produce to the international market. This has placed tremendous pressure on the country's

agricultural sector. India's agricultural economy has undergone structural changes; the GDP share of agriculture has fallen. This isn't because of the reduced importance of agriculture, or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and non-agricultural sectors in India (Sharma, B. 2016). India is bestowed with vast arable land which is characterised by a variety of soils and agro-climatic conditions making the country capable of producing numerous crops. Today, the country has been recognized as a top producer of certain agricultural products including milk, spices, pulses, tea, cashews and jute, while it is the second-largest producer of rice, wheat, oilseeds, fruits, vegetables, sugarcane and cotton. Regardless of all these facts, the productivity of many crops in the country is low if compared with the productivity in many developed countries. Furthermore, India's population in 2023 stands at 142.86 crore, according to the United Nations Population Fund data. India has overtaken China, which has 142.57 crore, to become the most-populous country in the world. Providing quality and nutritious food for such a huge population has now become a major issue for India. Today, the majority of Indian farmers are facing a variety of glitches including high input costs, low productivity, low-income levels and weak agricultural marketing. Whereas, the concept of agricultural marketing includes many activities starting from the production process to its retailing (Yakanna, A. 2017). In India, both public and private sectors are making efforts to improve the conditions of agriculture. India's membership and commitment to the World Trade Organization (WTO) in 1995 was a clear sign of India's intention to take advantage of globalization and face the challenge of accelerating its economic growth (Mahadevan, 2003). Today, there are four main sources of demand for agricultural produce including food for human population, feed and fodder for livestock, feedstock for energy and raw material for industrial and non-agricultural uses (GoI, 2023 b). All these sources should be taken into account while planning for sustainable agriculture. With this background, an attempt has been made in this paper to discuss the futuristic trends in Indian agriculture.

Objectives

1. To understand the present scenario of Indian Agriculture.
2. To recognize the major constraints of Agricultural Development in India.
3. To anticipate decisive trends in the Agricultural Sector

Data and Methodology

The present study is based on both primary information and secondary data. Government reports, private publications, news articles and research papers were referred to as secondary sources of data. While, farming respondents were interviewed to obtain primary information.

Result and Discussion

Major constraints of agricultural development

Though most of the Indian population is dependent on agriculture, this sector of the national economy has multiple constraints. Agriculture in India is dependent on the vagaries of Monsoon and the average size of land holding in the country is small. Thus,

most of the farmers are either small or marginal. The agriculture in India is mainly intensive substance type. It is labor-dependent and characterized by several annoying anomalies including soil erosion and salinization, locust infestation, outbreak of diseases, low agricultural productivity, harmful effects of climate change, high cost of agriculture inputs, price fluctuation of agricultural produce, inadequate access to credit supply, less value addition, lack of commercialization and shortage of monetary investment. In India, high risks involved in the process of crop cultivation are pushing farmers out of the agriculture sector. Thousands of farmers, particularly in the states of Maharashtra, Telangana, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh have committed suicide due to financial losses. There is inadequate monetary investment in agricultural education, research and extension. Agricultural infrastructure including transportation and storage facilities, electricity supply, marketing and credit support system is not well-organized. The shortage of agro-processing services in the country has resulted in the wastage of agricultural produce and the country experiences huge post-harvest losses. Several agro-processing industries in India are not working efficiently, some of the sugar factories, cotton textile and spinning mills are closed down. There are some agro-based industries in the country that are not in a position to pay reasonable prices for the agricultural produce being used as raw materials by these industries. Agro-based industries in India are not yet developed up to the extent of their full potential. If developed properly, these industries may provide substantial employment opportunities, especially to the rural youth. Loss of agricultural produce during the process of harvesting, transportation and storage is one of the usual problems, the farmers of India face. There is a dearth of low-cost farm technology and the majority of the farmers have less access to advanced technology.

Anticipation of Decisive Trends in Agriculture

The paradigm shift in agriculture will set decisive trends in agricultural development in the near future. Some of the futuristic trends are given below.

1. In India, where ever possible, efforts will be made to bring barren lands under cultivation. The available resources will be used judiciously and efficiently by adopting appropriate technology. The use of non-conventional energy resources including solar, wind, hydroelectricity and biomass energy will be increased.
2. As a part of the time-saving strategy, people will be giving priority to processed, ready-to-eat, affordable and packaged food material, which will lead to the establishment of more agro-processing industries.
3. Rising preferences for healthy, pure and nutritious food would lead to the growth of sustainable agricultural practices including organic farming.
4. Research, technological improvements and protected cultivation of high-value crops will be strengthened.
5. There will be an introduction and widespread use of new technology in agriculture including harvesters, sugarcane-cutting machinery, efficient irrigation systems etc.
6. Improvement in the standard of living, reduction in poverty, effects of globalization and increasing health consciousness in India have led to the changing demand for

agricultural produce. Demand for non-grain food items including milk and milk products, eggs, meat, fish, vegetables and fruits will increase over the course of time.

7. Biotechnology will be used efficiently to develop drought-tolerant, high-yielding, eco-friendly and disease-resistant crop varieties and nutritious food will be produced. This will need sound investment in agricultural research.

8. Competition among the private and government companies will bring innovative and low-cost products, improved seed varieties, high-quality fertilizers, customized farm equipment and nutritious cattle feeds to the market.

9. Most of the retail trade in agriculture will be digitalized. Online Shopping of agricultural products including food items and items required in the form of agricultural input including Seeds, Fertilizers, Pesticides, Plant Growth Regulators, Irrigation and Farming Tools and Equipment with reasonable Prices, Customer Support and free home delivery will be ensured.

10. In view of making agriculture easy, gainful and environmentally friendly, efforts will be made by the government, Farmer's Producer Organizations (FPO), private companies, corporate and cooperatives to bring preciseness in farming using computer-aided technology (CAT), Electronic Commerce (e-Commerce), Artificial Intelligence (AI), Remote Sensing (RS), Global Positioning System (GPS), Geographic Information Systems (GIS), Internet of things (IoT), Nano Technology, drones and robots. Soil testing-based decisions will be taken while selecting a variety of crops to be grown and scheduling the application of water and fertilizers. This will ensure the efficient use of agricultural inputs, minimize the wastage of agricultural products, increase food production and enhance food quality and food safety.

11. Digital connectivity in the near future will play an important role in creating awareness among farmers. It will be successfully helpful in information sharing and implementation of government schemes. Digital technology will also increase farmers' connectedness with different stakeholders.

12. Efforts will be made to balance the supply of Agri-inputs with the demand for it. Prices of Agri-inputs will be stabilized by using crop-specific small equipment, avoiding food wastage, providing cheap and speedy transportation facilities, increasing the number of warehouses, establishing linkages between private and public sectors, developing local markets and stabilizing the market prices of agricultural products.

The future of agriculture in India is a cause of concern for administrators, planners, politicians and agricultural scientists of the country. Government, Non-Governmental Organizations (NGO's), Management and Research Institutions are making efforts to address the crucial challenges of agriculture in the country counting per capita less availability of arable land, sub-standard processing of agricultural products, inefficient and broken supply chain, inadequate use of farm technology, lack of infrastructure to support the efficient use of natural and human resources and inadequate market facilities. There is an utmost need to work on the development of cost-effective technologies ensuring environmental protection and conserving natural resources. Liberalization, Privatization and Globalization (LPG) are the strategies that were adopted

by the government of India under its new economic policy in 1991 which has affected the input markets rapidly. Reforms in agricultural marketing have made changes in the promotion of agricultural products, as permission for private investment and contract farming were granted. In addition, the developments in information technology, the introduction of advanced farm technology, investments in research and development by private agencies and the efforts taken by the government to invigorate the cooperative movement in the country to address the problems of agriculture sectors and crop cultivators are changing the appearance of Indian agriculture. Many startups related to logistics services, cold storage facilities, supply of farm fresh food to urban residents, production of organic food, promotion of commerce between buyers and sellers, weather prediction, delivering information on fertilizers and pesticides, providing technical support, resource planning in agriculture by youth shows that now they are capable of appreciating the importance of putting efforts and money in the agriculture sector. The development of technology in the near future will definitely improve the functioning of Indian agriculture. Limitations of the agriculture sector make the yields and outputs complex, however; still there is a wide scope for tapping untouched potential in the country to enhance the agricultural industry. Useful weather and soil conditions, growing demand for food and other agricultural products, unexploited opportunities in farming, subsidies and financial incentives provided by the government, development and maintenance of infrastructure, marketing and export promotion are attracting a large number of individuals, big multinational companies, startups and entrepreneurial ventures to ensure required investments in innovations, development of new technology, research, training and extension in the field of agriculture. Efforts are being made by the central and state governments, NGOs, private firms, research laboratories, management institutions and cooperative sectors to transform challenges faced by agriculture into opportunities. This transformation taking place across the country will ensure the bright future of Indian agriculture.

Suggestions

1. In India, high crop productivity should be ensured by adopting new technology and effective management systems.
2. Enhancement of soil quality and improvement in soil fertility has to be given priority
3. Rational use of resources, irrigation augmentation and its efficient management have to be guaranteed.
4. The agricultural credit system and crop insurance schemes should be strengthened.
5. Attention should be paid to the enhancement of market system.
6. Reasonable prices should be ensured for the agricultural produce.

Conclusion

In India, the growing population, increasing per capita income, reduction in poverty, improved standard of living and the effects of globalization have posed the rising demand for nutritious and a variety of good quality food materials in abundance. The holistic approach if adopted towards agricultural development including the enhancement in agricultural productivity, production of good quality food, resource

conservation, strengthening of the storage system, provision of finance, use of suitable marketing strategies and efficient, reliable, secured transportation facilities will definitely brighten the future of Indian agriculture.

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ISBN: 978-81-959050-4-1

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Fern International Publication Pune
Govt. Regd. No. UDYAM-MH-32-0072613
Malshiras, Dist-Solapur (MS), India
and
Sr.No.-48/60/1/3, Swapnapurti Niwas Yerwade Vasti, Vadgaon
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Email- fppune2003@gmail.com



Price-750

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Fern International Publication Pune

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Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

E-mail: fppune2003@gmail.com

Publisher Address

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras,
Solapur, 413107

Mob- 888454089

and

Amitsons Digital Copier, Pune Swargate

106, Paras Chamber, 1st Floor, Above Bank Of

India, Near Laxminarayan Theatre, Swargate, Pune- 411009

Mob-7058486065

Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
India, Near Laxminarayan Theatre,
Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

Copyright: Jyoti K. Mane

Publication Date: 20/10/2023

Price: 1000

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Anticipation of Decisive Trends in Agriculture

The paradigm shift in agriculture will set decisive trends in agricultural development in the near future. Some of the futuristic trends are given below.

1. In India, where ever possible, efforts will be made to bring barren lands under cultivation. The available resources will be used judiciously and efficiently by adopting appropriate technology. The use of non-conventional energy resources including solar, wind, hydroelectricity and biomass energy will be increased.
2. As a part of the time-saving strategy, people will be giving priority to processed, ready-to-eat, affordable and packaged food material, which will lead to the establishment of more agro-processing industries.
3. Rising preferences for healthy, pure and nutritious food would lead to the growth of sustainable agricultural practices including organic farming.
4. Research, technological improvements and protected cultivation of high-value crops will be strengthened.
5. There will be an introduction and widespread use of new technology in agriculture including harvesters, sugarcane-cutting machinery, efficient irrigation systems etc.
6. Improvement in the standard of living, reduction in poverty, effects of globalization and increasing health consciousness in India have led to the changing demand for

agricultural produce. Demand for non-grain food items including milk and milk products, eggs, meat, fish, vegetables and fruits will increase over the course of time.

7. Biotechnology will be used efficiently to develop drought-tolerant, high-yielding, eco-friendly and disease-resistant crop varieties and nutritious food will be produced. This will need sound investment in agricultural research.

8. Competition among the private and government companies will bring innovative and low-cost products, improved seed varieties, high-quality fertilizers, customized farm equipment and nutritious cattle feeds to the market.

9. Most of the retail trade in agriculture will be digitalized. Online Shopping of agricultural products including food items and items required in the form of agricultural input including Seeds, Fertilizers, Pesticides, Plant Growth Regulators, Irrigation and Farming Tools and Equipment with reasonable Prices, Customer Support and free home delivery will be ensured.

10. In view of making agriculture easy, gainful and environmentally friendly, efforts will be made by the government, Farmer's Producer Organizations (FPO), private companies, corporate and cooperatives to bring preciseness in farming using computer-aided technology (CAT), Electronic Commerce (e-Commerce), Artificial Intelligence (AI), Remote Sensing (RS), Global Positioning System (GPS), Geographic Information Systems (GIS), Internet of things (IoT), Nano Technology, drones and robots. Soil testing-based decisions will be taken while selecting a variety of crops to be grown and scheduling the application of water and fertilizers. This will ensure the efficient use of agricultural inputs, minimize the wastage of agricultural products, increase food production and enhance food quality and food safety.

11. Digital connectivity in the near future will play an important role in creating awareness among farmers. It will be successfully helpful in information sharing and implementation of government schemes. Digital technology will also increase farmers' connectedness with different stakeholders.

12. Efforts will be made to balance the supply of Agri-inputs with the demand for it. Prices of Agri-inputs will be stabilized by using crop-specific small equipment, avoiding food wastage, providing cheap and speedy transportation facilities, increasing the number of warehouses, establishing linkages between private and public sectors, developing local markets and stabilizing the market prices of agricultural products.

The future of agriculture in India is a cause of concern for administrators, planners, politicians and agricultural scientists of the country. Government, Non-Governmental Organizations (NGO's), Management and Research Institutions are making efforts to address the crucial challenges of agriculture in the country counting per capita less availability of arable land, sub-standard processing of agricultural products, inefficient and broken supply chain, inadequate use of farm technology, lack of infrastructure to support the efficient use of natural and human resources and inadequate market facilities. There is an utmost need to work on the development of cost-effective technologies ensuring environmental protection and conserving natural resources. Liberalization, Privatization and Globalization (LPG) are the strategies that were adopted

by the government of India under its new economic policy in 1991 which has affected the input markets rapidly. Reforms in agricultural marketing have made changes in the promotion of agricultural products, as permission for private investment and contract farming were granted. In addition, the developments in information technology, the introduction of advanced farm technology, investments in research and development by private agencies and the efforts taken by the government to invigorate the cooperative movement in the country to address the problems of agriculture sectors and crop cultivators are changing the appearance of Indian agriculture. Many startups related to logistics services, cold storage facilities, supply of farm fresh food to urban residents, production of organic food, promotion of commerce between buyers and sellers, weather prediction, delivering information on fertilizers and pesticides, providing technical support, resource planning in agriculture by youth shows that now they are capable of appreciating the importance of putting efforts and money in the agriculture sector. The development of technology in the near future will definitely improve the functioning of Indian agriculture. Limitations of the agriculture sector make the yields and outputs complex, however; still there is a wide scope for tapping untouched potential in the country to enhance the agricultural industry. Useful weather and soil conditions, growing demand for food and other agricultural products, unexploited opportunities in farming, subsidies and financial incentives provided by the government, development and maintenance of infrastructure, marketing and export promotion are attracting a large number of individuals, big multinational companies, startups and entrepreneurial ventures to ensure required investments in innovations, development of new technology, research, training and extension in the field of agriculture. Efforts are being made by the central and state governments, NGOs, private firms, research laboratories, management institutions and cooperative sectors to transform challenges faced by agriculture into opportunities. This transformation taking place across the country will ensure the bright future of Indian agriculture.

Suggestions

1. In India, high crop productivity should be ensured by adopting new technology and effective management systems.
2. Enhancement of soil quality and improvement in soil fertility has to be given priority
3. Rational use of resources, irrigation augmentation and its efficient management have to be guaranteed.
4. The agricultural credit system and crop insurance schemes should be strengthened.
5. Attention should be paid to the enhancement of market system.
6. Reasonable prices should be ensured for the agricultural produce.

Conclusion

In India, the growing population, increasing per capita income, reduction in poverty, improved standard of living and the effects of globalization have posed the rising demand for nutritious and a variety of good quality food materials in abundance. The holistic approach if adopted towards agricultural development including the enhancement in agricultural productivity, production of good quality food, resource

conservation, strengthening of the storage system, provision of finance, use of suitable marketing strategies and efficient, reliable, secured transportation facilities will definitely brighten the future of Indian agriculture.

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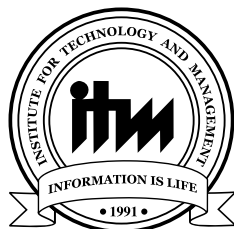
International Research Conference on
the theme

Social and Environmental Sustainability - A Management Perspective (SOCEN'23)

Dates: 4th, 5th, & 6th October 2023
Kharghar, Navi Mumbai

Organised by

ITM BUSINESS SCHOOL KHARGHAR
NAVI MUMBAI



Published by **ITM Business School**

25 & 26 Institutional Area, Sector - 4, Kharghar (E), Navi Mumbai 410 210

ISBN : 978-93-5967-434-6

Message from the Convenor

The concept of sustainability has pervaded the world, and society at large. Numerous authors have written on the topic, each expressing unique ideas of where sustainability might lead society and how it can help entities. Among the various dimensions of sustainability (Human, social, economic and environmental) social sustainability has not been discussed much (Eizenberg and Jabareen 2017). The social dimension is key to the concept of sustainability as it emphasizes on the well-being of humans (Janker 2020). On the other hand environmental sustainability has become the pressing need of the hour.

Keeping in view the importance of Social and environmental sustainability in today's world, ITM Business School, Kharghar organized three days International Research Conference "SOCEN-2023" on 4-6th October, 2023. This conference seeks to bring ideas and thoughts on social and environmental sustainability from a management perspective to create a better tomorrow.

The conference was great success witnessing 110 papers from India and overseas. Renowned researchers from across the globe shared their insights as key note speakers. These included :

Dr Paurav Shukla : University of Southampton, UK

Dr Sunil Sahadev : University of Brighton, UK

Dr Stephen Wilkinson : UNOWD, Dubai

Dr Festus Victor Bekun: Istanbul University, Turkey

Dr Narasingha Das : Lebanese American University, Lebanon

Dr Avik Sinha : MDI Gurgaon

Prof P.J Mathew : Chief Mentor

The conference proceedings consists of abstracts and papers of all three dates. My best wishes to the participants and happy reading.

Dr Sangeeta Trott

Convenor

Message from the Director

SOCEN is an expression of the fact that the earth is common to all, and we need to plan and act on preserving it for our future generations! This theme of our conferences propelled researchers to probe deeper into social and environmental sustainability and create awareness and a sense of care for nature which has always been generous to mankind.

I extend my heartfelt congratulations to Dr Sangeeta Trott and the team on the successful publication of the conference proceedings for SOCEN 23. This marks a significant milestone for our institute and showcases the culmination of the hard work and dedication put forth by all involved in the Research Department team and is a testament to the institute's commitment to excellence. The conference witnessed 110 papers that were presented in the three days by students, academicians and corporates. The proceedings encapsulate cutting-edge research, innovative ideas, and diverse perspectives presented during the conference. Thanks to all the guests from academia and corporate who made remarkable references on how we can save the planet from further plunder.

I encourage everyone to spread the word about the publication and to explore the contents of the proceedings. Thank you, Researchers, for your outstanding contributions, and we look forward to celebrating many more successes together in the future.

Wishing all the best and happy reading.

Regards

Dr Lakshmi Mohan

Pro Vice Chancellor- ITM Skills University

Director- ITM Business School

Message from the Dean

It is my pleasure to congratulate all participants of the conference hosted by ITM Business School, ITM Skills University, Kharghar. The conference brought together scholars, researchers, and industry practitioners from diverse fields to engage in interdisciplinary dialogue and exchange of ideas. The theme of the conference was Social and Environmental Sustainability - A Management Perspective which reflects our commitment to addressing pressing challenges and advancing knowledge in the field of sustainability and green economy. Through a series of keynote presentations, panel discussions, and paper presentations, we had the opportunity to explore innovative approaches, share best practices, and collaborate on solutions to some of the most pressing issues of society. I am particularly excited about the breadth and depth of topics that are covered in the conference proceedings. From cutting-edge research in sustainability to transformative initiatives in social empowerment, the diversity of perspectives represented in this forum underscores the richness and dynamism of our academic community. I would like to congratulate the conference organizers, committee members, and all those who have contributed to the planning and execution of this event. Special compliment to the team for bringing out this conference proceeding. The organizing committee's hard work and dedication have been instrumental in ensuring the success of this conference and the publishing of this conference proceedings and I appreciate your efforts. It is through such scholarly interactions of all of you that we could collectively advance our understanding of complex issues and drive positive change in our respective fields. I wish you all had a stimulating and productive conference experience. May this proceeding here be marked by fruitful insights and meaningful future research that will continue to inspire you and the intellectual community at large.

Best wishes!!!

Dr. Sarit Prava Das

Dean Academics

INTERNATIONAL RESEARCH CONFERENCE SOCEN 2023

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Management of E-Waste in India: SWOT Analysis

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Abstract

As electronic waste or e-waste poses many environmental and human health hazards, generation of it has become a major cause of concern in the majority of the developed and developing countries on the planet including India. Ironically, the constituents of e-waste can be valuable, but at the same time, some of them are toxic in nature. Unfortunately, the efforts being taken for E-waste management in India have many limitations, that must be recognized and addressed properly. This can be done by implementing suitable methods of e-waste collection, segregation and disposal. Steps taken to conduct an appropriate awareness campaign for e-waste management may serve the purpose. With this background, the present paper highlights the status of e-waste generation in India and provides possible suggestions for efficient e-waste management by adopting a technique of SWOT Analysis. As there is a paucity of data on e-waste generation and its management, the study is based on some reports, publications, research articles and information available in newspapers. The paper suggests that the framing of suitable policies and their rigorous execution with the supportive legislature will prove to be helpful to cope with the issues related to e-waste management in India.

Keywords: E-waste, Management, India, SWOT, Analysis.

Introduction

Waste or E-waste WEEE refers to electrical or electronic items that have been discarded, are surplus, obsolete, or have broken. (CPCB, 2008). Electronic waste (also known as e-waste) or waste from electrical and electronic equipment (WEEE) (Kahhat et al., 2008) comprises primarily of equipment used in data processing, communication, entertainment, and commerce (Liu et al., 2006). It is growing rapidly due to the increasing use of electronic products globally (Dwivedy and Mittal, 2010). The amount of "e-waste" or electronic garbage in India has now become a big issue. E-waste disposal is a rising global environmental and public health concern, since electronic waste has become the world's fastest increasing portion of the formal municipal waste stream. (Dahl R., 2002). Most waste electrical gadgets in India are held in houses since individuals do not know how to dispose of them. This piling up e- waste is extremely complex in nature, but it is also a rich source of metals like gold, silver, and copper, all of which may be collected and recycled. So, e-waste trade and recycling alliances provide employment to many groups of people (Baud et. al. 2001). The usage of electronic components is increasing due to decreased prices and growing usage of internet advancements in Information and Communications Technology (Nnorom and Osibanjo, 2008a; 2007). More than half of the globally generated e-waste is exported for recycling mainly in Asian countries like China and India due to the cheap labour (Ha et al., 2009). With this view, as the management of e-waste in India has now become a cause of concern, the present paper attempts to examine e-waste management by adopting the reliable technique called SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of e-waste management.

Objective

The present paper attempts to study the management of e-waste in India to suggest feasible measures for further improvement in the field of e-waste management.

Materials and Methods

As there is a paucity of adequate reliable data on e-waste management in India, the present paper is based on the reports, publications, research articles and information available in newspapers. In addition, the local e-waste recyclers were interviewed to obtain information on e-waste collection, its handling and disposal. The technique of SWOT analysis is used in this study for assessing Strengths, Weaknesses, Opportunities and Threats to e-waste management in the country.

Status of e-waste generation in India

The generation of electronic waste has been increasing day by day in India. The Central Pollution Control Board (CPCB) has newly released estimates of e-waste generation in India at a national level, shedding light on the country's electronic waste management scenario. A press release was issued on the same on 20th July, 2023. According to data collected from countrywide sales and the average life of electrical and electronic equipment (EEE) mandated according to the E-waste Management Rules, 2016, India generated roughly 13,46,496.31 tonnes of e-waste in fiscal years 2020-21 and 2021-22, respectively. The ministry has taken inclusive efforts to improve e-waste management and promote environmental sustainability by modifying the previous set of guidelines. The new E-Waste (Management) Rules, 2022 were notified in November 2022 and have been in effect from 1st April 2023. These rules aim to confirm the environmentally sound handling of e-waste and establish an enhanced Extended Producer Responsibility (EPR) regime for e-waste recycling. Under the EPR, all manufacturers, producers, refurbishers, and recyclers are obligated to register on a portal developed by CPCB. One of the crucial aspects of the new rules is to enable the transformation of the informal e-waste sector into a formal one, thus ensuring that e-waste recycling is done in an environmentally responsible way. The provisions also present measures for environmental compensation and verification & audit to ensure compliance with the regulations. Emphasizing the promotion of a Circular Economy, the new rules advocate scientific recycling and appropriate disposal of e-waste. To enforce the E-Waste (Management) Rules across the country, an Action Plan has been set in place, and it is being vigorously implemented by all the States and Union Territories and State Pollution Control Boards (SPCBs) and/or Pollution Control Committees (PCCs). As part of the action plan, an e-waste Management review portal has been settled to monitor the status and progress of e-waste management initiatives. In a positive development, during the financial year 2021-22, India successfully collected and processed 5,27,131.57 tonnes of e-waste, showcasing the country's obligation to better e-waste management. The collective efforts made by various stakeholders in the public and private sectors have played an important role in achieving this milestone (Legality Simplified, 2023, July 20).

SWOT analysis of e-waste management in India

Strengths

1. In India, E-waste management policies and rules are in place. E-waste (Management) rules 2022, which came into force on April 1, 2023, are applicable to all manufacturers, dismantlers and recyclers of e-waste in the country.

2. Proper system of e-waste collection and reporting has been initiated in India. The government ensures industrial space for e-waste dismantling and recycling facilities, it also ensures that the policies are in place to safeguard the health and safety of employees working in this field.
3. In India, E-waste volume is increasing day by day. There is an increase in the usage of electronic products produced and consumed in India as well as that of imported leading to a tremendous upsurge in the consumption of electronic items. At the end of its usable life or when they become obsolete, it is discarded by the user. The end result is e-waste, which is in proportion to its consumption.
4. Formation of e-waste collection centres is initiated in India. E-Waste Management rule states that the producer has an extended responsibility for recycling E-Waste. To comply with the rules and to make their work lighter, a majority of producers have outsourced recycling to groups known as Producer Responsibility Organizations (PRO).
5. A growing number of entrepreneurs in India are generating electronic and electrical devices. The national necessity of communication, entertainment and security has led to a dramatic increase in demand for electronic and electrical products. Entrepreneurs venture in this sector competing with each other by providing new products, features and uses making the devices more user friendly.
6. There is a growing demand for recycled e-waste in India. Discarded e-waste contain valuable metals like silver, gold, palladium, indium, platinum and gallium. These elements are scarce and used in the production of electronic products and other communication devices. As these metals are scarce, their cost is high. Hence there is an utmost need to reuse, refurbish and recycle e-waste.

Weaknesses

1. In India there is a lack of expertise in the field of e-waste management. E-waste consists of many valuable metals like silver, gold, aluminium, platinum, copper and palladium, Simultaneously, it also contains harmful substances like cadmium, lead and mercury. In the absence of appropriate techniques and safety measures, recycling of e-waste can lead to release of toxins causing health hazards and environmental issues in the country.
2. There is a poor execution of policies and implementation of rules in India related to e-waste management. A large number of waste management organizations are not in a position to control the causes and effects related to problems with e-waste management and subsequently relating to environmental issues. India is a dumping ground for advanced nations. However, India is still in the early stages of applying best practices for managing e-waste. This means there is a gap between recommendation and actual execution of e-waste.
3. So far as e-waste handling and its management is concerned, there are some inter-ministry barriers. Environmental law and regulations in India are handled by the Ministry of Environment and Forests (MoEF). CPCB, SPCBs, GTZ and industry associations like MAIT are major organizations involved in managing e-waste in India. The MoEF provides guidance to these groups. To review the aspects of e-waste covered in various environmental legislations in India, the CPCB (Central Pollution Control Board) established a task force in 2007. This has laid down

guidelines in 2008 for the environmentally sound treatment of e-waste for individuals handling e-waste.

4. There is a lack of incentives for efficient e-waste management practices in India. Better management of e-waste in India relies on consumers. Extended Producer Responsibility, Design for the Environment, and the (3Rs) Reduce, Reuse, Recycle technology platform try to connect the market and customers in order to dispose of e-waste correctly. This is also an attempt to initiate consumers towards a sustainable consumer lifestyle. The reason is that the role and responsibility of institutions and stakeholders in e-waste management are not adequately described.
5. In India, the cost of monitoring e-waste is high. E-waste has two faced effects. First, it has excellent recycling value, secondly, it causes harm to the ecology of the environment. A very small amount of e-waste is recycled properly. To calculate the revenues and costs of e-waste recycling, e-waste goes through five stages i.e. Collection, transportation to a dismantling plant, manual dismantling, transportation to a metal recycling facility, and metal recovery are all options. India is fifth in the world in terms of e-waste production. Almost 95% of the e-waste is either burned or dumped in landfills in this country.
6. Unprotected contact with e-waste is one of the major problems of e-waste handling. Most of the e-waste is recycled in nonformal sectors. This work is done by rag pickers, who do the work with bare hands and without wearing a mask. Being exposed to e-waste, they can be affected by illnesses such as eye irritation, difficulty in breathing, frequent headaches etc. Recovery of metals from Printed Circuit Boards (PCBs) by primitive means is a most hazardous act. Proper education, awareness related to safety measures need to be provided to the nonformal sectors. The need is also to provide for a cost-effective technology so that people operating in this sector can earn their livelihood in a safer way.
7. Collection rate of household e-waste is low in the country. The formal e-waste sector constitutes a very small fraction and faces e-waste supply chain constraints due to informal e-waste collectors. Informal e-waste sectors are those that are within the reach of households and hence the collection and recycling of a greater portion of e-waste is not mobilized.
8. There is a lack of access to e-waste management and recycling technologies in the country. Recycling of e-waste is to reduce environmental pollution and mitigate climate change. To manage e-waste effectively we need to understand the economics involved with it. This includes the initial cost of equipment and material to be recycled. Usually, this cost is higher than producing new products from recycled material. The first cost involved is the limited resources required for recycling operations as well as the increased labour costs. The second cost is the worth of recycled materials which can be more expensive than new products made from raw materials. The third cost is disposal. Proper e-waste disposal necessitates the separation and treatment of hazardous compounds, which can be costly and time-consuming. Transportation facilities to carry e-waste in the country are inadequate and substandard. Recycling facilities are situated far away as e-waste is classified as hazardous waste. Hence e-waste needs to be transported over long distances. Economic feasibility in this matter has to be ensured. As e-waste is categorised as hazardous waste,

matters related to its export, import and transit require a permit to transport e-waste to recycling units. The cost of transportation along with the cost of permits can be very high.

9. Lack of knowledge about the appropriate handling of e-waste is one of the hurdles in e-waste management in India. The majority of Indians are unaware of the government guidelines in regard to e-waste disposal. Media and companies producing electronic goods should take up the responsibility for disseminating information related to handling e-waste.
10. Most of the settlements are characterized by absence of designated e-waste dumping sites. In India, waste is only bifurcated as dry waste and wet waste. Dry waste includes e-waste, glass, wood, cloth, plastic etc. So, there are no separate dumping sites for e-waste. As such the dry waste from households at collection centres have to be segregated. This poses a risk to handlers of waste.

Opportunities

- 1 The growing volume of e-waste offers opportunities to entrepreneurs in India. E-waste recycling, impact of technological advancement has led to the use of various electronic equipment. Today, consumers require gadgets suitable to their needs. This has led to an increase in the scope of business opportunities for entrepreneurs who are capable enough to come up with new ideas. Naturally, the end result is entrepreneurs are also required in recycling e-waste. If the initial cost of setting up a good facility can be overcome, there is bound to be a huge profit over a period of time.
- 2 There is a scope for enhanced e-waste management and resource recovery in India. E-waste arising from high-quality products is a very complex and continuous type of municipal waste generated. The problem related to recycling lies in the heterogeneous and complex nature of its composition which is more difficult to process when mixed with household waste. Research and development are ongoing in this field to create better physical infrastructure and cost-effective recycling technologies to manage e-waste. This promotes resource efficiency and a circular economy in the country. Resource recovery corresponds to a noteworthy economic value permanently lost in the market. E-waste contains high-value metals. Good infrastructure will help in the recovery of metals so as to meet the metal demand generated by the producers of new electronic and electrical equipment.
- 3 There is a wide scope for promotion of the 3R's i.e. Reduce, Reuse and Recycling of e-waste. Reduction refers to the integration of technology to produce high-efficiency products and reduction in transmission of loss. This improves product efficiency and increases the life span of the product. Simply given reuse means to make repeated use of the same product. If resources are utilized optimally, it leads to better growth. Recycling of e-waste is done to recover useful metals and other materials from e-waste. In the long run application of the 3R's can bring economic and health benefits to consumers. Producers of e-waste should take the initiative to spread awareness of the 3R's.
- 4 There is an opportunity for increasing landfill lifespan. For many years, e-waste has been filling landfills across the globe. Over a period of time, e-waste in landfills leaches and causes water to become toxic. Hence e-waste segregation is of great importance as the value of discarded e-waste is too high. This is a great opportunity for budding entrepreneurs to set up e-waste collection centres and use technological advances for the collection and monitoring of e-waste. Collected e-waste can

be stored for a maximum of one year. With the use of technology, the lifespan of the e-waste collection centres can be increased.

- 5 Formulization of the informal sector can be done by providing institutional support. Almost more than 95% of the e-waste is collected by the informal sector. i.e. rag pickers. They work in unhealthy environments. They get infected with different types of diseases. Validating the informal sector is a solution to recover a good amount of e-waste material consisting of valuable metals and also consider the health of the people employed in the informal sector.
- 6 There is a lot of scope for the urban mining of e-waste. Urban mining is a process to retrieve raw materials and energy from urban areas, specifically from stocks of waste electrical and electronic equipment (WEEE) generated from anthropogenic causes. Imparting knowledge to all sections of society is important.
- 7 Collection of e-waste can be done by using an e-platform. It is observed that the segregation of waste at the domestic level is done by women. But today with the working population consisting of women, there is less time and care given by the women or even members of households in segregation of waste and disposal of waste. The scope of business can be expanded by using an e-platform, where information on the collection of e-waste can be posted. Waste disposers can contact these e-waste centres who will arrange for the collection of the waste at a time suitable to the households.
- 8 Appropriate E-waste management is of great help in conserving natural resources. E-waste consists of a huge number of valuable metals. If recovered and reused to the optimum level, it will help save a lot of natural resources from being used unnecessarily.
- 9 Employment opportunities can be created in the process of e-waste collection, storage, segregation and recycling. If the process of e-waste is formalized, it can bring the people working in this sector together and have bargaining power. Formalizing the system requires a process to be followed and hence will open up job opportunities in the line of collection, storage, segregation and recycling of e-waste.
- 10 E-waste management may improve environmental and health conditions Formalising the e-waste collection sector requires some basic interventions and provides for a formal system. The system takes into consideration the health of the workers and the work environment. This improves the standard of living of the employed.

Threats

- 1 Some of the consumers in India show inappropriate behaviour. Most of them are careless. They ignore the importance of segregating waste, specifically while disposing e-waste. They are not aware of the threat e-waste causes to the environment and indirectly to their health too.
- 2 There is a lack of infrastructure essential for e-waste collection. The e-waste collection facilities require specific infrastructure for reuse, recycling and reduction of waste. E-waste is a part of dry waste of which a great amount can be reused and some part of it can be recycled. If e-waste is mixed with other waste and dumped in normal landfills, it can cause leaching.

- 3 India is lacking in investment to finance formal recycling facilities. The country has a very limited infrastructural capacity and the amount of e-waste generated is on a large scale. In India there are very few government approved e-waste recycling centres. The government offers the co-funded grant schemes. Forking out huge amount of finance for setting up infrastructure for such facilities is not feasible for private institutions. Infrastructure involves having specialized collection channel which necessitates creating an attractive website, creative advertisements, maintain employees, transportation etc.
- 4 There is an illegal import of e-waste in large quantities. Loopholes in law facilitate illegal imports that bring in a lot of profits. The Customs Tariff Act states that new computers can be imported for free whereas not mention is there regarding second hand computers. Traders take advantage of this point and huge amount of e-waste enters the borders of the country.
- 5 Environmental degradation takes place due to the presence of toxic constituents of e-waste. In addition, E-waste is not biodegradable. It not only affects human health but is also toxic and accumulates in the environment. To recover valuable metals from electronic items, they are either burnt in the open or acid bath method is used. This causes toxic materials to be released into the environment.
- 6 E-waste causes health hazards and unhealthy working conditions. Exposure to a variety of chemicals released during e-waste processing is harmful to human health and causes adverse effects including skin disease, under-development of the brain in children, damage to the nervous system, malfunctioning of the kidneys, respiratory problems etc. These health problems mostly occur in the case of informal e-waste workers, when there is direct occupational exposure.
- 7 There is a lack of household e-waste inventory data. No data is available regarding an inventory of e-waste generated, which makes it difficult to calculate the quantity the e-waste recycled and disposed of. The rate of increase in the quantity of e-waste is not only because of the increase in consumption but also obsolescence. When consumers purchase electronic gadgets, the responsibility of the consumers is not specified on the product and hence no responsibility. Thus, consumers do not consider it necessary to keep an account of the e-waste generated by them.
- 8 There is always competition among formal and informal E-waste recyclers. In India, there are both formal and informal e-waste recyclers that constitute government-authorized and non-government-authorized concerns. The formal sector is one where the recyclers have a certain prescribed qualification or are given appropriate training, whereas the informal sector is where the recyclers are without the basic qualification or training to collect e-waste, formal sector has to pay higher charges than the informal sector.
- 9 Many a time there is a loss of environmental quality due to unscientific burning of e-waste. During the process of burning e-waste, large particles are released which swiftly re-deposit back onto the ground and pollute the soil. The spread of soil pollution depends on an array of factors like temperature, soil type, pH levels and soil composition. Over a period of time, these pollutants cause harm to microorganisms in the soil and to the plants. Animals consuming these plants end up with health problems.

Suggestions

1. Quantify and enlist the generated e-waste so that the problem of its management is well understood. Knowing the type of waste generated and the amount of waste generated will help a great deal. If we can understand the resources necessary, the capacity of the waste recycling facility, the manpower needed, the transportation facility, the storage facility etc. it will help in the smooth functioning of the capacity.
2. Ensure the recycling and reuse of imported e-waste. Imported e-waste is an addition to the pile of e-waste generated within the country. E-waste dumped into India by advanced countries is from better-quality products. The objective should be to recover as much as possible and reuse it.
3. Avoid the illegal import of e-waste. The Central Board of Indirect Taxes and Customs (CBIC), has stated in Annexure-I that all field formations and the Directorate of Revenue Intelligence (DRI) under CBIC keep continuous watch to check illegal import of e-waste into India and act in accordance with law whenever such infringements are observed.
4. Import of e-waste should be better regulated. Import or export of e-waste is in breach of the law in both countries. Other than environmental concerns and the increase in the quantity of e-waste to be disposed of, it is better to be on the safer side of the law by regulating imports of e-waste.
5. Provide incentives to the companies involved in recycling of e-waste. E-waste handling is a hazardous job. Government should encourage entrepreneurs to take up e-waste recycling by providing them with the necessary financial and legal support. Without incentives and encouragement, it is difficult to regularize e-waste collection in the formal sector.
6. Ensure the rigorous monitoring and enforcement of the provisions of the E-Waste (Management) Rules 2016. The E-Waste (Management) Rules, 2016 mandate CPCB to formulate procedures for implementation of E-Waste Rules, which includes specific guidelines for extended producer responsibility, channelization, collection centers, storage, transportation, environmentally sound deconstruction and recycling, refurbishment, and random sampling of EEE for RoHS parameter testing are all options.
7. Monitoring of health and environmental conditions of informal e-waste collection centers should be mandatory. E-waste is hazardous to the health of the collectors. E-waste collectors of informal collection centers should be given proper guidelines regarding safety measures to be taken while handling e-waste. They should also be informed about the environmental degradation that occurs due to improper handling of e-waste.
8. People employed at e-waste collection and recycling centers should be taken care of. They should be provided with compensation for any adverse effect on their health.
9. Safety devices should be provided to the people involved in the handling of e-waste. As handling e-waste can cause health hazards, proper safety gear should be provided to the people handling e-waste to minimize the effects on their health. This is more related to informal e-waste collection centers.

10. Producers of electronic material should be held liable for environmental toxicity due to improper handling of electronic/electrical devices and waste generated due to their improper disposal.
11. Customers can be made aware of improper e-waste management. The first step of discarding e-waste comes from the end consumers. Awareness needs to be created among consumers regarding e-waste and its segregation at the household level. A small step taken by households can make a big difference in the health of the collectors of e-waste. This awareness can be spread through street plays, skits, advertisements on radio and television, posters, banners etc.

Limitations of the Study

The present study is of descriptive nature that involves qualitative scrutiny of the available literature and ground truth verification of the information. As there is a shortage of authentic and sufficient data on e-waste, it does not involve quantitative investigation and survey components of data, attitude and practices.

Conclusion

There is a rapid growth of e-waste in India due to the substantial development in the electronics sector and the import of electronic items from developed countries. Electronic waste is harmful to health and the environment. It damages the quality of ecosystems. The toxic constituents of e-waste may prove to be harmful to human health and other living organisms in the environment. Though, there are e-waste management systems in place and implementation of strategies to handle the task of harmless disposal of e-waste, still there are many challenges, the systems are facing while implementing these strategies. This paper suggests some measures helpful to recover some valuable materials, attain appropriate management and provide favourable business opportunities related to e-waste in India.

Acknowledgment

Thanks are due to the local e-waste recyclers for sharing their experiences and views on e-waste management and providing essential information for ground truth verification of the information obtained through various secondary sources.

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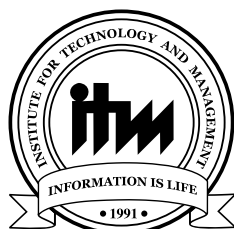
International Research Conference on
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Kharghar, Navi Mumbai

Organised by

ITM BUSINESS SCHOOL KHARGHAR
NAVI MUMBAI



Published by **ITM Business School**

25 & 26 Institutional Area, Sector - 4, Kharghar (E), Navi Mumbai 410 210

ISBN : 978-93-5967-434-6

Message from the Convenor

The concept of sustainability has pervaded the world, and society at large. Numerous authors have written on the topic, each expressing unique ideas of where sustainability might lead society and how it can help entities. Among the various dimensions of sustainability (Human, social, economic and environmental) social sustainability has not been discussed much (Eizenberg and Jabareen 2017). The social dimension is key to the concept of sustainability as it emphasizes on the well-being of humans (Janker 2020). On the other hand environmental sustainability has become the pressing need of the hour.

Keeping in view the importance of Social and environmental sustainability in today's world, ITM Business School, Kharghar organized three days International Research Conference "SOCEN-2023" on 4-6th October, 2023. This conference seeks to bring ideas and thoughts on social and environmental sustainability from a management perspective to create a better tomorrow.

The conference was a great success, witnessing 110 papers from India and overseas. Renowned researchers from across the globe shared their insights as key note speakers. These included :

Dr Paurav Shukla : University of Southampton, UK

Dr Sunil Sahadev : University of Brighton, UK

Dr Stephen Wilkinson : UNOWD, Dubai

Dr Festus Victor Bekun: Istanbul University, Turkey

Dr Narasingha Das : Lebanese American University, Lebanon

Dr Avik Sinha : MDI Gurgaon

Prof P.J Mathew : Chief Mentor

The conference proceedings consist of abstracts and papers of all three dates. My best wishes to the participants and happy reading.

Dr Sangeeta Trott

Convenor

Message from the Director

SOCEN is an expression of the fact that the earth is common to all, and we need to plan and act on preserving it for our future generations! This theme of our conferences propelled researchers to probe deeper into social and environmental sustainability and create awareness and a sense of care for nature which has always been generous to mankind.

I extend my heartfelt congratulations to Dr Sangeeta Trott and the team on the successful publication of the conference proceedings for SOCEN 23. This marks a significant milestone for our institute and showcases the culmination of the hard work and dedication put forth by all involved in the Research Department team and is a testament to the institute's commitment to excellence. The conference witnessed 110 papers that were presented in the three days by students, academicians and corporates. The proceedings encapsulate cutting-edge research, innovative ideas, and diverse perspectives presented during the conference. Thanks to all the guests from academia and corporate who made remarkable references on how we can save the planet from further plunder.

I encourage everyone to spread the word about the publication and to explore the contents of the proceedings. Thank you, Researchers, for your outstanding contributions, and we look forward to celebrating many more successes together in the future.

Wishing all the best and happy reading.

Regards

Dr Lakshmi Mohan

Pro Vice Chancellor- ITM Skills University

Director- ITM Business School

Message from the Dean

It is my pleasure to congratulate all participants of the conference hosted by ITM Business School, ITM Skills University, Kharghar. The conference brought together scholars, researchers, and industry practitioners from diverse fields to engage in interdisciplinary dialogue and exchange of ideas. The theme of the conference was Social and Environmental Sustainability - A Management Perspective which reflects our commitment to addressing pressing challenges and advancing knowledge in the field of sustainability and green economy. Through a series of keynote presentations, panel discussions, and paper presentations, we had the opportunity to explore innovative approaches, share best practices, and collaborate on solutions to some of the most pressing issues of society. I am particularly excited about the breadth and depth of topics that are covered in the conference proceedings. From cutting-edge research in sustainability to transformative initiatives in social empowerment, the diversity of perspectives represented in this forum underscores the richness and dynamism of our academic community. I would like to congratulate the conference organizers, committee members, and all those who have contributed to the planning and execution of this event. Special compliment to the team for bringing out this conference proceeding. The organizing committee's hard work and dedication have been instrumental in ensuring the success of this conference and the publishing of this conference proceedings and I appreciate your efforts. It is through such scholarly interactions of all of you that we could collectively advance our understanding of complex issues and drive positive change in our respective fields. I wish you all had a stimulating and productive conference experience. May this proceeding here be marked by fruitful insights and meaningful future research that will continue to inspire you and the intellectual community at large.

Best wishes!!!

Dr. Sarit Prava Das

Dean Academics

INTERNATIONAL RESEARCH CONFERENCE SOCEN 2023

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Status of E-Waste Management in India

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Abstract

E-Waste is electronic products that are unwanted, not working and nearing or at the end of their useful life. Computers, laptops, smartphones, televisions, stereos, copiers and scanners are everyday electronic products. Use of electrical and electronic equipment on a large scale in India has resulted in the accumulation of large amounts of e-waste. E-waste management in India faces many challenges such as the large size of e-waste, lack of awareness about handling and disposal of e-waste, insufficient space for segregation, storage and recycling of e-waste, lack of research in e-waste management etc. Thus, toxic materials from uncontrolled e-waste enter the environment and it leads to many adverse effects on human health, soil and water quality. On the other hand, as e-waste consists of many valuable materials, it is wasted due to the dumping of e-waste. With this background, this secondary data-based paper attempts to understand the current scenario of e-waste management and issues related to e-waste in India by adopting an explanatory approach.

Key Words: E-Waste, Management, Pollution, Status, India.

Introduction

Electronic waste or e-waste is used to describe all electrical appliances and electronic devices that are discarded for reuse, recycling, or dumped in the bin. E-waste can be classified into [three categories](#): large household appliances, also called white goods, such as refrigerators, washing machines and air conditioners; goods built on information technology and telecommunications, also known as grey goods, such as computers, laptops, mobile phones, printers; and consumer goods, also known as brown goods, like televisions, cameras and recorders (Pendharkar, V. 2018). The electronics industry is the world's largest and fastest-growing manufacturing industry (Radha, 2002; DIT, 2003) with the annual global estimated production of e-waste to surpass 50 million tons in 2020 (Baldé, C. P. et. al. 2017). The last decade has seen tremendous growth in the manufacturing and consumption of electronic and electrical equipment all over the world. As a consequence of this, combined with rapid product obsolescence, and lower costs, discarded electronic and electrical equipment or 'E-waste' is now the most rapidly growing waste problem in the world. Most companies today design their products for planned or perceived obsolescence. This is reinforced through marketing and retailing practices, and affordability and convenience have taken over from product durability as primary drivers (Jennifer, 2005). The e-waste problem has reached great proportions with an estimated 50 million tons of e-waste produced worldwide each year. The Indian market is flooded with huge quantities of electrical and electronic products and gadgets, with huge internal demand (Vibhute, N. et al. 2021). The disposal of e-waste is an emerging global environmental and public health issue, as this waste has become the most rapidly growing segment of the formal municipal waste stream in the world. (Dahl R. 2002). India is not an exception to this. In India, the quantity of 'e-waste' or electronic waste has now become a major environmental problem. With this background, the present study attempts to address the current scenario of e-waste management and issues related to e-waste.

Objectives

- To understand the current scenario of e-waste management in India.
- To study the issues related to E-waste in India.
- To suggest measures for coping with the problem of e-waste management in India.

Materials and Methods

The present paper utilizes the data and information obtained from secondary sources viz. government reports, NGO publications, research, and news articles. It adopts the exploratory method to arrive at the conclusion. Some of the information obtained from empirical evidence is also considered. The paper focuses on e-waste management and also suggests some measures to cope with the issues related to E-waste in India.

E-Waste Life Cycle

Electronic devices all over the world are always designed to resist decomposition. Materials found in e-waste like glass may take millions of years for its decomposition. Thus, it is always better to recycle them using certified facilities. As electronic and electrical materials are not easily decomposed, they need to be sorted, disassembled and separated according to their type. Metal, glass, plastics and other materials found in the e-waste can be recycled to produce new products to save valuable natural resources from further exploitation. Manufacturers, shopkeepers, buyers, dealers, exporters, disassemblers, scrap dealers, smelters and recyclers are major stakeholders in the e-waste supply chain. As e-waste contains both toxic materials including Mercury, lead, cadmium, polybrominated flame retardants, barium, lithium and valuable materials such as iron, aluminum, platinum, silver and gold in it, management of e-waste is one of the emerging problems, however, it offers the business opportunity. Consequently, E-waste recycling is a vital matter of waste treatment. It is also important as the valuable materials can be recovered from it. Nevertheless, the process of collection and recycling of e-waste is complex in its nature that involves various products, people, particularly producers, dealers, retailers, buyers, recyclers, enterprises, area, machinery, financial support etc.

E-Waste Management in India

Electronic waste in recent years has become a vital environmental and health concern. India being a major consumer of electronic products faces a substantial challenge in managing e-waste effectively. The rising use of electronic devices and the rapid pace of technological developments contribute to the growing e-waste problem in India. Inappropriate disposal of e-waste results in many risks to the environment and the health of human beings. Several electronic devices contain hazardous materials like lead, mercury, cadmium and brominated flame retardants which can contaminate soil, water and air if not disposed properly. In view of addressing this issue, the government of India has formulated policies and regulations to manage e-waste properly. The E-Waste (Management and Handling) Rules 2011 were made functional to ensure proper collection, recycling and disposal of e-waste in an eco-friendly manner. These rules impose responsibilities on manufacturers, producers and bulk consumers of electronic goods to manage their e-waste effectively. According to these regulations, manufacturers should compulsorily set up e-waste collection centers and implement recycling and disposal mechanisms. They also need to get Extended Producer Responsibility (EPR) authorization and become accountable for the complete lifecycle of their products with proper e-waste management.

The rules also necessitate producers to incorporate labeling on their products indicating the eco-friendly disposal options available.

The government has established e-waste management facilities across the country to encourage proper disposal and recycling of electronic waste. These facilities help in the safe handling and dismantling of e-waste where hazardous substances are segregated and disposed of acceptably. Public awareness campaigns and educational initiatives have also been taken to promote responsible e-waste management practices. People are encouraged to take their e-waste to authorized collection centers rather than disposing of them with regular household waste. Moreover, some initiatives have been undertaken to promote the reuse and restoration of electronic devices to extend their lifespan and minimize e-waste generation. One of the primary challenges is the lack of awareness and knowledge among consumers about proper disposal and recycling methods. Many people still dispose of their electronic waste through informal networks which can lead to environmental and health hazards. The informal sector involved in recycling e-waste also faces challenges like insufficient infrastructure, lack of training and exposure to hazardous substances. To cope with these challenges, large investment is needed to build robust e-waste management systems, improve infrastructure and enhance the capacity of stakeholders involved in the recycling process. In short E-waste management is a persistent issue in India due to the increasing usage of electronic devices. The government has taken steps to regulate e-waste management through policies and regulations and public awareness campaigns have been launched to promote responsible practices. Yet, additional efforts are needed to address the challenges and build a sustainable e-waste management framework in the country.

Intricacy in E-Waste flows

E-waste in India generates from various sources and is characterized by its complex nature. It consists of both toxic as well as valuable substances. Thus, segregation of it has become a tedious process. As e-waste goes through many steps, from its generation to recycling, a number of interlinked stakeholders are involved in the value chain of e-waste. Consequently, e-waste follows different paths viz. formal recycling sector, informal recycling sector and semi-formal recycling sector. Interaction between these sectors is not established well. Most of the E-waste ends up with scrap traders and dealers who, for economic reasons, commonly transfer it into the informal sector.

Issues Related to E-Waste

There are several issues of e-waste in India.

E-Waste as a complex cocktail

E-waste involves a complex mix of unsafe and toxic materials. It consists of precious metals like silver (Ag), gold (Au), palladium (Pd) and platinum (Pt). One can find more than 50 elements from the periodic table in electronic equipment. Electronic devices are an alternative source of base metals such as copper (Cu) and tin (Sn) as well as special metals such as cobalt (Co), Indium (In) and antimony (Sb). It also consists of some toxic substances such as lead (Pb), mercury (Hg), cadmium (Cd), arsenic (As) and flame retardants.

1. Lack of awareness

India is lacking in public awareness, public legal education and also in legal e-waste literacy. People

are not fully aware of the ways to reduce and control e-waste. This has resulted in a very low recycling rate of e-waste. Customers of electronic devices and materials do not know the hazardous effects of e-waste. They have less legal knowledge about the penalties for inappropriate disposal of e-waste and are unaware of efforts being made by Non-Government Organizations (NGO's), local government bodies, state and central governments for effective e-waste management.

1. Imports of E-Waste

Cross-border flow of waste equipment into India- 80 percent of E-waste in developed countries meant for recycling is sent to developing countries such as India, China, Ghana and Nigeria. (Lundgren, 2012).

2. Lack of financial incentives

Most of the cities in India are lacking in a number of e-waste collection and recycling centers where households, establishments and industries can willingly drop e-waste. The majority of the urban population is accustomed to selling e-waste. They get a discount in exchange for the old product while purchasing any new electrical/electronic products from the retail market. Lack of financial incentives for the best e-waste management and proper e-waste disposal practices results in inappropriate disposal of e-waste.

3. Size of E-Waste generated

India is the fifth biggest producer of e-waste in the world; discarding 1.7 million tonnes (Mt) of electronic and electrical equipment in 2014 (Economic Times, 2015). It produces nearly 12.5 lakh MTs of e-waste every year, (ASSOCHAM, 2014).

4. Dearth of legal knowledge

Lack of legal knowledge on e-waste handling and disposal is one of the root causes of inappropriate management of e-waste. No clear guidelines on e-waste handling and disposal are available. The legal information on the handling and disposal of e-waste is not available on common platforms.

5. Dearth of Infrastructure

Infrastructure developed for the collection, handling, segregation, storage, transportation, disposal and recycling of e-waste in many Indian cities is not copious. Cities are not having sufficient space for conducting these activities. The high cost of e-waste recycling technology and machinery, high prices of land to be purchased for conducting e-waste management and related activities, inefficient collection and transportation facilities are the major hurdles in e-waste management in India.

6. Health-related risks

Since e-waste consists of several hazardous and toxic substances, it poses health-related risks. Improper disposal of e-waste pollutes soil and groundwater. Exposure to such pollution and unscientific handling of e-waste leads to the occurrence of various health issues like vomiting, eye irritation, headache, sickness etc. Persons involved in the process of recycling e-waste may suffer from damage to vital organs like liver and kidneys. Exposure to toxic e-waste for longer periods may lead to the occurrence of cancer, miscarriage and neurological illnesses.

7. Issue of child labor

In India, about 4.5 lakh child laborers in the age group of 10-14 are found to be engaged in various E-waste activities and that too without adequate protection and safeguards in various yards and recycling workshops. So, there is an urgent need to bring out effective legislation to prevent the entry of child laborers into E-waste market- its collection, segregation and distribution. (ASSOCHAM, 2014)

8. Unwillingness of authorities

Improper coordination among authorities accountable for the disposal and management of e-waste is one of the reasons behind the inappropriate management of e-waste in India. The concerned authorities are not always willing to conduct their duties and responsibilities. It is found that, several times the local government bodies in many cities do not take initiatives for appropriate e-waste management.

9. Improper security

Although India barred the import of e-waste under the E-Waste management rules, 2016, a substantial quantity of e-waste still ends up in the country's informal market from abroad.

10. Research paucity

India has long been known for its talent in the fields of science and technology. However, despite having a pool of talented researchers and engineers, the country is lagging behind in research and development. The situation is even more concerning when compared to other emerging economies like China, Brazil and Russia. According to the World Bank, India spends only 0.7% of GDP on research and development, compared to the global average of 2.2% (Godse, S. 2023).

11. High cost of e-waste recycling

In India, the cost of e-waste recycling is high. As there is a lot of uncertainty in the supply of e-waste, no investors are willing to invest in this field. Thus, about 90 to 95% of e-waste recycling is done in the non-formal sector, PCBs are treated in primitive methods to remove components and valuable metals. Burning cable and unwanted electrical/electronic materials to recover copper takes place in the open air leading to the leaching of chemicals and heavy metals into landfills and the recovery yield is also poor.

Suggestions

1. People should be made aware of e-waste collection, handling, storage, transportation, recycling and its overall management.
2. Efforts should be taken to integrate the organized and unorganized sectors working in the field of e-waste management.
3. Incentives should be provided in the form of financial support and boost morale as well as attract and retain talent.
4. Punitive actions should be taken for violating guidelines, rules and regulations regarding e-waste management.
5. Faster Clearance should be given to the projects related to e-waste management.

Limitations of the Study

This is a primary-level study in a descriptive form that involves qualitative scrutiny of the available

literature. It does not involve on-ground or on-site assessment, quantitative analysis and survey components of knowledge, attitude and practices in the environment.

Conclusion

The study reveals that the generation of e-waste in India is huge. Lack of awareness of e-waste management and legal knowledge, high cost of e-waste recycling techniques and machinery, lack of research, high risk in e-waste handling, complexity and toxic nature of e-waste are some of the major issues. Public awareness, integration of organized and unorganized sectors, provision of incentives, implementation of the e-waste-related legislature and faster clearance of e-waste recycling projects are some of the measures that should be undertaken for efficient e-waste management in India.

Acknowledgment

The authors are thankful to the skilled and unskilled workers, authorities, researchers and government employees involved in e-waste management for sharing their views and opinions.

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ISBN: 978-81-959050-4-1

**NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS
SUSTAINABLE DEVELOPMENT**



**Dr. Shantaram G. Baviskar
Dr. Manisha S. Pawar**

NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS SUSTAINABLE DEVELOPMENT



Fern International Publication Pune
Govt. Regd. No. UDYAM-MH-32-0072613
Malshiras, Dist-Solapur (MS), India
and
Sr.No.-48/60/1/3, Swapnapurti Niwas Yerwade Vasti, Vadgaon
Budruk, Pune, Pin-411041
Email- fppune2003@gmail.com



Price-750

Natural Sciences and Environmental Awareness towards Sustainable Development

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Fern International Publication Pune

Natural Sciences and Environmental Awareness towards Sustainable Development

Editors

Dr. Shantaram G. Baviskar, Dr. Manisha S. Pawar

Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

E-mail: fppune2003@gmail.com

Publisher Address

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras,
Solapur, 413107

Mob- 888454089

and

Amitsons Digital Copier, Pune Swargate

106, Paras Chamber, 1st Floor, Above Bank Of

India, Near Laxminarayan Theatre, Swargate, Pune- 411009

Mob-7058486065

Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
India, Near Laxminarayan Theatre,
Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

Copyright: Jyoti K. Mane

Publication Date: 20/10/2023

Price: 1000

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Green Energy for Emerging India: Potential, Policies and Challenges

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Abstract

Today, India is on the verge of transitioning from conventional energy resources to sustainable growth powered by green energy resources. Green energy will be the source of next phase of India's growth. The present paper attempts to understand the potential and challenges in the adaptation of green energy resources in the light of various policies framed by the Government of India in order to attain its NDC commitments. The study is based on secondary sources of data viz. publications and reports by international and national bodies. A few research papers were also referred to obtain the information. It is observed that India's attainment of Net Zero emissions depends on its successful harnessing of renewable energy resources; besides working towards improving fossil fuel efficiency, framing policies for utilisation of green energy, innovation in environment friendly technologies and bringing efficiency in the transportation of power supply. Towards this end, India has already formulated policies and undertaken a slew of measures such as the National Solar Mission, National Hydrogen Energy Mission, PM KUSUM etc. However, the challenges remain in terms of lack of research and development, land acquisition, inefficiencies in power distribution, the rapid growth of population, urbanization, industrialization, high dependence on fossil fuel based energy resources etc.

Keywords: Green Energy, India, Potentials, Policies, Challenges.

Introduction:

The challenge of global warming induced climate change has imposed a sense of urgency among the decision-makers across the world to adapt to a more sustainable model of growth and reduce dependence on fossil fuels. An important landmark demonstrating the collective intention to fight climate change and restrict the increase in

global average temperatures is the Paris Agreement adopted by 196 parties at the United Nations Climate Change Conference on 12th December 2015. Though India's energy use is less than world average on per capita basis, it is the world's third largest energy consuming country. (India Energy Outlook, 2021). In its Updated Nationally Determined Contribution (NDC) under Paris Agreement submitted in August 2022 to UNFCCC, India has stated its intention '*to adopt a climate friendly and cleaner path*' towards economic development. India has set ambitious and commendable targets such as, reducing emissions intensity of its GDP by 45% by 2030 from 2005 levels, achieving 50 percent cumulative electric power from non-fossil fuel based sources by 2030, restoring forest cover thereby creating an additional carbon sink of 2.5 to 3 billion tonnes by 2030, mobilising investments in development programmes towards sectors vulnerable to climate change, building capacities and technology transfer related to climate change. With this background, the present paper highlights the major policies and programs launched by the government to utilise the green energy resources at their optimum level.

Objectives:

The objective of the present paper is to study the potential and challenges in the adaptation of green energy sources in the light of various policies framed by the Government in its mission to attain the NDC commitments.

Data and Methodology:

The present study is based on the secondary information obtained from national and international reports including the reports published by the International Energy Agency and Ministry of New and Renewable Energy, India. Information available in research papers has also been taken into consideration. The paper is written in theoretical form.

Result and Discussion:

India's attainment of Net Zero emissions by 2070 depends on its successfully harnessing non-renewable energy sources including Wind energy, Solar power, Biomass, Hydropower, and Nuclear Power; besides adopting climate-friendly technologies, framing environment-friendly standards and regulations, working towards improving coal efficiency, and bringing efficiency in power supply. Towards this end, India has already formulated policies and undertaken a slew of measures such as the National Solar Mission, National Hydrogen Energy Mission, PM-KUSUM Scheme, National Bioenergy Programme, etc. However, the challenges remain in terms of investment financing, research and development, land acquisition, demands of a huge burgeoning population, urbanization, high dependence on coal, etc.

a. Solar energy: Solar power comprises 50.24% of the total potential for energy from renewable sources which is estimated at 14,90,727 MW as of 31st March 2022 (GoI, 2023). India being located in the tropical region is endowed with an abundance of solar energy. According to the Ministry of New and Renewable Energy, India's land area receives about 5000 trillion kWh of energy from the Sun per year. This comes to around 7,48,990 MW. The National Institute of Solar Energy (NISE) has estimated that 748 GW of energy can be produced from Solar PV modules by utilizing 3% of wasteland (Murthy

G. S., 2022). Solar energy can help in meeting the growing energy demand without harming the environment and is a clean, easy to maintain and sustainable method of generating power. (Sharma, et. al. 2012). The Development of Solar Parks and Ultra Mega Solar Parks Scheme that was started in December 2014 has been extended till 2026. Under this Scheme, the Central Government shares the financial burden of setting up solar parks with the states. A total of 50 solar parks across 12 states in the country have been sanctioned till now, with a total capacity of 37,990 MW. Out of these, 11 solar parks with an aggregate capacity of 8,521 MW have been completed, and 7 solar parks with an aggregate capacity of 3,985 MW have been partially completed. Financial Assistance through the VGF (Viability Gap Funding) Scheme up to specified limits is provided for Solar PV Power Projects. In order to promote rooftop solar usage, the Solar Rooftop Subsidy Scheme has been launched where a 30% subsidy for installation is provided to states in general categories, and a subsidy up to 70 % is provided by the Central government in case of states in special categories. In order to develop high-efficiency solar PV manufacturing through cutting-edge technology, a Production Linked Incentive (PLI) Scheme for the National Programme on High-Efficiency Solar PV Modules has been formulated with an outlay of Rs. 24000 crores. Under Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyaan (PM-KUSUM), small farmers, co-operatives, panchayats, etc. are assisted in setting up solar energy-based power plants up to 2MW and standalone solar agricultural pumps. As of 30 Sept 2023, a total of 137.95 MW installed solar capacity has been achieved under this program, and 262,873 standalone solar pumps have been installed. The International Solar Alliance is an inter-governmental grouping of countries that lie between the Tropic of Cancer and the Tropic of Capricorn. The initiative first proposed by the Indian Prime Minister, in November 2015 aims at harnessing solar energy for growth, replacing carbon-intensive fossil fuels, and ensuring energy security. As of June 30, 2023, India has commissioned solar projects with a total capacity of 70.10 GW which includes 57.22 GW from ground-mounted solar projects, 10.37 GW from rooftop solar projects, and 2.51 GW from off-grid solar projects. (Ministry of New and Renewable Energy, 2023). Some of the challenges faced in the successful harnessing of solar power are land procurement, the decline in wastelands in recent decades, regulatory bottlenecks, and multiple approvals required, (India Energy Outlook, 2021)

b. Wind energy: Along with solar, wind power is an important source of green and renewable energy in India. Of the total renewable power generation potential as of 31 March 2022, the wind power potential is 46.66% at 6,95,509 MW (120m hub height). (Energy Statistics India, 2023). The National Institute of Wind Energy (NIWE) has identified the eight windy states that can realise most of this potential- Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, and Telangana. In terms of the cumulative installed capacity of wind energy, India ranks fourth in the world. Several policies offering fiscal and financial incentives have been formulated by the Government to encourage wind power projects such as Accelerated Depreciation benefits; concessional custom duty exemption on certain components of

wind electric generators, Generation Based Incentive (GBI) Scheme, etc. The National Institute of Wind Energy, Chennai provides support in the form of wind resource assessment and identification of potential sites. Offshore wind turbines are a comparatively new development in this sector with the first offshore turbine built in Denmark in 1991. India has a vast coastline of 7600km which offers tremendous potential to harness the wind power through offshore turbines. The National Offshore Wind Energy Policy has been notified by the Government to ensure offshore wind energy development in the country.

c. Hydropower: Hydropower is clean, renewable, and a low-carbon source of energy. In the year 2022-23, energy from India's hydroelectric power plants accounted for 12.5% of the total power generated in the country. (Powell Lydia et. al. 2023). According to the STEPS scenario projection by IEA outlined in India Energy outlook in 2021, 'modern bioenergy, solar, wind and hydropower could meet a quarter of India's total energy demands in 2040' with hydropower witnessing capacity doubling to about 100GW in 2040. (India Energy Outlook, 2021). According to the Small Hydro Database of July 2016 compiled by the Hydro and Renewable Energy Department (HRED), there is an estimated potential for power generation of 21133 MW across 7133 sites in the country from small and mini hydel projects. The major challenges in large hydropower projects are related to land acquisition, resettlement, and rehabilitation (India Energy Outlook, 2021). Environmental and social costs, deforestation, and loss of biodiversity are some of the other challenges associated with large-scale hydropower projects. (Powell Lydia et. al. 2023). However, small hydropower projects are more environmentally friendly and do not cause deforestation and displacement. Hydropower can contribute significantly to power system flexibility as compared to other energy sources.

d. Bioenergy: Traditional bio-mass mostly used in rural areas in the form of fuel wood, straw, dung, charcoal, etc, is inefficient, unhealthy, and harmful to the environment. Modern bioenergy technologies can help to convert surplus biomass, bagasse, organic waste, agricultural residues, forest industries residues, and other waste into energy with a minimum negative impact on the environment while avoiding emissions. It is estimated that 130 Mtoe of energy can be generated from sustainable organic waste streams. (India Energy Outlook, 2021). A National Bioenergy Programme has been formulated by the Ministry of New and Renewable Energy for the period April 2021 to March 2025 with an outlay of Rs. 858 Crores to realise the energy potential of biofuels and biomass. Under this scheme, support and financial assistance for setting up biogas, Bio CNG plants, and other Waste to Energy projects is provided. The National Biofuels Policy, of 2018 targets 'bioethanol blending in gasoline of up to 10% in 2022 and 20% in 2030' (India Energy Outlook, 2021). The policy also envisages setting up 12 new biorefineries across the country with an investment of around Rs. 10000 Crore by Oil Marketing Companies. Some of the challenges in the adoption of bioenergy are supply chain uncertainties, high upfront costs and financing required, and use of bio-mass for non-energy purposes like fodder for animals, as manure, fuel for households in rural areas, etc.

e. Hydrocarbon: Green hydrogen produced using renewable energy can help India

reduce its carbon emissions and attain its NDC commitments. It has the potential to replace fossil fuels in transportation, shipping, steel manufacturing, fertilizer production, petroleum refining, etc., and provide energy security. The National Green Hydrogen Mission has been implemented by the Government of India to enable the production, usage, and export of Green Hydrogen. It aims to replace fossil fuels with renewable fuels and feedstocks to produce hydrogen. Currently, most of the hydrogen consumed is generated from fossil fuel-based sources and is referred to as Grey Hydrogen. The National Green Hydrogen Mission aims to create capabilities to generate at least 5 MMT of Green Hydrogen per annum by 2030 with the potential to reach production to 10MMT with the growth of export markets. The various initiatives under this mission include facilitating the building of infrastructure and supply chains for storage and delivery of green hydrogen, reducing input and capital costs to increase cost-competitiveness, achieving scale and low costs, providing financial incentive mechanisms, creating a robust standard and regulations framework, R & D, etc.

f. Nuclear Power: Nuclear energy is a low-carbon, releases less carbon emission, and economically viable source of energy. Currently, there are 23 operational nuclear power reactors in India with an installed capacity of 7480MWe. This capacity is proposed to be increased to 22,480 MWe by 2031, with nuclear power accounting for nearly 9% of India's electricity by 2047. (World Nuclear Association, June 2023). Nuclear Power will form a significant part of India's energy basket as it aims to achieve its NDC goals and move away from fossil fuels.

g. Other Policies: Other technologies and policies towards encouraging green energy and realizing the NDC commitments include the Green Energy Corridors Initiative that was launched in 2015-16 to synchronize and facilitate the integration of energy produced from renewable sources with India's national grid system, better energy efficiency and fuel quality standards for passenger cars through Bharat Stage VI, Faster Adoption and Manufacturing of Electric Vehicles (FAME) II in 2019 to encourage EV adoption, constructing supercritical coal plants with higher efficiencies, promoting Clean Coal technologies, stricter pollution emissions norms for thermal plants introduced in 2015, distribution of LED bulbs through Ujala Scheme etc.

Conclusion:

Being the most populous and developing country, India needs a huge supply of energy to develop economically and to improve the standard of living of its population. Though the country is blessed with a variety of green energy resources, it has not yet utilized its green resources up to their full potential. The government of India and the state governments are making an effort to increase the use of green energy resources by adopting suitable policies, providing financial support and encouraging environment friendly technologies. However, there is a wide scope for improvement in the development and utilization of green energy sources in India by overcoming inherent challenges and adopting appropriate measures.

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Sustainable Agriculture



**Book Chapter as
Per UGC Guideline**

Title	: Environmental, Industrialization, Management, Economics, Agriculture, Rural and Urban Development Towards Sustainable Potential
Editor Name	: Dr. Babalola, Ayodele Samuel, Riswan M, Dr. Prasanna Srinivas, Santosh P. Mane
Publishing Agency	: Fern International Publication Pune
Publisher Address	: Jyoti Kerappa Mane Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras , Malshiras, Solapur, 413107
Printed By	: Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	: I st
ISBN	: 978-81-959050-0-3
Copyright	: Jyoti Kerappa Mane
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Publication- Fern International Publication Pune

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E-Waste Management with Special Reference to India

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DOI-10.5281/zenodo.7631679

Abstract

Today, the generation of e-waste particularly in developed and developing countries has become a cause of concern due to its hazardous effects on human health and living organisms. India is not an exception to this. However, the management and treatment of e-waste in India have certain limitations. Thus the issue of E-waste has to be studied systematically. With this view, the present paper attempts to understand the present scenario of e-waste management in India. The paper is based on secondary data, which reveals that the e-waste generation in India varies from state to state and city to city. There are certain challenges to e-waste management in the country like lack of reliable data on e-waste generation and its management. The paper gives some suggestions for effective e-waste management and concludes that there is an urgent need for an in-depth investigation and assessment of present and future scenarios of e-waste management in India.

Key Words: Management, E-waste, Disposal, Recycling, India

Introduction

Today, the advancement in science and technology has brought spectacular developments in modern times that have enhanced the quality of our lives. At the same time, these have led to diverse problems of hazardous waste and other wastes generated from electric and electronic products. These harmful and other wastes pose a great threat to human well-being and the environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and the environment (GoI, 2011). Electronic waste (e-waste), that is, waste arising from end-of-life electronic products such as computers, mobile phones, LED bulbs, televisions, VCRs, stereos, copiers, and fax machines etc. is one of the fastest growing waste streams in the world today (Rama, M. et. Al., 2019). The annual global production of e-waste is estimated to surpass 50 million tons in 2020 (Baldé, C. P. et.al. 2017). E-waste in India is not only increasing in amount but also in its toxicity, the reason being the rapid growth in productivity and consumption in the electronics sector (Dwivedy and Mittal, 2010). About 50,000 tons of e-waste are imported to India each year (Manomaivibool, 2009). The electronic and electrical components manufacturing industries are the largest growing

sectors in India (Sepúlveda et al., 2010) producing 40,000 tons of e-waste itself every year (Sthiannopkao and Wong, 2013). Thus, the present research paper highlights the related issues and strategies to mitigate this emerging problem in India.

Objectives

1. To know about the current scenario of e-waste management in India
2. To provide suggestions on challenges in e-waste management

Materials and Methods

The present study is theoretical and is based on secondary sources of data viz. the government and private publications, research articles and reports.

E-waste and India

Today, e-waste has emerged as one of the serious environmental issues, which is related to public health matters. India is one of the major e-waste-producing countries in the world. It produces approximately 2 million tonnes of e-waste annually. In addition, it imports e-waste from developed countries around the world. Electronic gadgets, Computer and telecom devices, medical equipment's and electric equipment are the major sources of e-waste generation in India.

Table 1: Year-wise e-waste generation in India

Sr. No.	Year	E-waste generation (Million Metric Tonnes)
1	2015	1.97
2	2016	2.22
3	2017	2.53
4	2018	2.86
5	2019	3.23
Total		12.81

Source: CSE, 2020 compiled from The Global E-waste Statistics Partnership Table 1 reveals that, in the year 2015, India's e-waste production was 1.97 Million Metric Tonnes (MMT). It increased to 2.22 MMTs in 2016 and 2.53 MMT in 2017. This rising trend of e-waste generation continued in 218 and 2019 also. E-waste generation in these years was 2.86 MMT and 3.23 MMT and E-waste formally collected 30 kt , appx 1% collection rate. The yearly growth in e-waste generation was approximately 13 percent.

Table 2: Percentage contribution by states to annual e-waste generation

Sr. No.	State	% Contribution
1	Maharashtra	13.9
2	Tamil Nadu	9.1
3	Andhra Pradesh	8.7
4	Uttar Pradesh	7.1
5	Waste Bengal	6.9
6	Delhi	6.7
7	Karnataka	6.2
8	Gujarat	6.1
9	Madhya Pradesh	5.3
10	All other states	30.0
Total		100.00

Source: Electrical and Electronics manufacturing in India, ASSOCHAM & NEC Technologies, 2018
E-waste generation in India shows a state-wise variation (Table 2). In 2018, Maharashtra was the most industrialized state which generated 13.9% e-waste followed by the states of Tamil Nadu and

Andhra Pradesh (9.1% and 8.7% respectively). Uttar Pradesh generated 7.1% e-waste of the total e-waste generated in the country, while each of the states viz. West Bengal, Delhi, Karnataka, Gujarat and Madhya Pradesh generated more than 5% e-waste in 2018.

Table 3: Major e-waste generating cities in India

Sr. No.	City	e-waste generation in Metric Tonnes (MT)
1	Mumbai	96000
2	Delhi and NCR	85000
3	Bengaluru	57000
4	Chennai	47000
5	Pune	19000

Source: Vrushali P., Citizen Matters, Indian Cities Stare at a mountain of e-waste, with little Idea how to manage It, June 11, 2018

In 2018, Mumbai, Delhi and NCR, Bengaluru, Chennai and Pune were the top five e-waste-generating cities in the country (Table 3). Mumbai with its highest e-waste production in the country (96000 MT) ranked first followed by Delhi and NCR with its 85000 MT e-waste production. The city of Bengaluru generated around half (57000) of

the e-waste produced by Mumbai. Chennai generated 47000 MT of e-waste and Pune generated 19000 MT of e-waste.

Challenges before e-waste management in India

The major challenges of e-waste management found are as below

1. Unscientific handling of e-waste
2. More than 30% of the population resides in urban areas which substantially contributes to e-waste generation.

3. Scattered sources of e-waste generation make e-waste management problematic.
4. Lack of skilled and unskilled workforce needed for e-waste collection, handling and disposal.
5. Adoption of improper methods of e-waste disposal by industries.
6. Financial constraints in the field of e-waste management.
7. Weaknesses of e-waste producing industries,
8. Negligence of e-waste handling and managing institutions.
9. Implementation of unsuitable and improper technology for e-waste generation
10. Vague implementation of e-waste generation and prohibition laws.
11. Paucity and improper installation of e-waste collection bins
12. Unfocused mechanism of e-waste collection

Challenges to policymakers

1. Lack of e-waste generation, prohibition and management laws in the recent scenario.
2. Dearth of advanced methods of e-waste management
3. Absence of separate e-waste management and disposal department in local government bodies.
4. Inefficiency of the waste segregation system
5. Lack of positive attitude towards cleanliness among the citizens.
6. The unavailability of dependable data on e-waste generation is a major obstacle for policymakers ready to design an e-waste management strategy and to an industry wishing to take rational investment decisions.
7. Only a small amount of the e-waste finds its way to recyclers due to the absence of a well-organized take-back scheme for consumers.
8. It is because of the lack of harmless e-waste recycling mechanisms available in the informal sector, that there is a reliance on formal sectors, which poses risks to human health.
9. lack of infrastructures facilities, financial and policy supports also present challenges in e-waste management.

Suggestions

1. There should be a separate e-waste management department in urban local government bodies.
2. Local government bodies should collaborate with industries for collecting, transporting and processing e-waste material.
3. E-waste management targets should be achieved phase-wise and systematically.

4. Standard and proven methods for e-waste management should be adopted.
5. There should be a strict vigilance on unorganized sectors.
6. Privatization of the Recycling and reuse industry should be made. Jobs in this industry involve collection, processing, reuse, remanufacturing and more.
7. Awareness campaigning has to be created through formal and informal education systems. Mass media and social media can be used effectively.
8. Privatization and commercialization of e-waste recycling should be made.
9. Workshops on e-waste handling and management should be conducted.
10. Government should provide financial assistance in the form of incentives and subsidies to the e-waste recycling plants.

Conclusion:

The generation of a large amount of e-waste in various states and cities in India has made the problem of solid waste disposal and management more complex. Lack of reliable data, unavailability of proper disposal methods and shortage of knowledge about e-waste disposal are some of the obstacles in e-waste management. Thus, there is an urgent need for a thorough investigation and assessment of present and future scenarios of e-waste management. Quantification, characterization, qualitative analysis, evaluation of disposal practices and assessment of environmental impacts of e-waste management has become the need of the hour today. Use of suitable and standard methods of e-waste collection, transportation, treatment, storage, recovery and disposal need to be recognized and adopted considering the amount and quantity of e-waste. Public Private Partnership in recycling and disposal of e-waste is essential. Production of low waste-generating electronic gadgets, equipment's and instruments should be encouraged. Minimal use of toxic material should be used in electronic devices. Thus, a collective approach from national and international bodies, including public awareness, is crucial to managing e-waste,

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ISBN: 978-93-100-0564-6

EDITOR

DR. EKNATH MUNDHE

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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STATUS OF AYURVEDIC HEALTH TOURISM IN INDIA

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Abstract: *Ayurveda is considered as the oldest form of medicine that was originated and nurtured in the Indian subcontinent for centuries. Being an interesting feature of tourist attractions, today, India is emerging as an important health tourism destination because it has several pull factors like excellent Ayurvedic treatment at low cost, easy accessibility to Ayurvedic medicine, and Ayurvedic treatment centers with scenic locations for excellent holidays. National and international acceptance of Ayurvedic healing has widened the boundaries and prospects of Ayurvedic health tourism. With this background, the present paper attempts to understand the concept of Ayurveda, the scope for health tourism owing to Ayurveda and suggests measures for the growth of Ayurvedic tourism based on both primary and secondary data.*

Keywords: *Ayurvedic, Tourism, Status, India, Health.*

Introduction

Tourism and its influences on livelihood are a very old phenomenon. Tourism provides a number of opportunities to the people who are remotely located. The host region gains multiple benefits from tourism services in the form of money and other developmental aspects. Today, tourism has become an important policy tool dedicated to the change, development and reconstruction of physical and sociocultural environments and thus, as an industry, it defines and influences not only physical landscapes, land use and planning but also social structures, local cultures and other regional and local economies (Saarinen J., 2008). Tourism is classified into various types including religious tourism, heritage tourism, historical tourism, adventure tourism, ecotourism, agro tourism, health tourism etc.

Health tourism has mainly advanced in the last three decades (Kaspar, 1990; Garcia-Altes, 2005; Reisman, 2010) and includes a variety of key participants such as advisers, healthcare providers, insurance companies, information websites and media services (Neil et al. 1015). Individuals seeking alternative medicine therapy look for low-cost procedures for complicated surgeries such as heart, cosmetics and knee replacement which are provided by Ayurveda at destinations like Thailand, Singapore, India and Taiwan (Ye, Qiu and Yuen, 2011), Malaysia (Musa, Thiru Moorthi, and Doshi, 2012). Also, nowadays, instead of seeking long-haul destinations, tourists prefer shorter trips and well-known destinations. It is expected that by 2030, health tourism will represent 31% of international tourism (UNWTO 2013).

Health tourism refers to travelling to other countries to obtain medical, dental and surgical treatment¹. Or the practice of Travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, Health care travel and medical care travel². Health tourism refers to travelling to other countries to obtain medical, dental and surgical treatment¹. Or the practice of Travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, Health care travel and medical care travel². Health tourism refers to travelling to other countries to

obtain medical, dental and surgical treatment¹. Or the practice of travelling abroad and order to receive medical treatment is health tourism. Also called as medical tourism, wellness tourism, health care travel and medical care travel².

In recent times, India has emerged as a popular destination for health tourism and marketing. Ayurveda as a part of it has brought a new definition to vacationing in India. The reasons for this are that it comprises low medical cost as compared to other countries, use of non-toxic, harmless herbs resources, etc. Also, the waiting time for treatment in India is much lower as compared to other countries (Murlidhar, S. and Kartikey, P. 2016). The Make in India initiative of the Indian government, including Ayurveda is a part of the 'Wellness' industry. However, India has not yet achieved its full potential in the field of Ayurvedic health tourism. With this background, the present paper attempts to understand the current scenario of Ayurvedic health tourism in India and provides feasible suggestions to cope with the situation.

Objectives

The present study aims to understand the status of Ayurvedic health tourism in India which has been achieved with the help of the following objectives

1. To understand the concept of Ayurveda.
2. To recognize the scope for health tourism owing to Ayurveda.
3. To give suggestions for the development of health tourism on account of Ayurveda.

Methodology

The present research is of a theoretical nature and is based on both primary and secondary data sources. The secondary sources include government publications, survey reports, research papers and news articles, while the primary information was obtained by conducting interviews with tour organizers, Ayurvedic treatment centers and Ayurvedic health tourists.

Discussion

The study on Ayurveda health tourism has revealed that Ayurveda is one of the well-accepted medical practices in India. An average of 83% of the respondents agreed that Ayurvedic health tourism has an optimistic future. They are hopeful that, the process of globalization and GATT agreement will play an important role in the development and spread of this sector. A favorable visa policy adopted by the Indian government will definitely serve the purpose. A majority of the respondents have emphasized the need for the commercialization of Ayurvedic health tourism. As per many respondents, propagation of information on the advantages of Ayurveda, and effective advertising of Ayurvedic medicine with allied products and health care centers is needed. Respondents are also of the view that the medical researchers should ensure effective treatment even at the last stage of the disease which provides immediate relief to the patient. According to 38% of the respondents, an inclusive approach is essential for the development of Ayurvedic health tourism, which means aspects such as infrastructural development, support from the government, standardization of health-related services, favorable policies for allocation and extension of Indian Visas etc.

A Glimpse of Ayurveda

Ayurveda is one of the popular traditional streams of medicine that has continued and grown for centuries and continues to be even today. Evolved over two-plus millennia, Ayurveda is one of the accepted medical systems. It includes Yoga, Meditation, Pranayama, special nutrition, herbal medicines, reflexology, cathartics etc. Ayurvedic preparation hinges on complex herbal compounds, minerals, and metallic substances. It has also included some surgical techniques.

According to Ayurveda, there are three primary energies in the body viz. Vata, Pitta and Kapha. Each of these three doshas has its own distinctive abilities and a disproportion in any of these can result in different health problems. Studies also revealed that suppression of natural urges is considered unhealthy and may lead to illness.

Ayurveda is categorized into eight branches which are together known as 'Ashtanga Ayurveda'. The meaning of word 'Ashtanga' is eight parts or branches including Kaya Chikitsa (Internal Medicine), Baala Chikitsa (Paediatrics treatment), Damstra Chikitsa (Toxicology), Shalya Chikitsa (Surgery), Jara Chikitsa (Geriatrics), Graha Chikitsa (Psychiatry) and Vrishya Chikitsa (Aphrodisiac therapy), Urdhyanga Chikitsa (treatment of eyes, nose, and throat, head related diseases). With the vast knowledge of natural medicine, this alternative medicine structure will be sustained in the future. Several avenues are yet to be explored by the experts, scholars, researchers and medical practitioners in the field of Ayurveda which will help to keep this traditional medicine system alive and contribute to its growth. Nonetheless, it is because of the inadequate literary evidence and lack of awareness among the masses about the basic principles of Ayurveda, that the knowledge of Ayurveda has not been properly disseminated and reached some of the countries in the world.

Advantages of Ayurvedic health treatment

1. **Weight management:** This relates to Body Mass Index (BMI) and depends upon particular body weight, and lifestyle to maintain the desired body weight. Ayurveda provides an efficient weight management process by suggesting a suitable diet, exercise and helpful practices.
2. **Healthy skin:** Ayurvedic oil massage not only deeply moisturizes but also gives glowing skin.
3. **Stress management:** Stress is ubiquitous. Ayurveda offers Yoga practice to reduce stress levels with physical benefits and mental benefits. Often it is advised to devise specific Yoga practices to reduce and prevent stress.
4. **Body cleansing:** Ayurveda offers an assured process of body cleansing by suggesting a detox diet and several other natural methods of cleansing.
5. **Manage blood pressure:** Ayurveda offers home remedies that help to regulate blood pressure and a healthy heart.
6. **Prevent immunity disorder:** Ayurveda promotes a nutritious diet, appropriate exercise and sound sleep with the regular practice of Yoga, Pranayama and Meditation. All these methods help boost immunity.
7. **Chronic pain:** Chronic pain is associated with several physical and mental health conditions like depression, lack of sound sleep, social isolation, overuse of medicines etc. Yoga, Meditation, Deep breathing techniques, progressive muscle relaxation and cognitive behavioral therapy offered by Ayurveda help to reduce chronic pain.

- 8. Gastrointestinal Problems:** This refers to problems in the digestive system and its treatment is important for maintaining good health as it plays a significant role in the absorption and circulation of nutrients and the elimination of toxins and wastes from the body. Ayurveda suggests preventive care and curative medicine to cope with gastric issues.

Benefits of Ayurvedic health tourism

There is numerous Ayurvedic health care centers spread across the country that offer health treatment services including *Panchakarma*, *Shirodhara*, *virechana*, *vaman*, *basti*, *nasyam treatment*, *raktmokshan*, *abhyanga*, *Kati vasti* etc. Most of these centers play an important role in developing the tourism industry that offers several benefits at individual, institutional and national levels as a whole. Some of these benefits are stated below.

1. Ayurvedic health tourism is one of the ways to generate foreign exchange.
2. Employment and job opportunities offered by Ayurvedic health tourism may restrict brain drain.
3. Ayurvedic tourism boosts growth in Gross Domestic Product (GDP) and helps in revenue generation due to the growth of national and international tourism.
4. After the pandemic of COVID-19, Ayurvedic practices have gained significance in the health and tourism industry with India's magnetic influence making it the most desirable destination for tourists across the globe.
5. Ayurvedic health tourism explores new technology.
6. People from other countries can get cheaper Ayurvedic treatment in India than they get in their own country.
7. Ayurvedic health tourism delivers effective and efficient medical services at low cost.
8. This healthcare system promotes the plantation of a variety of medicinal plants, resulting in many environmental benefits.
9. Ayurveda health tourism improves political friendship.
10. Promotion of Ayurvedic health tourism ensures development in infrastructural facilities, such as job and employment opportunities in various sectors, particularly in hotel logistics and transportation industry.

Suggestions

1. Ayurveda is one of the most commonly accepted health resources all through the world. However, it is lacking in commonalities in its different aspects. Thus, there is an utmost need to develop globally accepted standards in terms of guidelines and classifications, as well as integrate Ayurveda into the health system. This will enable one to compare the data on various facets of Ayurveda. Standardization of services should be ensured.
2. Most of the Ayurveda literature is available in Sanskrit and Hindi languages, which needs to be translated into at least major languages being spoken across the globe.
3. Research in Ayurveda should be strengthened to bring preciseness in diagnosis, treatment and recognition of medicinal effectiveness.
4. Enhancement of both preventive caring facilities and the production of curative medicine should be ensured in Ayurveda.
5. An entrepreneurial attitude should be developed among those involved in the field of Ayurveda.

6. A regular supply of input/raw materials for the production of Ayurvedic medicine should be ensured.
7. Traditional skills related to Ayurveda should be documented and preserved properly.
8. Quality control measures in the field of Ayurveda should be initiated.
9. Ayurveda treatment centers should be provided with basic infrastructure and facilities including land, water and electricity supply, loans on low-interest rates, concessions in medicinal sales tax, marketing facilities etc.
10. Indian brands in Ayurveda should be built abroad to strengthen the marketing of Ayurvedic medicines, devices and services.
11. Inter-sectorial coordination between the health and tourism sectors should be promoted.
12. Information on the advantages of Ayurveda should be disseminated by means of appropriate broadcasting technology.
13. A traveler's traveler-friendly scheme for receiving medical visas should be implemented in order to make the process of travel smoother across international borders.
14. A provision should be made to extend visas depending on the health condition of the traveler.
15. Governments should play a crucial role in the development of Ayurvedic health tourism.
16. Ayurvedic health tourism can be developed by adapting Public-private partnerships.

Conclusion

Ayurvedic health tourism is not new to India. In this country, it has been practiced since time immemorial. Nowadays it is gaining a lot of popularity as people are health-conscious and interested in seeking quality health services at low cost and without any side effects. Efforts are being made by the government of India, non-government organizations, and at the individual level to popularize Ayurvedic health tourism. The study revealed that, in spite of many efforts, Ayurvedic health tourism is not developed at its full potential. Thus, there is an utmost need for its popularization by using social media. Government and non-governmental organizations should make special efforts to utilize the country's full potential of Ayurvedic health tourism by adopting a policy of Public-private Partnership.

Limitations of the Study

Due to the paucity of sufficient data on Ayurvedic health tourism in India, the present study relies on the theoretical information obtained from secondary sources. It limits the use of suitable statistical and cartographic techniques in this paper.

Acknowledgment

Authors are highly grateful to the tour organizers and in charge of Ayurvedic health care centers for sharing their views, opinions and experiences on the present scenario of Ayurvedic health tourism in India.

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ISBN - 978-93-5725-793-0

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Schemes for Empowerment of Women in India

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DOI- 10.5281/zenodo.7701295

Abstract

The present paper attempts to understand the efforts taken by the government for women empowerment in India. It studies various government schemes framed and implemented for women empowerment. Based on secondary data obtained from various sources like government publications and research articles, this theoretical paper concludes that there is a dire need of framing suitable women empowerment schemes and their proper implementation. Reliable and detailed information on these schemes should be reached to needy women and their groups at its earliest. Government should support and monitor such schemes for their effective implementation. Individual and organizational participation in the implementation of such schemes is of great help.

Key Words: Women, Empowerment, Schemes, Government, India.

Introduction:

Women empowerment refers to increasing the spiritual, political, social, educational, gender, or economic strength of individuals and communities of women (Thakur S. and Naikoo, A. 2016). It is a multi-dimensional process that involves personal, social, psychological, economic, and political aspects (Panday, N. 2014). Women's empowerment is a new phrase in the vocabulary of gender literature. The phrase is used in two broad senses i.e., general, and specific. In a general sense, it refers to empowering women to be self-dependent by providing them access to all freedoms and opportunities, which they were denied in day-to-day because of their being women. In a specific sense, women's empowerment refers to enhancing their position in the power structure of society. The word women empowerment essentially means that women have the power or capacity to regulate their day-to-day lives in social, political and economic terms -a power which enables them to move from the periphery to the center stage (Mamanshetty S., 2018). The need for women empowerment arose because of the discrimination and male domination in Indian society since ancient times. Women are being suppressed by their family members and society for many reasons. They have been targeted for many types of violence and discriminatory practices by the male members in the family and society in India and other countries as well. Wrong and old practices for men in society from ancient times have taken the form of well-developed customs and traditions. There is a tradition of worshipping many female goddesses in India including giving honours to the women forms in the society like mothers, sister, daughters, wives and other female relatives or friends. But it does not mean that only respecting or honouring women can fulfil the need

for development in the country. It needs the empowerment of the rest half population of the country in every walk of life (Shireesha, E. 2021). With this background, the present study attempts to understand the schemes for women's empowerment in India.

Objectives:

The main aim of the present study is to understand the efforts taken by the government for women empowerment in India. This has been achieved with the help of following objectives:

1. To study the government schemes for women empowerment in India.
2. To provide useful suggestions for the effective implementation of women empowerment schemes in the country.

Materials and Methods

The present paper is descriptive in its nature. It utilizes the secondary data obtained from various sources like government publications, research articles and information available on social media.

Results and Discussions

The present study reveals that there are various schemes of state and central government being implemented for the empowerment of women in India. Some of the important schemes with their objectives with beneficiary selection criteria are given below:

1. Beti Bachao Beti Padhao Scheme

In view of addressing the concerns of gender discrimination and women empowerment in the country, the government of India introduced the Beti Bachao, Beti Padhao scheme in 2015 with an initial funding of Rs. 100 crores. The meaning of Beti Bachao, Beti Padhao is to 'Save the girl child, educate the girl child'. This scheme aims at educating citizens against gender bias and improving the effectiveness of welfare services for

girls. This scheme was introduced after the national census results for 2011 revealed a detraction of Child Sex Ratio and Sex Ratio at Birth. The child Sex Ratio is defined as the number of girls per 1,000 boys with 0-6 years age. This ratio has showcased a steady decline, from 945 in 1999 to 918 girls for every 1,000 boys in 2011. It was found that the Sex Ratio at Birth was the main factor behind this. Gender-biased sex-selective abortion and post-birth discrimination in neglecting the health, nutrition, educational and economic needs of the girl child were the main causes of the declining sex ratio in the country. It was observed that the socio-cultural and religious preference for boys was the basic cause of the declining sex ratio and this was the motive behind launching Beti Bachao, Beti Padhao Scheme for girls in the country.

The main objectives of this scheme are as follows:

1. To Improve the child-sex ratio
2. To ensure gender equality and women empowerment in the country
3. To prevent gender-biased, sex-selective abortions.
4. To ensure the survival, protection and fitness of girl child
5. To encourage education and participation of the girl child.

2. Mahila police Volunteers

Ministry of Women and Child Development in collaboration with the Ministry of Home Affairs has envisaged the engagement of Mahila Police Volunteers in the States and Union Territories who will act as a link between police and community to help victimised women. Chief Secretaries of States and Union Territories were instructed to adopt this inventiveness in their concerned States. During the financial year 2016-17, the state of Haryana adopted this scheme for the districts of Karnal and Mahendergarh. Thus, Haryana was the first state in the country to implement this scheme. This was followed by the sanction of proposals forwarded by the states of Andhra Pradesh, Jharkhand, Gujarat, Mizoram, Chhattisgarh, Karnataka and Madhya Pradesh for the implementation of the Mahila Police Volunteers scheme. In fact, this scheme is implemented by the central government. However, it should be implemented by state governments and Union Territories with substantial financial and administrative participation. The Central Women and Child Development Ministry actively pursue the State Governments and Union Territories administrations for the effective implementation of this Scheme.

3. Mahila Shakti Kendras (MSK)

Mahila Shakti Kendra Scheme was approved by the government for the period from 2017-18 to 2019-20. Empowerment of rural women through community participation was the main purpose of implementing this scheme in the country. The scheme is envisaged to be implemented at both national and state levels. Community engagement through College Student Volunteers is envisioned in 115 most backward districts as part of the Block Level initiatives. Student volunteers were instrumental in women's awareness of important government schemes, developmental programs and related social issues. District Level Centre for Women has also been envisaged for 640 districts to be covered in a phased manner, these centres served as a link between village, block and state levels in facilitating women-centric schemes. Under the Scheme, State Resource Centre for Women is provided for all States and Union Territories, District Level Centre for Women in 640 districts were to be covered in a phased manner (220 districts during 2017-18, 220 more in 2018-19 and the remaining 200 districts in 2019-20) and Block Level initiative to be focussed in 115 most backward districts covering 8 blocks in each district. The Scheme is implemented through the State Government and Union Territory Administration with a cost-sharing ratio of 60:40 between centre and states except for NE and Special Category States where funding ratio is 90:10.

4. Nari Shakti Puraskar

It is an annual award given by the Ministry of Women and Child Development of the Government of India to individual women or the institution or NGOs that are taking efforts for women empowerment in the country. It is the topmost civilian honor for women in India and is presented by the president of India on 8th March (International Women's Day) at Rashtrapati Bhavan in New Delhi. This award was introduced in the year 1999 as a Stree Shakti Puraskar, which was renamed and reorganised in the year 2015. This puraskar is being awarded in six institutional and two individual categories, which carry a cash prize of Rs. 2,00,000 and 1,00,000 rupees, respectively.

5. Nirbhaya

The Government of India has set up a special fund called the 'Nirbhaya Fund' for taking initiatives aimed at ensuring the safety and security of women in the country. An Authorized Committee of officers constituted under the Nirbhaya Framework assesses and recommends the proposals for providing financial support under Nirbhaya Fund in combination with the concerned Ministries, Departments, or Implementing Agencies. After

appraisal by the Committee, the concerned Ministries or Departments obtain approval from their respective and competent financial authorities to release funds and implement the approved projects or schemes directly or through States or Union Territories or Implementing Agencies. Under the Nirbhaya Fund, the “One Stop Centre Scheme” is being implemented across the country since 1st April 2015. One Stop Centre Scheme aims at facilitating women affected by violence with a range of integrated services under one roof such as Police facilitation, medical aid, providing legal and psycho-social counselling and temporary shelter. One Stop Centre Schemes are to be set up within a 2 km radius of the hospitals or medical facilities either in newly constructed buildings in an approved design or in pre-existing buildings. Under the scheme, one Stop Centres are being set up in all districts of the country.

6. Pradhan Mantri Matru Vandana Yojana (PMMVY):

Pradhan Mantri Matru Vandana Yojana is a Centrally Sponsored Conditional Cash Transfer Scheme, for its implementation across the country with effect from 1st January 2017. The maternity benefit under this scheme is available to all Pregnant Women and Lactating Mothers, excluding Pregnant Women and Lactating mothers, who are in regular employment with the Central Government or the State Governments or Public Sector Undertakings or those who are getting similar benefits under any law for the time being in force, for a first living child of the family. Under this scheme, financial support of Rs.5,000/- is provided to the eligible beneficiary in suitable instalments during pregnancy and lactation in response to an individual fulfilling certain nutrition and health-seeking conditions. The deserving and eligible beneficiary also receives the remaining cash incentive as per approved norms towards maternity benefits under Janani Suraksha Yojana after institutional delivery so that on an average, a woman gets financial assistance of rupees six thousand only.

7. Pradhan Mantri Ujjwala Yojana (PMUY):

Pradhan Mantri Ujjwala Yojana aims at protecting the health of women and children by providing them with clean cooking fuel viz. Liquefied Petroleum Gas, so that, they don't have to compromise their health in kitchens filled with smoke or walk in risky areas for the collection of firewood. This scheme was launched by the Hon'ble Prime Minister of India on 1st May 2016 in Uttar Pradesh at Ballia. Under this scheme, in all five crores connections of Liquefied Petroleum Gas were expected to be provided to Below Poverty Level families. Ensuring

the empowerment of women, particularly in the rural parts of the country, the connections are being issued in the name of women of the households.

8. Sakhi Niwas

Today, a substantial number of women are leaving their usual place of residence in search of jobs and employment opportunities in large cities and industrial clusters of the country. One of the crucial problems faced by these women is the dearth of safe and suitably located housing facilities. Considering this fact, the government of India thus introduced a scheme in 1972-73 of grant-in-aid for the construction of a new structure or the expansion of existing buildings for providing hostel facilities to working women in cities, towns and even in rural parts of the country where employment opportunities for women are available. Based on the study, the existing scheme has been revised to promote the availability of safe and suitably located accommodation facilities for working women who need to live far from their families due to perform their professional duties. The hostels constructed under this scheme for working women shall be made available to all working women without any discrepancy with respect to caste, creed, color, religion, material, and social status etc., subject to norms set under the scheme. Women under training for the job may also be conditionally lodged in such hostels. This scheme covers working women, who may be single, widowed, divorced, separated, or married but whose husband or immediate family does not reside in the same city, Women who are under training for a job provided the total training period does not exceed one year. This is only on the condition that there is a vacancy available after accommodating working women. The number of women under training for jobs should not exceed 30% of the total capacity. Girls up to the age of 18 years and boys up to the age of 5 years, accompanying working mothers will be provided accommodation, with their mothers.

9. Swadhar Greh (A Scheme for Women in Difficult Circumstances)

Swadhar Greh is a scheme implemented by the Ministry of Women and Child Development, Government of India, to provide short-stay accommodation facilities and rehabilitation services to women who are in difficult circumstances such as destitute, deserted by their husbands, failure, victims of natural disasters and women released from jail without family support. Swadhar Greh provides a supportive and protective environment to these women and offers a range of services such as shelter, food, clothing, and counselling services to help them regain their emotional strength and

financial independence. The scheme also offers skill development and training programs to women in view of enhancing their employability and provides legal aid and support services to help them address their legal issues. Swadhar Greh aims to promote self-reliance and empower women to live dignified life. This scheme is being implemented across the country through non-governmental and other organizations. Under the Scheme, Swadhar Greh will be made available in every district with a capacity of 30 women with the following objectives:

1. To cater to the fundamental need for food, clothing, shelter, medical treatment, and care of women in distress and who are without any socio-economic support.
2. To enable these women to recover their emotional strength that gets hindered due to their encounters with undesirable situations.
3. To support them with legal aid and guidance for enabling them to take steps for their readjustment in their own family and also in the society in which they live.
4. To do their economic and emotional rehabilitation.
5. To act as a foundation that comprehends and fulfils various requirements of women in distress.
6. To empower these women to start their life afresh with dignity.
7. The following strategies can be adopted to achieve the objectives of the scheme:
8. Temporary accommodation facilities with the provision of food, clothing, medical facilities etc.
9. Professional and skill gradation training for economic rehabilitation of these women
10. Counselling, awareness creation and behavioural training
11. Legal aid and Guidance
12. Counselling through mobile and telephone.

10. Women Helpline Scheme

The Scheme of Women Helpline is intended to provide 24-hour, immediate and emergency response to women affected by violence through referral, linking with appropriate authorities such as police, One Stop Centre, hospital and information about women-related government schemes and programs across the country through using a single number.

Suggestions

1. The details of women empowerment schemes should be reached up to needy women. It can be achieved through the effective use of electronic, print, and social media.

2. constant monitoring and unceasing financial assistance should be ensured for the effective implementation of women empowerment schemes.
3. Government should continuously monitor the implementation of these schemes.
4. Physical and mental health of women should be ensured by framing and implementing suitable women empowerment policies.
5. Strict implementation of the women-related legislature should be ensured.

Conclusion

The study concludes that the present status of Indian women is not as good as it should be. Thus, there is a dire need for framing and implementing various schemes and programs in favour of women's empowerment in India. Though there is a variety of women empowerment schemes available, the government, NGOs and individuals should ensure their effective implementation.

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ISBN: 978-81-959050-4-1

**NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS
SUSTAINABLE DEVELOPMENT**



Dr. Shantaram G. Baviskar
Dr. Manisha S. Pawar

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Fern International Publication Pune
Govt. Regd. No. UDYAM-MH-32-0072613
Malshiras, Dist-Solapur (MS), India
and
Sr.No.-48/60/1/3, Swapnapurti Niwas Yerwade Vasti, Vadgaon
Budruk, Pune, Pin-411041
Email- fppune2003@gmail.com



Price-750

Natural Sciences and Environmental Awareness towards Sustainable Development

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Fern International Publication Pune

Natural Sciences and Environmental Awareness towards Sustainable Development

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Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

E-mail: fppune2003@gmail.com

Publisher Address

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras,
Solapur, 413107

Mob- 888454089

and

Amitsons Digital Copier, Pune Swargate

106, Paras Chamber, 1st Floor, Above Bank Of

India, Near Laxminarayan Theatre, Swargate, Pune- 411009

Mob-7058486065

Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
India, Near Laxminarayan Theatre,
Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

Copyright: Jyoti K. Mane

Publication Date: 20/10/2023

Price: 1000

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The Future of Agriculture in India

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Abstract

Agriculture in India is still providing a livelihood to the majority of the country's population and is the backbone of India's self-sufficiency in food grains. However, the last two decades have seen India go through a severe farming crisis and record lower-than-expected agricultural growth. Considering this fact, the present paper attempts to investigate the current scenario of Indian agriculture, the constraints of agricultural development and it also anticipate the decisive trends in the agricultural sector. The paper, based on both primary information and secondary data, reveals that, though efforts are being taken to improve the agricultural conditions in India, there is an urgent need to accept a holistic approach to the development of this sector.

Keywords: Future, India, Agriculture, Sustainable, Technology.

Introduction

Agriculture is a diverse sector and its major sub-sectors are crops, livestock, fishery and forestry (GoI, 2023 a). In India, the agricultural industry is significant (Saini P. et. al. 2022). It is the backbone of India's national economy and a mainstay of livelihood for the majority of households; thus, it can never be underrated. It is agriculture that feeds the country's population (Bethu, S. 2016). Though the contribution of agriculture to the gross domestic product has declined over decades, it shows remarkable growth. Nevertheless, agricultural production is still expected to increase so that the population of the country should be well nourished. The demand for agricultural produce has risen throughout time as the country's population has grown and the need for food security has increased (Biswas, S. 2022). The rapid growth of population and the rising purchasing capacity of individuals in the country have created a large demand for nutritious food. In addition, globalization has allowed the supply of agricultural produce to the international market. This has placed tremendous pressure on the country's

agricultural sector. India's agricultural economy has undergone structural changes; the GDP share of agriculture has fallen. This isn't because of the reduced importance of agriculture, or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and non-agricultural sectors in India (Sharma, B. 2016). India is bestowed with vast arable land which is characterised by a variety of soils and agro-climatic conditions making the country capable of producing numerous crops. Today, the country has been recognized as a top producer of certain agricultural products including milk, spices, pulses, tea, cashews and jute, while it is the second-largest producer of rice, wheat, oilseeds, fruits, vegetables, sugarcane and cotton. Regardless of all these facts, the productivity of many crops in the country is low if compared with the productivity in many developed countries. Furthermore, India's population in 2023 stands at 142.86 crore, according to the United Nations Population Fund data. India has overtaken China, which has 142.57 crore, to become the most-populous country in the world. Providing quality and nutritious food for such a huge population has now become a major issue for India. Today, the majority of Indian farmers are facing a variety of glitches including high input costs, low productivity, low-income levels and weak agricultural marketing. Whereas, the concept of agricultural marketing includes many activities starting from the production process to its retailing (Yakanna, A. 2017). In India, both public and private sectors are making efforts to improve the conditions of agriculture. India's membership and commitment to the World Trade Organization (WTO) in 1995 was a clear sign of India's intention to take advantage of globalization and face the challenge of accelerating its economic growth (Mahadevan, 2003). Today, there are four main sources of demand for agricultural produce including food for human population, feed and fodder for livestock, feedstock for energy and raw material for industrial and non-agricultural uses (GoI, 2023 b). All these sources should be taken into account while planning for sustainable agriculture. With this background, an attempt has been made in this paper to discuss the futuristic trends in Indian agriculture.

Objectives

1. To understand the present scenario of Indian Agriculture.
2. To recognize the major constraints of Agricultural Development in India.
3. To anticipate decisive trends in the Agricultural Sector

Data and Methodology

The present study is based on both primary information and secondary data. Government reports, private publications, news articles and research papers were referred to as secondary sources of data. While, farming respondents were interviewed to obtain primary information.

Result and Discussion

Major constraints of agricultural development

Though most of the Indian population is dependent on agriculture, this sector of the national economy has multiple constraints. Agriculture in India is dependent on the vagaries of Monsoon and the average size of land holding in the country is small. Thus,

most of the farmers are either small or marginal. The agriculture in India is mainly intensive substance type. It is labor-dependent and characterized by several annoying anomalies including soil erosion and salinization, locust infestation, outbreak of diseases, low agricultural productivity, harmful effects of climate change, high cost of agriculture inputs, price fluctuation of agricultural produce, inadequate access to credit supply, less value addition, lack of commercialization and shortage of monetary investment. In India, high risks involved in the process of crop cultivation are pushing farmers out of the agriculture sector. Thousands of farmers, particularly in the states of Maharashtra, Telangana, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh have committed suicide due to financial losses. There is inadequate monetary investment in agricultural education, research and extension. Agricultural infrastructure including transportation and storage facilities, electricity supply, marketing and credit support system is not well-organized. The shortage of agro-processing services in the country has resulted in the wastage of agricultural produce and the country experiences huge post-harvest losses. Several agro-processing industries in India are not working efficiently, some of the sugar factories, cotton textile and spinning mills are closed down. There are some agro-based industries in the country that are not in a position to pay reasonable prices for the agricultural produce being used as raw materials by these industries. Agro-based industries in India are not yet developed up to the extent of their full potential. If developed properly, these industries may provide substantial employment opportunities, especially to the rural youth. Loss of agricultural produce during the process of harvesting, transportation and storage is one of the usual problems, the farmers of India face. There is a dearth of low-cost farm technology and the majority of the farmers have less access to advanced technology.

Anticipation of Decisive Trends in Agriculture

The paradigm shift in agriculture will set decisive trends in agricultural development in the near future. Some of the futuristic trends are given below.

1. In India, where ever possible, efforts will be made to bring barren lands under cultivation. The available resources will be used judiciously and efficiently by adopting appropriate technology. The use of non-conventional energy resources including solar, wind, hydroelectricity and biomass energy will be increased.
2. As a part of the time-saving strategy, people will be giving priority to processed, ready-to-eat, affordable and packaged food material, which will lead to the establishment of more agro-processing industries.
3. Rising preferences for healthy, pure and nutritious food would lead to the growth of sustainable agricultural practices including organic farming.
4. Research, technological improvements and protected cultivation of high-value crops will be strengthened.
5. There will be an introduction and widespread use of new technology in agriculture including harvesters, sugarcane-cutting machinery, efficient irrigation systems etc.
6. Improvement in the standard of living, reduction in poverty, effects of globalization and increasing health consciousness in India have led to the changing demand for

agricultural produce. Demand for non-grain food items including milk and milk products, eggs, meat, fish, vegetables and fruits will increase over the course of time.

7. Biotechnology will be used efficiently to develop drought-tolerant, high-yielding, eco-friendly and disease-resistant crop varieties and nutritious food will be produced. This will need sound investment in agricultural research.

8. Competition among the private and government companies will bring innovative and low-cost products, improved seed varieties, high-quality fertilizers, customized farm equipment and nutritious cattle feeds to the market.

9. Most of the retail trade in agriculture will be digitalized. Online Shopping of agricultural products including food items and items required in the form of agricultural input including Seeds, Fertilizers, Pesticides, Plant Growth Regulators, Irrigation and Farming Tools and Equipment with reasonable Prices, Customer Support and free home delivery will be ensured.

10. In view of making agriculture easy, gainful and environmentally friendly, efforts will be made by the government, Farmer's Producer Organizations (FPO), private companies, corporate and cooperatives to bring preciseness in farming using computer-aided technology (CAT), Electronic Commerce (e-Commerce), Artificial Intelligence (AI), Remote Sensing (RS), Global Positioning System (GPS), Geographic Information Systems (GIS), Internet of things (IoT), Nano Technology, drones and robots. Soil testing-based decisions will be taken while selecting a variety of crops to be grown and scheduling the application of water and fertilizers. This will ensure the efficient use of agricultural inputs, minimize the wastage of agricultural products, increase food production and enhance food quality and food safety.

11. Digital connectivity in the near future will play an important role in creating awareness among farmers. It will be successfully helpful in information sharing and implementation of government schemes. Digital technology will also increase farmers' connectedness with different stakeholders.

12. Efforts will be made to balance the supply of Agri-inputs with the demand for it. Prices of Agri-inputs will be stabilized by using crop-specific small equipment, avoiding food wastage, providing cheap and speedy transportation facilities, increasing the number of warehouses, establishing linkages between private and public sectors, developing local markets and stabilizing the market prices of agricultural products.

The future of agriculture in India is a cause of concern for administrators, planners, politicians and agricultural scientists of the country. Government, Non-Governmental Organizations (NGO's), Management and Research Institutions are making efforts to address the crucial challenges of agriculture in the country counting per capita less availability of arable land, sub-standard processing of agricultural products, inefficient and broken supply chain, inadequate use of farm technology, lack of infrastructure to support the efficient use of natural and human resources and inadequate market facilities. There is an utmost need to work on the development of cost-effective technologies ensuring environmental protection and conserving natural resources. Liberalization, Privatization and Globalization (LPG) are the strategies that were adopted

by the government of India under its new economic policy in 1991 which has affected the input markets rapidly. Reforms in agricultural marketing have made changes in the promotion of agricultural products, as permission for private investment and contract farming were granted. In addition, the developments in information technology, the introduction of advanced farm technology, investments in research and development by private agencies and the efforts taken by the government to invigorate the cooperative movement in the country to address the problems of agriculture sectors and crop cultivators are changing the appearance of Indian agriculture. Many startups related to logistics services, cold storage facilities, supply of farm fresh food to urban residents, production of organic food, promotion of commerce between buyers and sellers, weather prediction, delivering information on fertilizers and pesticides, providing technical support, resource planning in agriculture by youth shows that now they are capable of appreciating the importance of putting efforts and money in the agriculture sector. The development of technology in the near future will definitely improve the functioning of Indian agriculture. Limitations of the agriculture sector make the yields and outputs complex, however; still there is a wide scope for tapping untouched potential in the country to enhance the agricultural industry. Useful weather and soil conditions, growing demand for food and other agricultural products, unexploited opportunities in farming, subsidies and financial incentives provided by the government, development and maintenance of infrastructure, marketing and export promotion are attracting a large number of individuals, big multinational companies, startups and entrepreneurial ventures to ensure required investments in innovations, development of new technology, research, training and extension in the field of agriculture. Efforts are being made by the central and state governments, NGOs, private firms, research laboratories, management institutions and cooperative sectors to transform challenges faced by agriculture into opportunities. This transformation taking place across the country will ensure the bright future of Indian agriculture.

Suggestions

1. In India, high crop productivity should be ensured by adopting new technology and effective management systems.
2. Enhancement of soil quality and improvement in soil fertility has to be given priority
3. Rational use of resources, irrigation augmentation and its efficient management have to be guaranteed.
4. The agricultural credit system and crop insurance schemes should be strengthened.
5. Attention should be paid to the enhancement of market system.
6. Reasonable prices should be ensured for the agricultural produce.

Conclusion

In India, the growing population, increasing per capita income, reduction in poverty, improved standard of living and the effects of globalization have posed the rising demand for nutritious and a variety of good quality food materials in abundance. The holistic approach if adopted towards agricultural development including the enhancement in agricultural productivity, production of good quality food, resource

conservation, strengthening of the storage system, provision of finance, use of suitable marketing strategies and efficient, reliable, secured transportation facilities will definitely brighten the future of Indian agriculture.

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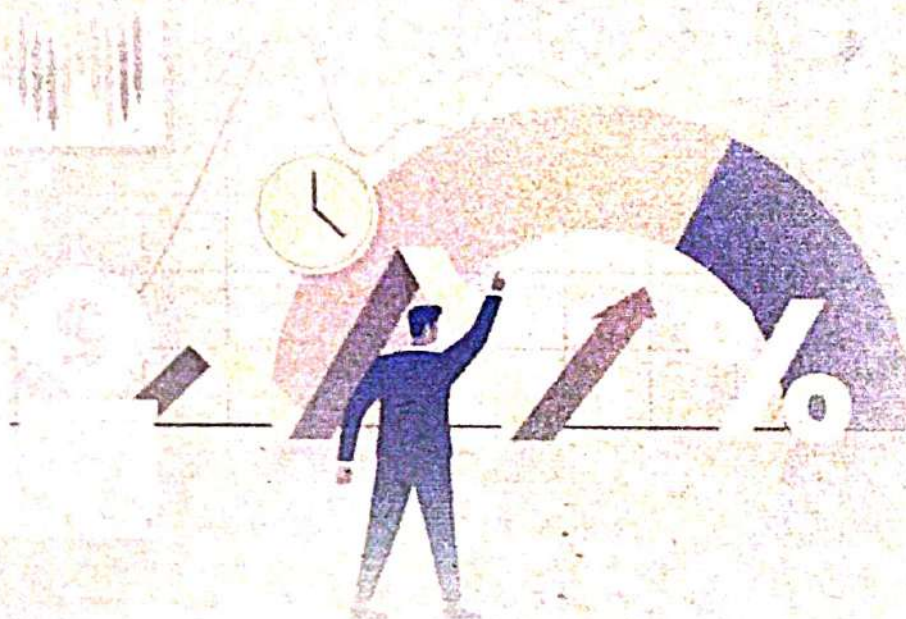
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Published & Printed by : Sheth Publishers Private Ltd., Unit No. 4, Ground Floor,
Lalwani Industrial Estate, 14, G.D. Ambekar Marg, Wadala, Mumbai - 400 031
☎ 6662 4553 / 6662 4554 FAX : 6662 4556.

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**S.Y.B.Sc. (C. S.)
SEMESTER - IV (CBCS)**

SOFTWARE ENGINEERING

SUBJECT CODE: USCS404

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June 2023, Print - 1

Published by : Director,

Institute of Distance and Open Learning,
University of Mumbai,
Vidyanagari, Mumbai - 400 098.

DTP composed and Printed by: Mumbai University Press

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S.Y.B.Sc. (C. S.)
SEMESTER - IV (CBCS)
SOFTWARE ENGINEERING
SYLLABUS

Course: USCS404	TOPICS (Credits : 02 Lectures/Week: 03) Software Engineering	
Unit I	Introduction: The Nature of Software, Software Engineering, The Software Process, Generic Process Model, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Component-Based Development, The Unified Process Phases, Agile Development- Agility, Agile Process, Extreme Programming Requirement Analysis and System Modeling: Requirements Engineering, Eliciting Requirements, SRS Validation, Components of	15L
	SRS, Characteristics of SRS , Object-oriented design using the UML - Class diagram, Object diagram, Use case diagram, Sequence diagram, Collaboration diagram, State chart diagram, Activity diagram, Component diagram, Deployment diagram	
Unit II	System Design: System/Software Design, Architectural Design, Low-Level Design Coupling and Cohesion, Functional-Oriented Versus The Object-Oriented Approach, Design Specifications, Verification for Design, Monitoring and Control for Design Software Measurement and Metrics: Product Metrics – Measures, Metrics, and Indicators, Function-Based Metrics, Metrics for Object-Oriented Design, Operation-Oriented Metrics, User Interface Design Metrics, Metrics for Source Code, Halstead Metrics Applied to Testing, Metrics for Maintenance, Cyclomatic Complexity, Software Measurement - Size-Oriented, Function-Oriented Metrics, Metrics for Software Quality Software Project Management: Estimation in Project Planning Process –Software Scope And Feasibility, Resource Estimation, Empirical Estimation Models – COCOMO II, Estimation for Agile Development, The Make/Buy Decision, Project Scheduling - Basic Principles, Relationship Between People and Effort, Effort Distribution, Time-Line Charts	15L

Unit III	Risk Management - Software Risks, Risk Identification, Risk Projection and Risk Refinement, RMMM Plan Software Quality Assurance: Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Six Sigma, Software Reliability, The ISO 9000 Quality Standards, Capability Maturity Model Software Testing : Verification and Validation, Introduction to Testing, Testing Principles, Testing Objectives, Test Oracles, Levels of Testing, White-Box Testing/Structural Testing, Functional/Black-Box Testing, Test Plan, Test-Case Design	15L

Text book(s):

- 1) Software Engineering, A Practitioner's Approach, Roger S, Pressman.(2014)

Additional Reference(s):

- 1) Software Engineering, Ian Sommerville, Pearson Education
- 2) Software Engineering: Principles and Practices",Deepak Jain,OXFORD University Press,
- 3) Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI
- 4) Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons
- 5) A Concise Introduction to Software Engineering, Pankaj Jalote, Springer

INTRODUCTION

Unit Structure :

- 1.0 Objectives
- 1.1 Introduction
- 1.2 The Nature of Software
- 1.3 Software Engineering
- 1.4 The Software Process
- 1.5 Generic Process Model
- 1.6 The Waterfall Model
- 1.7 Incremental Process Models
- 1.8 Evolutionary Process Models
- 1.9 Component-Based Development
- 1.10 The Unified Process Phases
- 1.11 Agile Development- Agility
- 1.12 Agile Process
- 1.13 Extreme Programming
- Let us Sum Up
- List of References
- Bibliography
- Unit End Exercises

1.0 OBJECTIVES

After going through this chapter, you will be able to:

- Software
- Software Engineering
- Different Process Models used in software Engineering

1.1 Introduction

The end product that software developers create and provide ongoing support for is computer software. It includes computer programmes that run on machines of every size and architecture, content displayed while computer programmes run, and descriptive data in both physical and digital formats that cover almost any electronic medium. Software engineers can create high-quality computer software through the use of a methodology, a set of techniques, and a variety of tools.

1.2 THE NATURE OF SOFTWARE

Software serves two functions. It is both a product and a vehicle used to transport a product. As a product, it provides the processing power embodied by computer hardware or, more broadly, by a network of

computers accessible via local hardware. Software is an information transformer, whether it is found in a mobile phone or a mainframe computer. It produces, manages, acquires, modifies, displays, or transmits data. As the vehicle used to deliver the product, software serves as the foundation for computer control (operating systems), information communication (networks), as well as the creation and control of additional programs (software tools and environments).

1.2.1 Defining Software

- Software is instructions (computer programs) that when executed provide desired features, function, and performance.
- Software is developed or engineered; it is not manufactured in the classical sense
- **Software doesn't "wear out".**
 - When something is no longer of any use, it reaches the "wear out" state. That is, it can not perform the function it was built for. For example, a printer reaches "wear out" state and it can't print anymore. This doesn't include the recycling options. One makes use of a dead printer to do anything else but printing.
 - On the other hand, software does not wear out. Like hardware, software also shows a high failure rate at its infant state. Then it gets modifications and the defects get corrections and thus it comes to the idealized state. This idealized state continues.
 - alternative software with implementation of current user demands can replace a software. Though, not having a recent feature is not a defect, users tend to use the latest alternatives. If we consider this as failure for the software then the failure rate increases with time. This will make the software deteriorate due to change, but still the software can perform its operation as it was performing in the beginning. That is why software doesn't wear out.

1.2.2 Software Application Domain

There are seven categories of software

1. **System software:** is a collection of programs written to service other programs. Some system software (e.g., compilers, editors, and file management utilities) processes complex, but determinate, information structures. Other systems applications (**e.g. Operating system components, drivers, networking software, telecommunications processors**) process largely indeterminate data.
2. **Application software:** is a stand-alone program that solves a specific business need. Applications in this area process business or technical data in a way that facilitates business operations or management/technical decision making. One of the significant and

essential things to note about application software is that it cannot run independently. To run application software, you have to use a system platform capable of supporting it.

3. **Engineering/scientific software:** has been characterized by “number crunching” algorithms. Applications range from astronomy to volcanology, from automotive stress analysis to space shuttle orbital dynamics, and from molecular biology to automated manufacturing.
4. **Embedded software:** resides within a product or system and is used to implement and control features and functions for the end user and for the system itself. **e.g., keypad control for a microwave oven, digital functions in an automobile such as fuel control, dashboard displays, and braking systems.**
5. **Product-line software:** It is designed to provide a specific capability for use by many different customers. Product-line software can focus mass consumer markets (e.g., word processing, spreadsheets, computer graphics, multimedia, entertainment, database management, and personal and business financial applications).
6. **Web applications:** It is called “WebApps,” this network-centric software category spans a wide array of applications. In their simplest form, WebApps can be little more than a set of linked hypertext files that present information using text and limited graphics.
7. **Artificial intelligence software**—makes use of nonnumerical algorithms to solve complex problems that are not amenable to computation or straightforward analysis. Applications within this area include robotics, expert systems, pattern recognition (image and voice), artificial neural networks, theorem proving, and game playing.

1.3 SOFTWARE ENGINEERING

- Software engineering is an engineering discipline that is concerned with all aspects of software production from the early stages of system specification through to maintaining the system after it has gone into use.
- Software Engineering is defined as the systematic approach to the development, operation, maintenance, and retirement of software.
- Software engineering is a layered technology. Referring to Figure 1.1, any engineering approach (including software engineering) must rest on an organizational commitment to quality. Total quality management, Six Sigma, and similar philosophies¹⁰ foster a continuous process improvement culture, and it is this culture that ultimately leads to the development of increasingly more effective approaches to software engineering.
- **Quality focus:** The bedrock that supports software engineering is a **quality focus**.

- **Process Layer:** The foundation for software engineering is the **process layer**. The software engineering process is the glue that holds the technology layers together and enables rational and timely development of computer software. Process defines a framework that must be established for effective delivery of software engineering technology. The software process forms the basis for management control of software projects and establishes the context in which technical methods are applied, work products (models, documents, data, reports, forms, etc.) are produced, milestones are established, quality is ensured, and change is properly managed.
- **Method:** Software engineering methods provide the technical how-to's for building software. Methods encompass a broad array of tasks that include communication, requirements analysis, design modeling, program construction, testing, and support. Software engineering methods rely on a set of basic principles that govern each area of the technology and include modeling activities and other descriptive techniques.
- **Tools:** Software engineering tools provide automated or semi automated support for the process and the methods. When tools are integrated so that information created by one tool can be used by another, a system for the support of software development, called computer-aided software engineering, is established

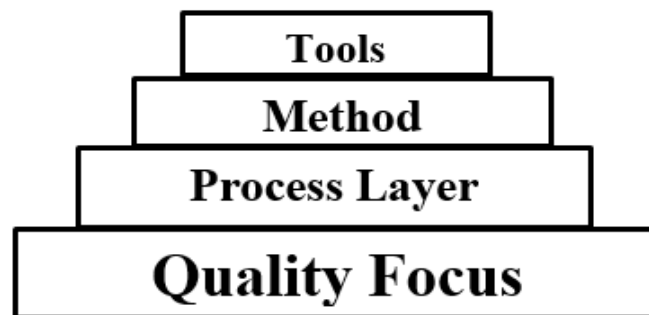


Fig 1.1 Software Engineering Layers

1.4 SOFTWARE PROCESS

- A process is a collection of activities, actions, and tasks that are performed when some work product is to be created.
- In the context of software engineering, a process is not a rigid prescription for how to build computer software. Rather, it is an adaptable approach that enables the people doing the work (the software team) to pick and choose the appropriate set of work actions and tasks. The intent is always to deliver software in a timely manner and with sufficient quality to satisfy those who have sponsored its creation and those who will use it.

- A process framework establishes the foundation for a complete software engineering process by identifying a small number of framework activities that are applicable to all software projects, regardless of their size or complexity.

Process Framework Activities:

For the purpose of illustrating typical process activities, the process framework is necessary. A process framework for software engineering lists five framework tasks. Framework activities include, for instance, planning, modeling, building, and implementation. A set of required work outputs, project milestones, and software quality assurance (SQA) points are included in each engineering action specified by a framework activity.

- **Communication:** By communication, customer requirement gathering is done. Communication with consumers and stakeholders to determine the system's objectives and the software's requirements.
- **Planning:** Establish engineering work plan, describes technical risk, lists resources requirements, work produced and defines work schedule.
- **Modeling:** Architectural models and design to better understand the problem and for work towards the best solution. The software model is prepared by:
 - o Analysis of requirements
 - o Design
- **Construction:** Creating code, testing the system, fixing bugs, and confirming that all criteria are met. The software design is mapped into a code by:
 - o Code generation
 - o Testing
- **Deployment:** In this activity, a complete or non-complete product or software is represented to the customers to evaluate and give feedback. On the basis of their feedback, we modify the product for the supply of better products.

Umbrella Activities:

Software engineering process framework activities are complemented by a number of umbrella activities. In general, umbrella activities are applied throughout a software project and help a software team manage and control progress, quality, change, and risk. Typical umbrella activities include:

- **Software project tracking and control**—allows the software team to assess progress against the project plan and take any necessary action to maintain the schedule. Risk management—assesses risks that may affect the outcome of the project or the quality of the product.
- **Software quality assurance**—defines and conducts the activities required to ensure software quality.

- **Technical reviews**—assesses software engineering work products in an effort to uncover and remove errors before they are propagated to the next activity.
- **Measurement**—defines and collects process, project, and product measures that assist the team in delivering software that meets stakeholders' needs; can be used in conjunction with all other framework and umbrella activities.
- **Software configuration management**—manages the effects of change throughout the software process.
- **Reusability management**—defines criteria for work product reuse (including software components) and establishes mechanisms to achieve reusable components.
- **Work product preparation and production**—encompasses the activities required to create work products such as models, documents, logs, forms, and lists

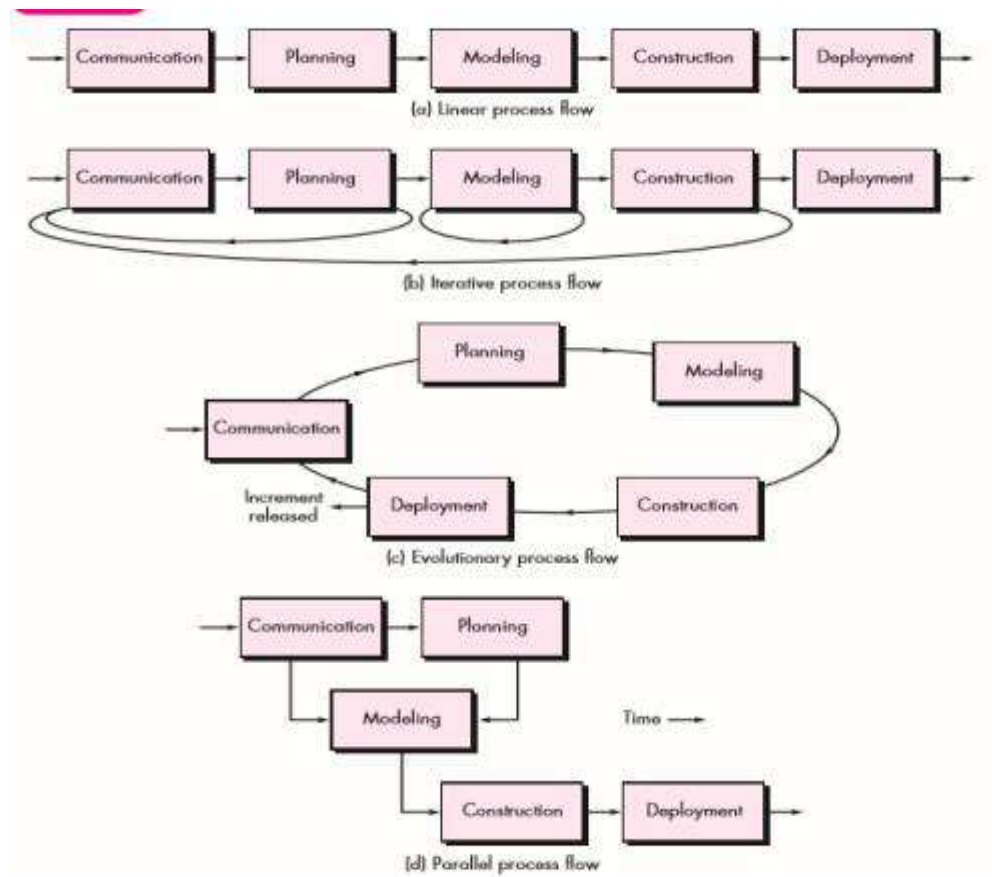
1.5 GENERIC PROCESS

A process was defined as a collection of work activities, actions, and tasks that are performed when some work product is to be created. Each of these activities, actions, and tasks reside within a framework or model that defines their relationship with the process and with one another. Each software engineering action is defined by a task set that identifies the work tasks that are to be completed, the work products that will be produced, the quality assurance points that will be required, and the milestones that will be used to indicate progress.

A generic process framework for software engineering defines five framework activities—communication, planning, modeling, construction, and deployment. In addition, a set of umbrella activities—project tracking and control, risk management, quality assurance, configuration management, technical reviews, and others—are applied throughout the process.

1. A linear process flow executes each of the five framework activities in sequence, beginning with communication and culminating with deployment (Figure 1.2 a).
2. An iterative process flow repeats one or more of the activities before proceeding to the next (Figure 1.2b).
3. An evolutionary process flow executes the activities in a “circular” manner. (Figure 1.2c).
4. A parallel process flow (Figure 1.2d) executes one or more activities in parallel with other activities.

Fig 1.2 Process Flow



Identifying a Task Set

- First, choose a task set that best accommodates the needs of the project and the characteristics of your team.
- A task set defines the actual work to be done to accomplish the objectives of a software engineering action.
 - ❖ A list of the task to be accomplished
 - ❖ A list of the work products to be produced
 - ❖ A list of the quality assurance filters to be applied

Process Pattern

- A process pattern describes a process-related problem that is encountered during software engineering work, identifies the environment in which the problem has been encountered, and suggests one or more proven solutions to the problem.
- In more general terms, a process pattern provides us with a template, a consistent method for describing problem solutions within the context of the software process. By combining patterns, a software team can solve problems and construct a process that best meets the needs of a project.

- Process pattern types-
 - Stage patterns — defines a problem associated with a framework activity for the process.
 - Task patterns — defines a problem associated with a software engineering action or work task and relevant to successful software engineering practice
 - Phase patterns — define the sequence of framework activities that occur with the process, even when the overall flow of activities is iterative in nature.

1.6 THE WATERFALL MODEL

The waterfall model, sometimes called the classic life cycle, suggests a systematic, sequential approach to software development that begins with customer specification of requirements and progresses through planning, modeling, construction, and deployment.

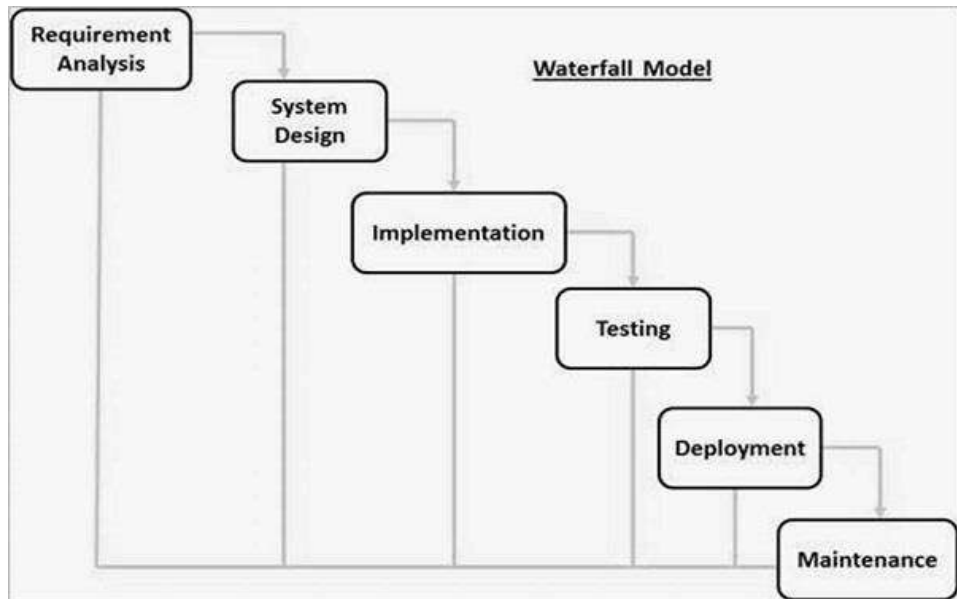


Fig 1.3 WaterFall Model

A variation in the representation of the waterfall model is called the V-model. Represented in Figure 1.4. As a software team moves down the left side of the V, basic problem requirements are refined into progressively more detailed and technical representations of the problem and its solution. Once code has been generated, the team moves up the right side of the V, essentially performing a series of tests (quality assurance actions) that validate each of the models created as the team moved down the left side.

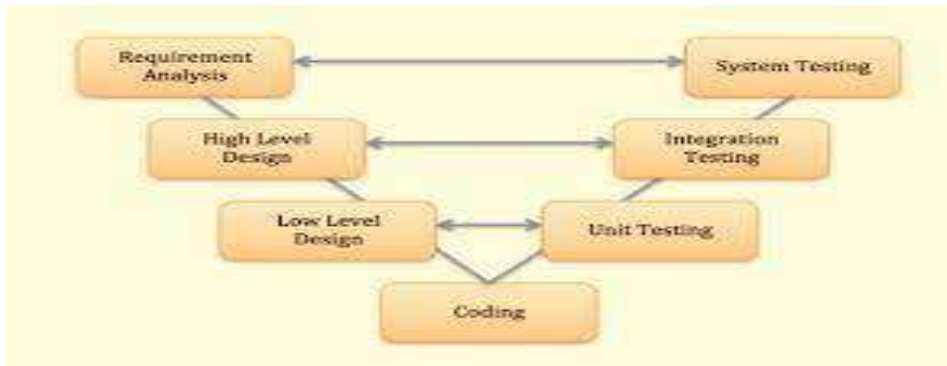


Fig 1.4 V-model

Advantages of waterfall model-

- This model works for small projects because the requirements are understood very well.
- The waterfall model is simple and easy to understand, implement, and use.
- All the requirements are known at the beginning of the project, hence it is easy to manage.

Disadvantages of the waterfall model

- The problems with this model are uncovered, until the software testing.
- The amount of risk is high.
- This model is not good for complex and object oriented projects.

1.7 INCREMENTAL PROCESS MODEL

The incremental model combines elements of linear and parallel process flows. Referring to Figure 1.5, the incremental model applies linear sequences in a staggered fashion as calendar time progresses. Each linear sequence produces deliverable “increments” of the software. When an incremental model is used, the first increment is often a core product. That is, basic requirements are addressed but many supplementary features (some known, others unknown) remain undelivered. The core product is used by the customer (or undergoes detailed evaluation). As a result of use and/or evaluation, a plan is developed for the next increment. The plan addresses the modification of the core product to better meet the needs of the customer and the delivery of additional features and functionality. This process is repeated following the delivery of each increment, until the complete product is produced. The incremental process model focuses on the delivery of an operational product with each increment. Early increments are stripped-down versions of the final product, but they do provide capability that serves the user and also provide a platform for evaluation by the user.

Advantages of incremental model

- This model is flexible because the cost of development is low and initial product delivery is faster.
- It is easier to test and debug during the smaller iteration.
- The working software generates quickly and early during the software life cycle. •
- The customers can respond to its functionalities after every increment.

Disadvantages of the incremental model

- The cost of the final product may cross the cost estimated initially.
- This model requires very clear and complete planning.
- The planning of design is required before the whole system is broken into small increments.
- The demands of customer for the additional functionalities after every increment causes problem during the system architecture.

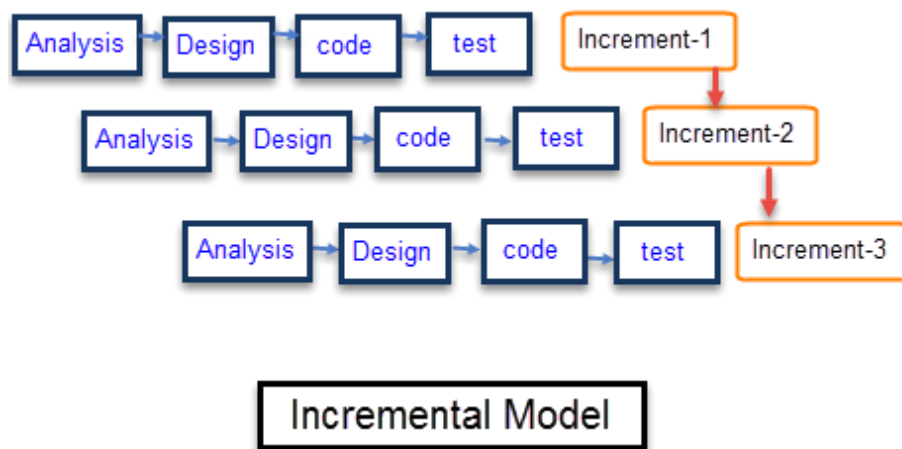


Fig 1.5 Incremental Model

1.8 EVOLUTIONARY PROCESS MODELS

Evolutionary models are iterative type models. They allow to develop more complete versions of the software. Following are the evolutionary process models.

1. The prototyping model
2. The spiral model
3. Concurrent development model

1.8.1. The Prototyping model

- Prototype is defined as the first or preliminary form using which other forms are copied or derived.
- Prototype model is a set of general objectives for software. It does not identify the requirements like detailed input, output.
- It is a software working model of limited functionality. In this model, working programs are quickly produced.

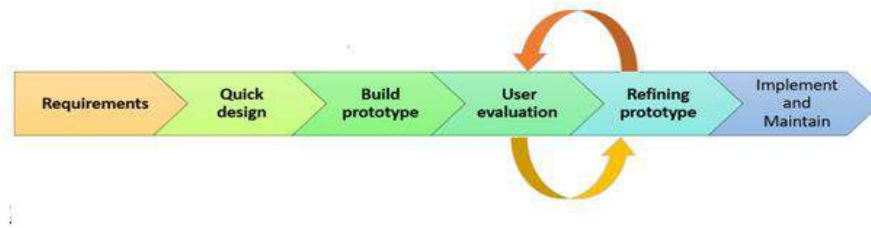


Fig1.6 Prototyping Model

The different phases of Prototyping model are

- **Communication:**
In this phase, developers and customers meet and discuss the overall objectives of the software.
- **Quick design**
Quick design is implemented when requirements are known. It includes only the important aspects like input and output format of the software. It focuses on those aspects which are visible to the user rather than the detailed plan. It helps to construct a prototype.
- **Modeling quick design**
This phase gives a clear idea about the development of software because the software is now built. It allows the developer to better understand the exact requirements.
- **Construction of prototype**
The prototype is evaluated by the customer itself.
- **Deployment, delivery, feedback**
If the user is not satisfied with the current prototype then it refines according to the requirements of the user. The process of refining the prototype is repeated until all the requirements of users are met. When the users are satisfied with the developed prototype then the system is developed on the basis of final prototype.

Advantages of Prototyping Model:

- Prototype models need not know the detailed input, output, processes, adaptability of the operating system and full machine interaction.
- In the development process of this model users are actively involved.
- The development process is the best platform to understand the system by the user.
- Errors are detected much earlier.
- Gives quick user feedback for better solutions.
- It identifies the missing functionality easily.
- It also identifies the confusing or difficult functions.

Disadvantages of Prototyping Model:

- The client involvement is more and it is not always considered by the developer.
- It is a slow process because it takes more time for development.
- Many changes can disturb the rhythm of the development team.
- It is a thrown away prototype when the users are confused with it.

1.8.2. The Spiral model

Spiral model is a risk driven process model. It is used for generating software projects.

In a spiral model, an alternate solution is provided if the risk is found in the risk analysis, then alternate solutions are suggested and implemented.

It is a combination of prototype and sequential model or waterfall model.

In one iteration all activities are done, for large project's the output is small.

The framework activities of the spiral model are as shown in the following figure.

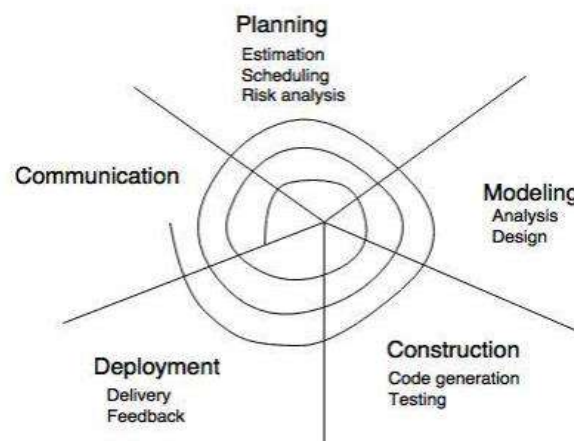


Fig. - The Spiral Model

NOTE: The description of the phases of the spiral model is same as that of the process model.

Advantages of Spiral Model

- It reduces a high amount of risk.
- It is good for large and critical projects.
- It gives strong approval and documentation control.
- In the spiral model, the software is produced early in the life cycle process.

Disadvantages of Spiral Model

- It can be costly to develop a software model.
- It is not used for small projects.

1.8.3. The concurrent development model

- The concurrent development model is called a concurrent model.
- The communication activity has completed in the first iteration and exits in the awaiting changes state.
- The modeling activity completed its initial communication and then went to the underdevelopment state.
- If the customer specifies the change in the requirement, then the modeling activity moves from the under development state into the awaiting change state.
- The concurrent process models activities moving from one state to another state.

Advantages of the concurrent development model

- This model is applicable to all types of software development processes.
- It is easy to understand and use.
- It gives immediate feedback from testing.
- It provides an accurate picture of the current state of a project.

Disadvantages of the concurrent development model

- It needs better communication between the team members.
- This may not be achieved all the time.
- It requires us to remember the status of the different activities.

1.8.4 Component Based Models

- Component based development is a software system development methodology where the system is developed using reusable software components. Component based development aims at improved efficiency, performance and quality of the system by recycling components.
- Commercial off-the-shelf (COTS) software components, developed by vendors who offer them as products, provide targeted functionality with well-defined interfaces that enable the component to be integrated into the software that is to be built.
- The component-based development model incorporates many of the characteristics of the spiral model. The component-based development model incorporates the following steps (implemented using an evolutionary approach):
 1. Available component-based products are researched and evaluated for the application domain in question.
 2. Component integration issues are considered.
 3. A software architecture is designed to accommodate the components.
 4. Components are integrated into the architecture.
 5. Comprehensive testing is conducted to ensure proper functionality

1.9 UNIFIED PROCESS MODEL

The life of a software system can be represented as a series of **cycles**. A cycle ends with the release of a version of the system to customers. Within the Unified Process, each cycle contains Five phases. A **phase** is simply the span of time between two **major milestones**, points at which managers make important decisions about whether to proceed with development and, if so, what's required concerning project scope, budget, and schedule.

Inception

The primary goal of the **Inception phase** is to establish the case for the viability of the proposed system.

The tasks that a project team performs during Inception include the following:

- Defining the scope of the system (that is, what's in and what's out)
- Outlining a **candidate architecture**, which is made up of initial versions of six different models
- Identifying critical risks and determining when and how the project will address them
- Starting to make the business case that the project is worth doing, based on initial estimates of cost, effort, schedule, and product quality

The primary goal of the **Elaboration phase** is to establish the ability to build the new system given the financial constraints, schedule constraints, and other kinds of constraints that the development project faces.

The tasks that a project team performs during Elaboration include the following:

- Capturing a healthy majority of the remaining functional requirements
- Expanding the candidate architecture into a full **architectural baseline**, which is an internal release of the system focused on describing the architecture
- Addressing significant risks on an ongoing basis
- Finalizing the business case for the project and preparing a project plan that contains sufficient detail to guide the next phase of the project (Construction)

Construction

- The primary goal of the **Construction phase** is to build a system capable of operating successfully in beta customer environments.
- During Construction, the project team performs tasks that involve building the system iteratively and incrementally (see "Iterations and Increments" later in this chapter), making sure that the viability of the system is always evident in executable form.
- The major milestone associated with the Construction phase is called **Initial Operational Capability**. The project has reached this milestone if a set of beta customers has a more or less fully operational system in their hands.

Transition

- The primary goal of the **Transition phase** is to roll out the fully functional system to customers.
- During Transition, the project team focuses on correcting defects and modifying the system to correct previously unidentified problems.
- The major milestone associated with the Transition phase is called **Product Release**.

Production

The production phase of the UP coincides with the deployment activity of the generic process. During this phase, the ongoing use of the software is monitored, support for the operating environment (infrastructure) is provided, and defect reports and requests for changes are submitted and evaluated.

1.10 AGILE DEVELOPMENT- AGILITY

- Agility means effective (rapid and adaptive) response to change, effective communication among all stockholders.
- Drawing the customer onto a team and organizing a team so that it is in control of work performed.
- The agile process forces the development team to focus on software itself rather than design and documentation.
- The agile process believes in iterative methods.
- The aim of agile process is to deliver the working model of software quickly to the customer For example: Extreme programming is the best known of agile process.
- Agility can be applied to any software process. However, to accomplish this, it is essential that the process be designed in a way that allows the project team to adapt tasks and to streamline them, conduct planning in a way that understands the fluidity of an agile development approach, eliminate all but the most essential work products and keep them lean, and emphasize an incremental delivery strategy that gets working software to the customer as rapidly as feasible for the product type and operational environment.

1.11 AGILE PROCESS

Any agile software process is characterized in a manner that addresses a number of key assumptions about the majority of software projects:

1. It is difficult to predict in advance which software requirements will persist and which will change. It is equally difficult to predict how customer priorities will change as the project proceeds.
2. For many types of software, design and construction are interleaved. That is, both activities should be performed in tandem so that design models are proven as they are created. It is difficult to predict how much design is necessary before construction is used to prove the design.
3. Analysis, design, construction, and testing are not as predictable (from a planning point of view) as we might like.

Agility Principles

Agility principles for those who want to achieve agility:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.

3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

Human Factors

If members of the software team are to drive the characteristics of the process that is applied to build software, a number of key traits must exist among the people on an agile team and the team itself

- **Competence:**“competence” encompasses innate talent, specific software-related skills, and overall knowledge of the process that the team has chosen to apply.
- **Common focus:**All team members should be focused on one goal—to deliver a working software increment to the customer within the time promised.
- **Collaboration:** Software engineering (regardless of process) is about assessing, analyzing, and using information that is communicated to the software team; creating information that will help all stakeholders understand the work of the team; and building information (computer software and relevant databases) that provides business value for the customer. To accomplish these tasks, team members must collaborate—with one another and all other stakeholders.
- **Decision-making ability:**The team is given autonomy—decision-making authority for both technical and project issues.
- **Fuzzy problem-solving ability.** Software managers must recognize that the agile team will continually have to deal with ambiguity and will continually be buffeted by change.
- **Self-organization:**In the context of agile development, self-organization implies three things: (1) the agile team organizes itself for the work to be done, (2) the team organizes the process to best accommodate its local environment, (3) the team organizes the work schedule to best achieve delivery of the software increment.

1.12 EXTREME PROGRAMMING

- Extreme programming uses an object-oriented approach as its preferred development paradigm.
- Extreme programming encompasses a set of rules and practices that occur within the context of four framework activities: planning, design, coding, and testing.

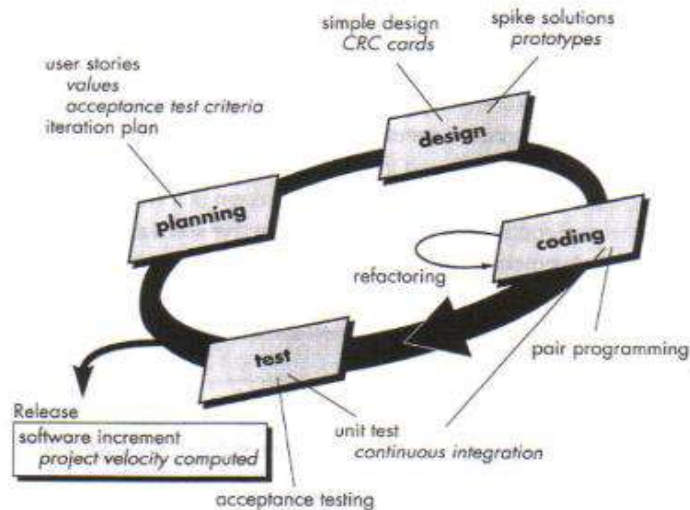


Fig. Extreme Programming Process

1. Planning:

- The planning activity begins with the creation of a set of stories that describe required features and functionality for software to be built.
- Each story is written by the customer and is placed on an index card. The customer assigns a value to the story based on the overall business value of the feature or function.
- Members of the XP (Extreme Programming) team then assess each story and assign a cost – measured in development weeks – to it.
- If the story will require more than three development weeks, the customer is asked to split the story into smaller stories, and the assignment of value and cost occurs again.
- Customers and the XP team work together to decide how to group stories into the next release to be developed by the XP team.
- Once a basic commitment is made for a release, the XP team orders the stories that will be developed in one of three ways:
 1. All stories will be implemented immediately.
 2. The stories with highest value will be moved up in the schedule and implemented first.
 3. The riskiest stories will be moved up in the schedule and implemented first.

- As development work proceeds, the customer can add stories, change the value of an existing story, split stories or eliminate them.
- The XP team then reconsiders all remaining releases and modifies its plan accordingly.

2. Design :

- XP design follows the KIS (Keep It Simple) principle. A simple design is always preferred over a more complex representation.
- The design provides implementation guidance for a story as it is written – nothing less, nothing more.
- XP encourages the use of CRC (Class Responsibility Collaborator) cards as an effective mechanism for thinking about the software in an object oriented context.
- CRC cards identify and organize the object oriented classes that are relevant to current software increment.
- The CRC cards are the only design work product produced as a part of XP process.
- If a difficult design is encountered as a part of the design of a story, XP recommends the immediate creation of that portion of the design called a ‘spike solution’.
- XP encourages refactoring – a construction technique.

3. Coding

- XP recommends that after stories are developed and preliminary design work is done, the team should not move to code, but rather develop a series of unit test that will exercise each story.
- Once the unit test has been created, the developer is better able to focus on what must be implemented to pass the unit test.
- Once the code completes, it can be unit tested immediately, thereby providing instantaneous feedback to the developer.
- A key concept during the coding activity is pair programming. XP recommends that two people work together at one computer workstation to create code for a story. This provides a mechanism for real time problem solving and real time quality assurance.
- As pair programmers complete their work, the code they developed is integrated with the work of others.
- This continuous integration strategy helps to avoid compatibility and interfacing problems and provides a smoke testing environment that helps to uncover errors early.

4. Testing :

- The creation of unit tests before coding is the key element of the XP approach.
- The unit tests that are created should be implemented using a framework that enables them to be automated. This encourages regression testing strategy whenever code is modified.
- Individual unit tests are organized into a “Universal Testing Suit”,

integration and validation testing of the system can occur on a daily basis. This provides the XP team with a continual indication of progress and also can raise warning flags early if things are going away.

- XP acceptance tests, also called customer tests, are specified by the customer and focus on the overall system feature and functionality that are visible and reviewable by the customer.

LET US SUM UP

This chapter provides a clear Software . It covers different models used in software engineering. It also presents different unified process phases. The Second half of the chapter focuses on Agile Development. The chapter concludes with a clear overview of Extreme programming.

QUESTIONS

1. What are the nature of software. Explain
2. Explain the term “software doesn't wear out”
3. Explain Software Engineering
4. Explain Software Process
5. What are the umbrella activities involved in software process
6. Explain generic process
7. Explain waterfall Model
8. Explain Incremental Model, Iterative Model, prototyping Model
9. Explain Unified Process Model
10. what are Agility Principles?
11. Explain Extreme Programming.

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REQUIREMENT ANALYSIS AND SYSTEM MODELING

Unit Structure :

- 2.0 Objectives
- 2.1 Introduction
- 2.2 Requirements Engineering
- 2.3 Eliciting Requirements
- 2.4 SRS Validation
- 2.5 Components of 15L SRS
- 2.6 Characteristics of SRS
- 2.7 Object-oriented design using the UML - Class diagram
- 2.8 Object diagram
- 2.9 Use case diagram
- 2.10 Sequence diagram
- 2.11 Collaboration diagram
- 2.12 State chart diagram
- 2.13 Activity diagram
- 2.14 Component diagram
- 2.15 Deployment diagram
- Let us Sum Up
- List of References
- Bibliography
- Unit End Exercises

2.0 OBJECTIVES

After going through this chapter, you will be able to:

- Requirement Engineering
- SRS
- UML in software Engineering

2.1 INTRODUCTION

The intent of requirements engineering is to provide all parties with a written understanding of the problem. This can be achieved through a number of work products: usage scenarios, functions and features lists, requirements models, or a specification.

2.2 REQUIREMENTS ENGINEERING

Requirements engineering refers to the wide range of jobs and methods that help one understand requirements. Requirements engineering is a significant software engineering activity that starts during the communication activity and continues through the modeling activity from the standpoint of the software process. It needs to be modified to meet the requirements of the work being done, the project, the product, and the process. It encompasses seven distinct tasks: inception, elicitation, elaboration, negotiation, specification, validation, and management.

Inception:

Stakeholders from the business community (e.g., business managers, marketing people, product managers) define a business case for the idea, try to identify the breadth and depth of the market, do a rough feasibility analysis, and identify a working description of the project's scope.

Elicitation.:

Ask the customer, the users, and others what the objectives for the system or product are, what is to be accomplished, how the system or product fits into the needs of the business, and finally, how the system or product is to be used on a day-to-day basis.

Elaboration:

The information obtained from the customer during inception and elicitation is expanded and refined during elaboration. Elaboration is driven by the creation and refinement of user scenarios that describe how the end user (and other actor) will interact with the system.

Negotiation:

It isn't unusual for customers and users to ask for more than can be achieved, given limited business resources. These conflicts can be reconciled through a process of negotiation. Customers, users, and other stakeholders are asked to rank requirements and then discuss conflicts in priority. Using an iterative approach that prioritizes requirements, assesses their cost and risk, and addresses internal conflicts, requirements are eliminated, combined, and/or modified so that each party achieves some measure of satisfaction.

Specification:

In the context of computer-based systems (and software), the term specification means different things to different people. A specification can be a written document, a set of graphical models, a formal mathematical model, a collection of usage scenarios, a prototype, or any combination of these.

Validation: The work products produced as a consequence of requirements engineering are assessed for quality during a validation step. Requirements

validation examines the specification to ensure that all software requirements have been stated unambiguously; that inconsistencies, omissions, and errors have been detected and corrected; and that the work products conform to the standards established for the process, the project, and the product.

Requirements management:

Requirements management is a set of activities that help the project team identify, control, and track requirements and changes to requirements at any time as the project proceeds.

functions and features lists, requirements models, or a specification.

2.3 ELICITING REQUIREMENTS

Requirements elicitation (also called requirements gathering) combines elements of problem solving, elaboration, negotiation, and specification.

1. Collaborative requirements gathering

- Gathering the requirements by conducting the meetings between developer and customer.
- Fix the rules for preparation and participation.
- The main motive is to identify the problem, give the solutions for the elements, negotiate the different approaches and specify the primary set of solution requirements in an environment which is valuable for achieving the goal.

2. Quality Function Deployment (QFD)

- In this technique, translate the customer need into the technical requirement for the software.
- The QFD system designs software according to the demands of the customer.

QFD consist of three types of requirement:

Normal requirements

- The objective and goal are stated for the system through the meetings with the customer.
- For customer satisfaction these requirements should be there.

Expected requirement

- These requirements are implicit.
- These are the basic requirements that are not clearly told by the customer, but also the customer expects that requirement.

Exciting requirements

- These features are beyond the expectation of the customer.
- The developer adds some additional features or unexpected features into the software to make the customer more satisfied. **For example**, the mobile phone with standard features, but the developer adds few additional functionalities like voice searching, multi-touch screen etc. then the customer is more excited about that feature.

3. Usage scenarios

- Until the software team does not understand how the features and function are used by the end users it is difficult to move technical activities.
- To achieve the above problem the software team produces a set of structures that identify the usage for the software.
- This structure is called 'Use Cases'.

4. Elicitation work product

- The work product created as a result of requirement elicitation that is depending on the size of the system or product to be built.
- The work product consists of a statement need, feasibility, statement scope for the system.
- It also consists of a list of users participate in the requirement elicitation.

2.4 SRS VALIDATION

A software requirements specification (SRS) is a document that is created when a detailed description of all aspects of the software to be built must be specified before the project is to commence. It is important to note that a formal SRS is not always written. In fact, there are many instances in which effort expended on an SRS might be better spent in other software engineering activities. However, when software is to be developed by a third party, when a lack of specification would create severe business issues, or when a system is extremely complex or business critical, an SRS may be justified. The work products created as a result of requirements engineering are checked for consistency, omissions, and ambiguity during the validation process. The main goal is to guarantee that the SRS correctly and clearly represents the real needs.

Requirements validation is similar to requirements analysis as both processes review the gathered requirements. Requirements validation studies the 'final draft' of the requirements document while requirements analysis studies the 'raw requirements' from the system stakeholders

(users). Requirements validation and requirements analysis can be summarized as follows:

Requirements validation: Have we got the requirements right?

Requirements analysis: Have we got the right requirements?

Requirements validation determines whether the requirements are substantial to design the system. The problems encountered during requirements validation are listed below.

- Unclear stated requirements
- Conflicting requirements are not detected during requirements analysis
- Errors in the requirements elicitation and analysis
- Lack of conformance to quality standards.

To avoid the problems stated above, a **requirements review** is conducted, which consists of a review team that performs a systematic analysis of the requirements.

Requirements Validation Checklist

It is often useful to examine each requirement against a set of checklist questions

- Are requirements stated clearly? Can they be misinterpreted?
- Is the source (e.g., a person, a regulation, a document) of the requirement identified? Has the final statement of the requirement been examined by or against the original source?
- Is the requirement bounded in quantitative terms?
- What other requirements relate to this requirement? Are they clearly noted via a cross-reference matrix or other mechanism?
- Does the requirement violate any system domain constraints?
- Is the requirement testable? If so, can we specify tests (sometimes called validation criteria) to exercise the requirement?
- Is the requirement traceable to any system model that has been created?
- Is the requirement traceable to overall system/product objectives?
- Is the specification structured in a way that leads to easy understanding, easy reference, and easy translation into more technical work products?
- Has an index for the specification been created?
- Have requirements associated with performance, behavior, and operational characteristics been clearly stated? What requirements appear to be implicit?

2.4 COMPONENTS OF SRS

SRS should have these components

1. Functional Requirements

Functional requirements specify what output should be produced from the given inputs. So they basically describe the connectivity between the input and output of the system. For each functional requirement:

1. A detailed description of all the data inputs and their sources, the units of measure, and the range of valid inputs be specified;
2. All the operations to be performed on the input data obtain the output should be specified, and
3. Care must be taken not to specify any algorithms that are not parts of the system but that may be needed to implement the system.
4. It must clearly state what the system should do if system behaves abnormally when any invalid input is given or due to some error during computation. Specifically, it should specify the behavior of the system for invalid inputs and invalid outputs.

2. Performance Requirements (Speed Requirements)

This part of an SRS specifies the performance constraints on the software system. All the requirements related to the performance characteristics of the system must be clearly specified. Performance requirements are typically expressed as processed transactions per second or response time from the system for a user event or screen refresh time or a combination of these. It is a good idea to pin down performance requirements for the most used or critical transactions, user events and screens.

3. Design Constraints

The client environment may restrict the designer to include some design constraints that must be followed. The various design constraints are standard compliance, resource limits, operating environment, reliability and security requirements and policies that may have an impact on the design of the system. An SRS should identify and specify all such constraints.

Standard Compliance: It specifies the requirements for the standard the system must follow. The standards may include the report format and according procedures.

Hardware Limitations: The software needs some existing or predetermined hardware to operate, thus imposing restrictions on the

design. Hardware limitations can include the types of machines to be used, operating system availability, memory space etc.

Fault Tolerance: Fault tolerance requirements can place a major constraint on how the system is to be designed. Fault tolerance requirements often make the system more complex and expensive, so they should be minimized.

Security: Currently security requirements have become essential and major for all types of systems. Security requirements place restrictions on the use of certain commands, control access to databases, provide different kinds of access, requirements for different people, require the use of passwords and cryptography techniques, and maintain a log of activities in the system.

4. External Interface Requirements

For each external interface requirements:

1. All the possible interactions of the software with people hardware and other software should be clearly specified,
2. The characteristics of each user interface of the software product should be specified and
3. The SRS should specify the logical characteristics of each interface between the software product and the hardware components for hardware interfacing.

2.5 CHARACTERISTICS OF SRS

Following are the Characteristics of a good SRS document:

1. **Correctness:** User review is used to provide the accuracy of requirements stated in the SRS. SRS is said to be perfect if it covers all the needs that are truly expected from the system.
2. **Complete:** software system will perform each and every function as per the SRS. A SRS is complete if everything the software is supposed to do and the responses of the software to all classes of input data are specified in SRS. To ensure completeness, one has to detect the absence of specification which is much harder to determine.
3. **Consistency:** Requirements at all levels must be consistent with each other. Any conflict between requirements within the SRS must be identified and resolved. The types of conflicts that generally occur are: For example, The format of an output report may be described in one requirement as tabular but in another as textual.
4. **Clarity:** The documented requirement should lead to only a single interpretation, independent of the person or the time when the interpretation is done. The SRS needs to be unambiguous to the authors, the users, other reviewers as well as the developers and testers who will use the document. So SRS writers should be careful about ambiguity.

5. **Ranking :** Generally, the requirements stated according to their priorities are critical, others are important but not critical, and there are some which are desirable but not very important.
6. **Modifiability:** SRS should be made as modifiable as likely and should be capable of quickly obtaining changes to the system to some extent.
7. **Traceability:** The SRS is traceable if the origin of each of the requirements is clear and if it facilitates the referencing of each condition in future development or enhancement documentation.

There are two types of Traceability:

1. **Backward Traceability:** This depends upon each requirement explicitly referencing its source in earlier documents.
2. **Forward Traceability:** This depends upon each element in the SRS having a unique name or reference number. The forward traceability of the SRS is especially crucial when the software product enters the operation and maintenance phase. As code and design documents are modified, it is necessary to be able to ascertain the complete set of requirements that may be concerned by those modifications.
3. **Testability:** An SRS should be written in such a method that it is simple to generate test cases and test plans from the report.

2.6 OBJECT-ORIENTED DESIGN USING THE UML

Object Oriented Design (OOD) is the process of defining the objects and their interactions to solve a problem that was identified and documented during the Object Oriented Analysis (OOA). OOD is a design model that is considered as a blueprint for software construction.

The general steps that a software engineer should take to execute object-oriented design are as follows:

1. Identify each subsystem and assign responsibilities to it.
2. Select a design approach for putting task management, interface support, and data management into practice.
3. Create a system-appropriate control mechanism.
4. Create procedural representations for each action and data structures for class attributes to do object design.
5. Perform message design using collaborations between objects and object relationships.
6. Create the messaging model
7. Examine the design model and iterate as necessary

The Unified Modelling Language, or the UML, is a graphical modeling language that provides us with a syntax for describing the major elements (called artifacts in the UML) of software systems. UML has a lot of different diagrams (models). The reason for this is that it is possible to look at a system from different viewpoints. UML being a graphical language includes nine such diagram models):

- Class diagram
- Object diagram
- Use case diagram
- Sequence diagram
- Collaboration diagram
- Statechart diagram
- Activity diagram
- Component diagram
- Deployment diagram

2.6.1 Class Diagram

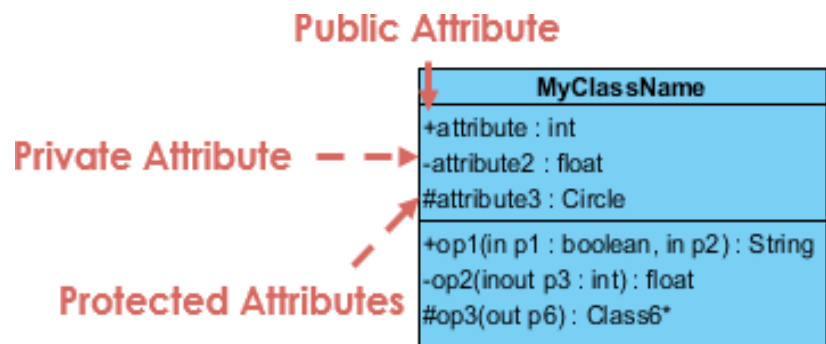
In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. A class represents a concept which encapsulates state (attributes) and behavior (operations). Each attribute has a type. Each operation has a signature. *The class name is the only mandatory information.*

Class Notation

A class notation consists of three parts:

1. **Class Name**
 - The name of the class appears in the first partition.
2. **Class Attributes**
 - Attributes are shown in the second partition.
 - The attribute type is shown after the colon.
 - Attributes map onto member variables (data members) in code.
3. **Class Operations (Methods)**
 - Operations are shown in the third partition. They are services the class provides.

- The return type of a method is shown after the colon at the end of the method signature.
- The return type of method parameters is shown after the colon following the parameter name.
- Operations map onto class methods in code
- The +, - and # symbols before an attribute and operation name in a class denote the visibility of the attribute and operation.



2.6.2 Object Diagram

Object is an instance of a class in a particular moment in runtime that can have its own state and data values. Before creating a class diagram, they might need to create an object diagram to discover facts about specific model elements and their links. They are useful to explain smaller portions of your system, when your system class diagram is very complex, and also sometimes modeling recursive relationship in diagram.

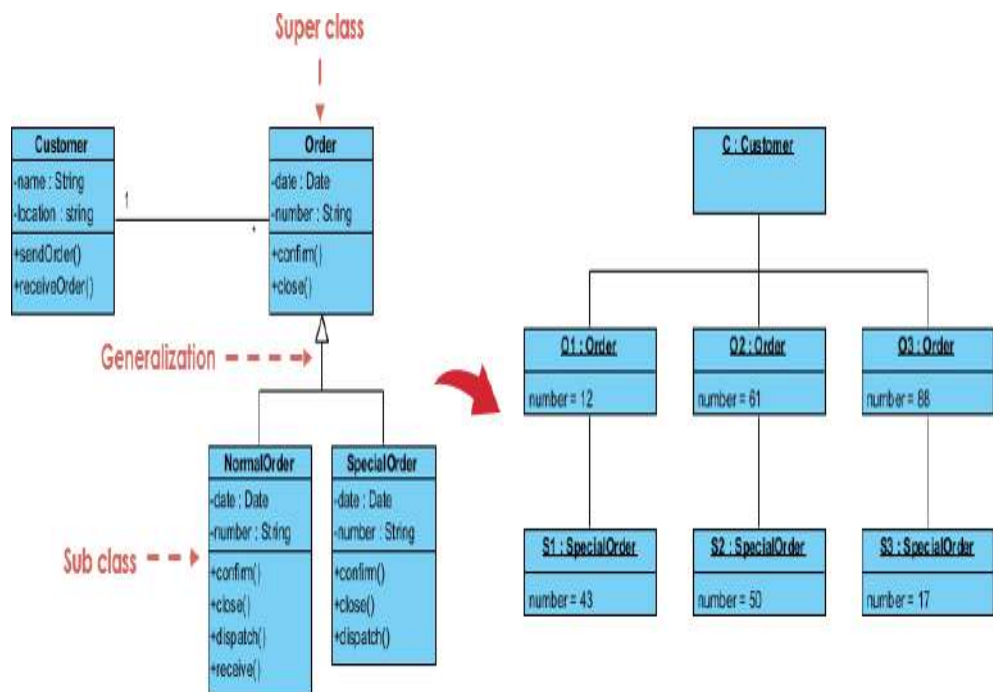


Fig 2.6.2 Class Diagram

Object Diagram

- Every object is actually symbolized like a rectangle, that offers the name from the object and its class underlined as well as divided with a colon.
- Similar to classes, a list of object attributes inside a separate compartment can be listed. However, unlike classes, object attributes should have values assigned for them.

2.6.3. Use Case Diagram

- A use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system.
- use case diagrams are ideal for:
 - Representing the goals of system-user interactions
 - Defining and organizing functional requirements in a system
 - Specifying the context and requirements of a system
 - Modeling the basic flow of events in a use case

The Common components of use case diagram include:

- **Actors:** The users that interact with a system. An actor can be a person, an organization, or an outside system that interacts with your application or system. They must be external objects that produce or consume data.
- **System:** A specific sequence of actions and interactions between actors and the system. A system may also be referred to as a scenario.
- **Goals:** The end result of most use cases. A successful diagram should describe the activities and variants used to reach the goal.

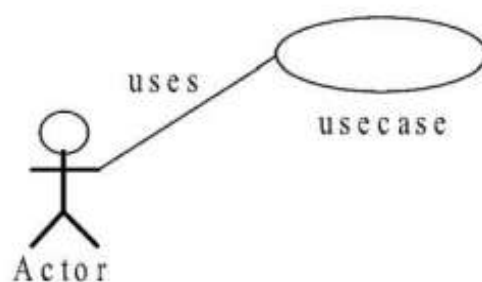


Figure : Basic Notation of a Use Case Diagram

2.6.4 Sequence Diagram

The sequence diagram is used primarily to show the interactions between objects in the sequential order that those interactions occur. One of the primary uses of sequence diagrams is in the transition from requirements expressed as use cases to the next and more formal level of refinement. Sequence Diagrams are driven by the Use Cases which are the system requirements. In this form objects are shown as vertical lines with the messages as horizontal lines between them. The sequence of messages is indicated by reading down the page (read left to right and descending). Sequence Diagrams are about deciding and modeling "how" the system will achieve "what" we described in the Use Case model.

Example of a "Make a Cup of Tea" sequence diagram generated from its corresponding use case description is as shown in Figure below.

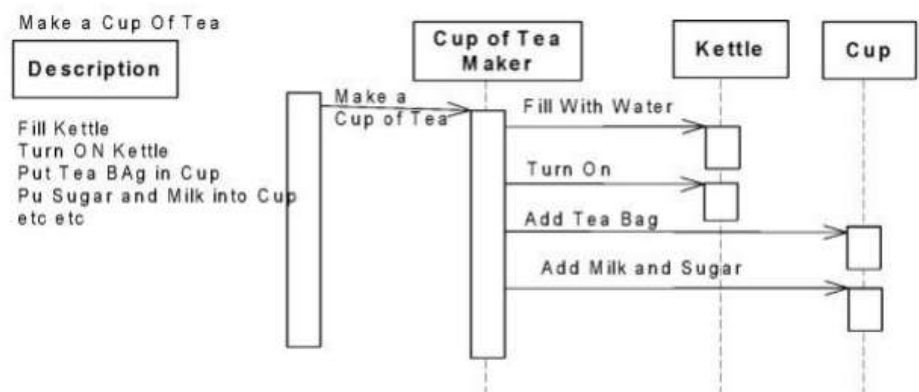


Figure: A Sequence Diagram for "Make a Cup of Tea" Use Case

2.6.5. Collaboration diagram

Communication diagrams, formerly known as collaboration diagrams, are almost identical to sequence diagrams in UML, but they focus more on the relationships of objects—how they associate and connect through messages in a sequence rather than interactions. A communication diagram offers the same information as a sequence diagram, but while a sequence diagram emphasizes the time and order of events, a communication diagram emphasizes the messages exchanged between objects in an application.

Symbols and notations of communication diagrams

- Rectangles represent objects that make up the application.
- Lines between class instances represent the relationships between different parts of the application.
- Arrows represent the messages that are sent between objects.
- Numbering lets you know in what order the messages are sent and how many messages are required to finish a process.

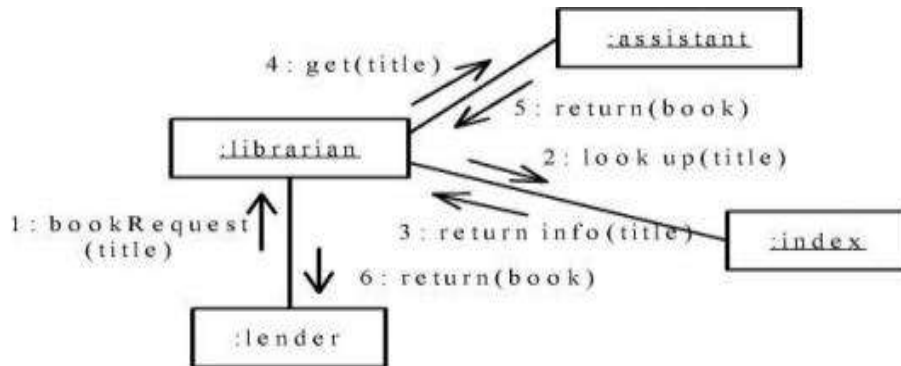
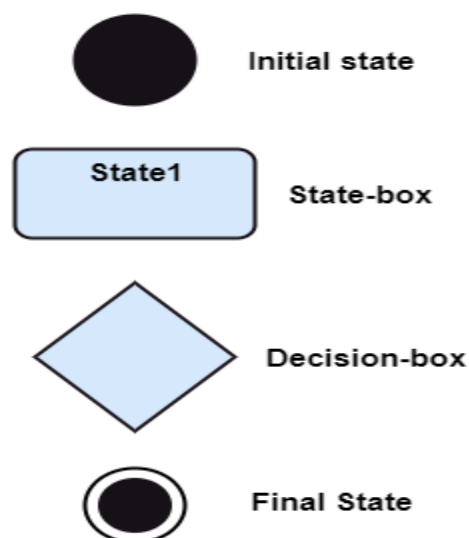


Figure: Example of a Collaboration Diagram

2.6.6 State Chart Diagram

A state diagram depicts how classes behave in response to external inputs. A state diagram, in particular, illustrates the behavior of a single item in response to a series of events in a system. It is sometimes referred to as a Harel state chart or a state machine diagram. This UML diagram depicts the dynamic flow of control from one state to the next of a specific item inside a system.

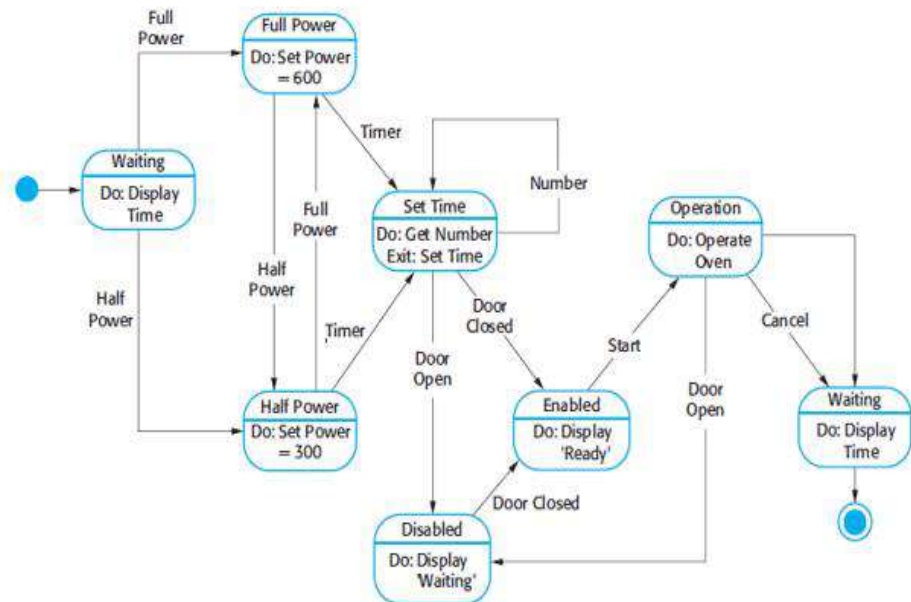
Notation of a State Machine Diagram



- **State:** States represent situations during the life of an object.
- **Transition:** A solid arrow represents the path between different states of an object. Label the transition with the event that triggered it and the action that results from it. A state can have a transition that points back to itself.
- **Decision:** It is of diamond shape that represents the decisions to be made on the basis of an evaluated guard.

- **Initial State:** A filled circle followed by an arrow represents the object's initial state.
- **Final State:** An arrow pointing to a filled circle nested inside another circle represents the object's final state.

Fig 2.6.6 State Chart Diagram



2.6.7 Activity Diagram

A UML activity diagram depicts the dynamic behavior of a system or part of a system through the flow of control between actions that the system performs. It is similar to a flowchart except that an activity diagram can show concurrent flows.

- The main component of an activity diagram is an action node, represented by a **rounded rectangle**.
- **Arrows** from one action node to another indicate the flow of control.
- A **solid black dot** forms the initial node that indicates the starting point of the activity.
- A **black dot surrounded by a black circle** is the final node indicating the end of the activity.
- A **fork** represents the separation of activities into two or more concurrent activities. It is drawn as a **horizontal black bar** with one arrow pointing to it and two or more arrows pointing out from it

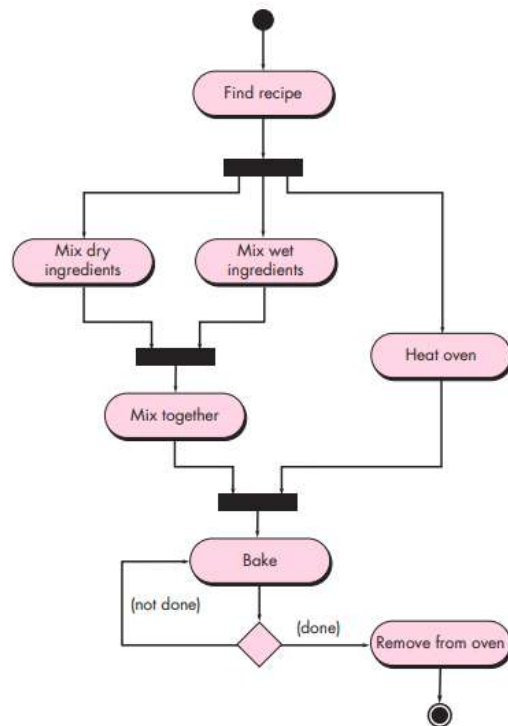


Fig 2.6.7 Activity Diagram

2.6.8 Component Diagram

The purpose of a component diagram is to show the relationship between different components in a system. The term "component" refers to a module of classes that represent independent systems or subsystems with the ability to interface with the rest of the system. A component diagram is similar to the package diagram. It works in the same way as the package diagram, showing the organizations and dependencies among a set of components. Component diagrams address the static implementation view of a system. Component diagrams emphasize the physical software entity e.g. files headers, executables, link-libraries etc, rather than the logical partitioning of the package diagram. It is based heavily on the package diagram, but has added ".dll" to handle I/O, and has added a test harness executable. Not heavily used, but can be 188 helpful in mapping the physical, real life software code and dependencies between them. Figure 2.8 shows a symbol used for a software component.



Component Diagram



Node Symbol



Package Symbol

2.6.9 Deployment Diagram

In UML, deployment diagrams model the physical architecture of a system. Deployment diagrams show the relationships between the software and hardware components in the system and the physical distribution of the processing. Deployment diagrams, which you typically prepare during the implementation phase of development, show the physical arrangement of the nodes in a distributed system, the artifacts that are stored on each node, and the components and other elements that the artifacts implement. Nodes represent hardware devices such as computers, sensors, and printers, as well as other devices that support the runtime environment of a system. Communication paths and deploy relationships model the connections in the system.

Deployment diagrams are effective for visualizing, specifying, and documenting the following types of systems:

- Embedded systems that use hardware that is controlled by external stimuli; for example, a display that is controlled by temperature change
- Client/server systems that typically distinguish between the user interface and the persistent data of a system
- Distributed systems that have multiple servers and can host multiple versions of software artifacts, some of which might even migrate from node to node.

LET US SUM UP

This chapter provides understanding about requirement engineering. It covers about SRS and its validation. The Second half of the chapter focuses on different diagrams available as part of UML which provide a rich set of representational forms for the design model.

QUESTIONS

1. Explain different tasks in Requirement Engineering.
2. Describe Eliciting requirements.
3. Explain SRS and its Validation
4. What are the components of SRS? Explain it
5. What are the characteristics of SRS
6. Explain Class diagram
7. Explain Object diagram
8. Explain Use case diagram

9. Explain Sequence diagram
10. Explain Collaboration diagram
11. Explain Statechart diagram
12. Explain Activity diagram
13. Explain Component diagram
14. Explain Deployment diagram

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SYSTEM DESIGN

Unit Structure :

3.0 Objectives

3.1 Introduction

3.2 System/Software Design

3.3 Architectural Design

3.4 Coupling

3.5 Cohesion

3.6 Functional-Oriented Versus the Object-Oriented Approach

3.7 Design Specifications

3.8 Verification for Design

3.9 Monitoring and Control for Design

Summary

List of References

Unit End Exercises

3.0 OBJECTIVES

The objectives of this chapter consist of:

- Understanding the open-closed principle, connection, coherence, and modularity design principles
- Getting familiar with function-oriented system's structure using the structure chart notation and the structured design process used to create the system's structure chart
- Fundamentals and process of object-orientation design for a system
- Understanding the guidelines for creating thorough designs, methods for confirming designs, and measures for measuring design complexity
- comprehend the significance of software architecture
- understand the choices that need to be taken during the architectural design process regarding the system architecture
- to learned about architectural patterns, tried-and-true methods of structuring system architectures that can be used to system designs

3.1 INTRODUCTION

When the architecture and document illustrating project has been created that needs to produced is presented, the design process may start. We further

enhance the architecture during design. Design is typically concentrated on what we have dubbed the module perspective. That is, we decide which modules need to be developed and which ones the system should have during the design phase. Often, the module view can be thought of as the architecture's individual components organized into modules. Here, the framework establishes component's development architecture. This straightforward component to module mapping, nevertheless, might not always be accurate. In that instance, it is imperative that we make sure the module view we produced during design adheres to the architecture.

A system's design is simply a blueprint or strategy for resolving a problem with the system. Here, a system is viewed as a collection of elements that communicate with one another to provide a particular behaviour or set of services for its environment.

There are typically two levels to the architecture development process. Choosing required elements, their parameters, and how they should be connected are the main concerns at the initial level. This is what is referred to as the high-level or module design. The intramural module architecture and how the requirements can be satisfied is decided at the second stage. To make the system design sufficiently complete for coding, framework incorporated detailing architecture. A methodology is a methodical process that involves using a set of techniques and principles to create a design. While most design approaches concentrate on architecture, they don't boil down the process to set of instructions the designer may follow without thinking.

3.2 SYSTEM/SOFTWARE DESIGN

If a system constructed exactly in accordance with the specification meet needs of that model, the architecture of that system is correct. Producing accurate designs is undoubtedly the aim of the design process. There can be several accurate designs, thus accuracy is not the only factor considered throughout the design phase. Not just creating a model architecture is the objective. Instead, it aims at coming up with the greatest design you can while staying within the constraints set through specifications.

We must define some evaluation criteria before we can assess a design. We shall concentrate on a system's modularity, determined by architecture, as primary requirement for analysis. It is obvious that modularity is a desired quality. System debugging is facilitated by modularity because it makes it simpler to isolate a system issue to a specific module. Modularity also facilitates system repair since replacing a component of the system only impacts a small number of other components.

Simply dividing a software system into a number of modules won't make it modular. Each module must have a clearly illustrated set of rules and specifications & a transparent alliance for communication with different entities in order to be considered modular. Two modularization criteria that are frequently employed together are coupling and cohesion.

3.3 ARCHITECTURAL DESIGN

Understanding how a system should be structured and creating that system's general structure are both aspects of architectural design. The architectural design level of the s/w architecture process is first one in the system evolution procedure. It determines primary entities of a model& their connections, requirements engineering serves as the important connectivity between architecture and engineering needs.

It is widely acknowledged that in agile processes, the establishment of a generic system architecture should take place early in the development process. Architectural progress that takes place incrementally rarely works. Restructuring design is costly, whereas refactoring components in reaction to changes typically rather simple.

To understand the concept, consider about Figure 1. The components that need to be built are shown in an abstract model of the architecture for a packing robot system. This robotic system is capable of packing a variety of objects. It picks out items on a conveyor, determines the kind of item, and chooses the appropriate packing all using a vision component. After that, the system transports items off of the delivery belt for packaging. It loads packaged goods onto a different conveyor. These elements and the connections between them are displayed in the architectural model.

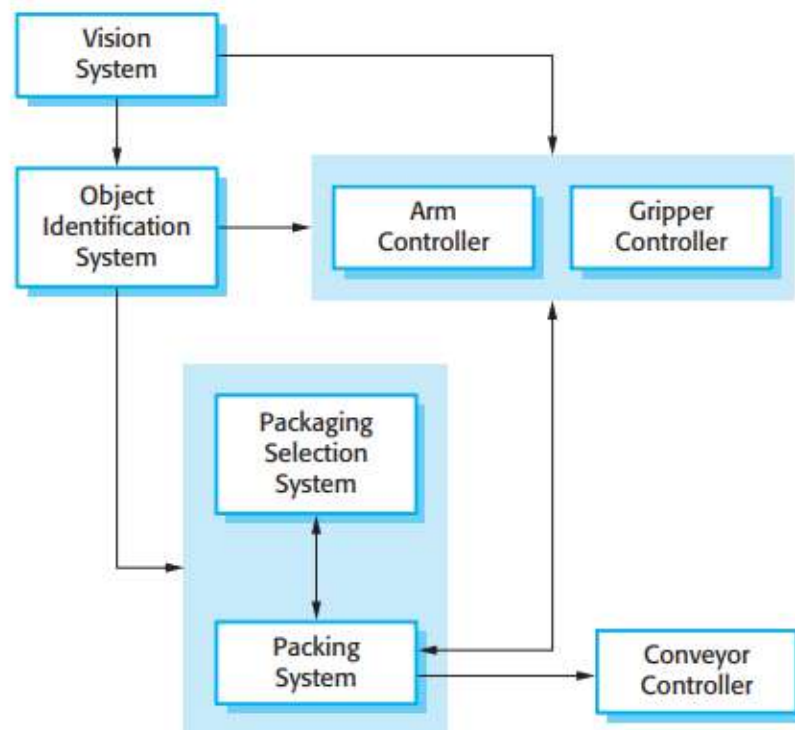


Figure 1: The architecture of a packing robot control system

Architectural design and requirements engineering procedures frequently overlap one another in practise. A system specification should ideally not contain any design data. With the exception of very small systems, this is

unrealistic. The specification must typically be organised and structured using architectural decomposition. As a result, you might suggest an abstract system architecture where link collections of system features or functions to substantial parts or subsystems is established. The system's requirements and features can then be discussed with stakeholders using this breakdown.

There are two degrees of abstraction available when designing software architectures:

- 1] Small-scale architecture focusses on design of specific projects. Here interested lies in how a programme is broken down into its component parts.
- 2] Architecture, in its broadest sense, refers to the design of intricate module incorporating different sub modules, programmes & programme elements. This corporate model dispersed across numerous computers, some of which may be owned and operated by various businesses.

3.4 COUPLING

If one module can run entirely on its own without the other, they are said to be independent. It goes without saying that if two modules are independent, they can be solved and modified independently. The modules of a system must interact with one another in order to achieve the desired outward behaviour of the system, hence they cannot all be independent of one another. The more linkages there are between modules, the more interdependent they are in that it takes a deeper understanding of one module to comprehend or address the problem in the other. Therefore, it is simpler to understand one module without understanding the other links between them. The concept of coupling makes an attempt to express this idea of "how strongly" certain modules are related.

The degree of linkages or the degree of interdependence between modules is referred to as coupling. In general, A and B are more tightly related the more information we need to grasp module A before we can fully comprehend module B. While "loosely coupled" have frail connectivity, "highly coupled" are connected by strong interconnections. There are no linkages between independent components. The s/w modules are developed during architectural formulation, therefore connection across them is primarily determined at that time and cannot be lessened during implementation.

The more complicated and obscure the interface between modules, the more coupling there is. The number of alliances should be kept to a minimum in order to maintain low coupling. Information is passed to and from other modules through a module's interface.

Another element affecting coupling is interface complexity. The degree of coupling will be larger the more intricate each interaction is. For instance, both the quantity and complexity of the items supplied as parameters affect

how complicated the entry interface for a procedure is. Interface complexity must support the necessary communication between modules to some extent. However, this minimum is frequently exceeded. We are unnecessarily increasing the coupling by breaking the record. Basically, we should keep a module's interface as straightforward and condensed as possible.

The third key element influencing coupling is the data workflow process at the alliances. Data and control are the two types of information that can travel via an interface. It is more challenging to comprehend & offer when control is passed or received. A module transfers data information when it provides some data as input & receives some as o/p. Table 1 summarises how these three elements affect coupling.

Table 1: Parameters influencing coupling

	Interface Complexity	Type of Connection	Type of Communication
Low	Simple obvious	To module by name	Data
High	Complicated obscure	To internal elements	Control Hybrid

Due to fact that objects have a greater semantic richness than functions, coupling takes on a slightly different appearance in OO systems. They are of three types:

- Interaction
- Component
- Inheritance

Methods of one class calling methods of another cause's interaction coupling. This circumstance resembles a function calling another function in many respects, and as a result, this coupling resembles coupling between functional modules. Within this group, coupling is smaller when only data is sent, but it increases when data flows since the invoked type affects how calling function is executed. Additionally, coupling increases as data transmission volume rises.

When two classes communicate and one class contains variables from the other class, this is referred to as component coupling. There are three distinct circumstances in which this may occur. If a class C has an instance variable of type C1, a method with a parameter of type C1, a method with a local variable of type C1, or all three, the class C can be a component connected with another class C1. Because any object from any subclass may be used at runtime, when C is component coupled with C1, it has the

potential to be component coupled with all subclasses of C1. It should be obvious that there will almost always be interaction coupling whenever there is component coupling. If the variables of class C1 are either in the signatures of the methods of class C or in some properties of class C, component coupling is thought to be weakest (and hence most desirable). If there is interaction through local variables, this interaction is not apparent from the outside, increasing coupling.

3.5 COHESION

This indicates how closely related its internal components are to one another. The cohesion of a module informs the designer of whether the various components of a module should be placed together in the same module. Coupling and cohesion are connected. Typically, there is less coupling between modules the more cohesive each module is within the system. Although this association is not exact, it has been seen in real-world situations. Different levels of cohesiveness exist: Coincidental, logical, temporal, procedural, communicational, sequential and functional.

The levels are coincidental (lowest) and functional (highest). When there is no significant relationship between the components of a module, there is accidental cohesiveness. An existing programme can be "modularized" by breaking it up into smaller bits and turning each of those pieces into a separate module. A module is likely to exhibit coincidental coherence if it combines a portion of code that appears in multiple places in order to reduce duplicate code.

If a module's components perform tasks that belong to the same logical class and there is some logical relationship between them, the module is said to have logical cohesiveness. A module that handles all the inputs or all the outputs is a common illustration of this type of cohesiveness. If we want to enter or output a certain record in such a scenario, we must communicate this to the module. This is frequently accomplished by including a specific status flag that will be utilised to select which module statements to execute. Such a module typically has complex and awkward code, in addition to creating hybrid information flow between modules, which is typically the worst type of coupling between modules. In general, it's best to stay away from logically cohesive units.

Similar to logical coherence, temporal cohesion refers to the execution of elements that are related in time. Typically, modules that carry out tasks like "initialization," "cleanup," and "termination" are time-bound. The pieces in a temporally bound module are logically related, but because they are all executed simultaneously, temporal cohesiveness is stronger than logical cohesion. By doing so, the issue of passing the flag is avoided, and the code is typically shorter.

A procedurally cohesive module is made up of components from a single procedural unit. A module's loop or series of decision statements, for instance, could be concatenated to create a new module. When a modular structure is derived from a type of flowchart, procedurally coherent modules frequently appear. Functional boundaries are frequently crossed through

procedural coherence. Several functions or merely a portion of a function may be present in a module with only procedural cohesiveness.

Elements in a module with communicational cohesion are connected by a reference to the same input or output data. In other words, in a communication-bound module, the components are grouped together because they share input or output data. This might include a module to "print and punch record," for instance. Modules with good communication may serve multiple purposes. However, if alternative structures with stronger cohesion cannot be readily recognised, communicational cohesiveness is high enough to be generally accepted.

Sequential cohesiveness occurs when components are grouped together in a module because the output of one serve as the input to another. Sequential cohesion does not offer any recommendations for how to group elements into modules if the result of one element serves as the input to another.

The strongest coherence is functional cohesion. Every component of a module that is functionally bound is connected to carrying out a single function. We don't just mean mathematical functions when we say "function"; we also include modules that achieve a specific task. Functionally cohesive modules can be seen in actions like "calculate square root" and "sort the array."

Cohesion in object-oriented systems has three aspects:

- Method cohesion
- Class cohesion
- Inheritance cohesion

Cohesion in functional modules is the same as method cohesion. It focuses on the rationale behind grouping the various method's code components together. When all of a method's statements work together to implement a single, clearly defined function, this is referred to as cohesiveness at its highest level.

Class cohesiveness examines the rationale behind the grouping of various characteristics and methods in this class. The objective is to have a class that implements a single abstraction or concept, with each component working to support that concept. A designer should attempt to adjust the design such that each class encapsulates a single notion since, generally speaking, anytime many concepts are wrapped within a class, the cohesion of the class is not as high as it could be.

The focus of inheritance cohesion is on the rationale for the grouping of classes in a hierarchy. Inheritance is mostly used to represent generalization-specialization relationships and to reuse code. If the hierarchy encourages generalization-specialization of a certain concept, which is likely to naturally result in code reuse, cohesion is deemed to be good. If the hierarchy's main purpose is code sharing and the superclass and subclass relationships are weak conceptually, it is regarded as lower.

3.6 FUNCTIONAL-ORIENTED VERSUS THE OBJECT-ORIENTED APPROACH

Functional programming uses immutable data to tell the program exactly what to do. Object-oriented programming tells the program how to achieve results through objects altering the program's state. Both paradigms can be used to create elegant code. Table 2 illustrates the detailed comparison between function oriented and object-oriented design approach.

Table 2: Comparison between function oriented and object-oriented design approach

COMPARISON FACTORS	FUNCTION ORIENTED DESIGN	OBJECT ORIENTED DESIGN
Abstraction	The basic abstractions, which are given to the user, are real world functions.	The basic abstractions are not the real world functions but are the data abstraction where the real world entities are represented.
Function	Functions are grouped together by which a higher level function is obtained.	Function are grouped together on the basis of the data they operate since the classes are associated with their methods.
execute	carried out using structured analysis and structured design i.e, data flow diagram	Carried out using UML
State information	In this approach the state information is often represented in a centralized shared memory.	In this approach the state information is not represented is not represented in a centralized memory but is implemented or distributed among the objects of the system.
Approach	It is a top down approach.	It is a bottom up approach.
Begins basis	Begins by considering the use case diagrams and the scenarios.	Begins by identifying objects and classes.
Decompose	In function oriented design we decompose in function/procedure level.	We decompose in class level.
Use	This approach is mainly used for computation sensitive application.	This approach is mainly used for evolving system which mimics a business or business case.

3.7 DESIGN SPECIFICATIONS

The Functional Needs set forth in Design Specifications indicate how a system fulfils those requirements. This may include guidelines for testing particular conditions, configuration options, or a review of functions or code, depending on the system. The functional specification's requirements should all be met.

Design specifications examples:

Good requirements can be tested and are unbiased. Design requirements could consist of

- Data types and specific inputs that must be entered into the system
- Code or calculations used to fulfil specified requirements

- outputs the system produces
- describing the technical safeguards to make systems secure
- Indicate how the system complies with any applicable legal requirements.

The Installation Qualification typically includes tests of the System Requirements and the installation procedure. In the operational qualification, input, processing, output, and security testing are often tested.

There is now some discussion in the industry over who needs to examine the Design Specification due to the highly technical nature of most design papers. The System Owner, System Developer, and Quality Assurance must all examine and accept the Design Specification. Quality Assurance certifies that the document complies with the necessary laws and that all requirements were satisfactorily met, although they are not required to review technical data.

The functional requirements document and the design specification may be integrated, depending on the length and complexity of the programme.

3.8 VERIFICATION FOR DESIGN

Before starting the following phase's activities, the design activity's output needs to be confirmed. If the design is expressed in a formal notation for which analysis tools are available, then it can be checked for internal consistency using tools (for example, the modules used by others are defined, a module's interface is consistent with how others use it, data usage is consistent with declaration, etc.). The design cannot be processed using tools if it is not stated in a formal, executable language, hence alternative methods of verification must be utilised. Design review is the method of verification that is most frequently used.

Design reviews are conducted to make sure that the design meets the specifications and is of high quality. If mistakes are committed during the design phase, they will eventually show up in the code and the finished system. It is desirable if design problems are discovered early, before they reveal themselves in the system, as the cost of fixing faults brought on by design errors rises with the delay in recognising the errors. The goal of design reviews is to find design flaws.

Similar to the inspection process, the system design review process involves a group of people meeting to discuss the design in order to identify any flaws or undesired characteristics. A member of the system design team, a member of the detailed design team, the author of the requirements document, the author in charge of maintaining the design document, and an independent software quality engineer are all required to be on the review group. As with any review, it is important to remember that the meeting's goal is to identify design flaws rather than attempt to remedy them; fixing is done later.

Only the designer's imagination can constrain how many ways faults might creep into a design. The fact that the design does not fully fulfil some requirements, however, is the most significant design flaw. For instance, a scenario for an exception situation cannot be handled or a design constraint has not been met. Modularity is the primary factor in determining design excellence. Efficiency is another important factor for which a design is assessed, though, as it is necessary to test whether it can meet performance requirements.

3.9 MONITORING AND CONTROL FOR DESIGN

Control is a management function that aids in error detection and the implementation of corrective measures. This is done to ensure that the organization's stated goals are fulfilled in the desired manner and to reduce deviation from standards.

Monitoring is the process of routinely observing and documenting the actions occurring within a project or programme. It is a procedure for regularly compiling data on every facet of the project.

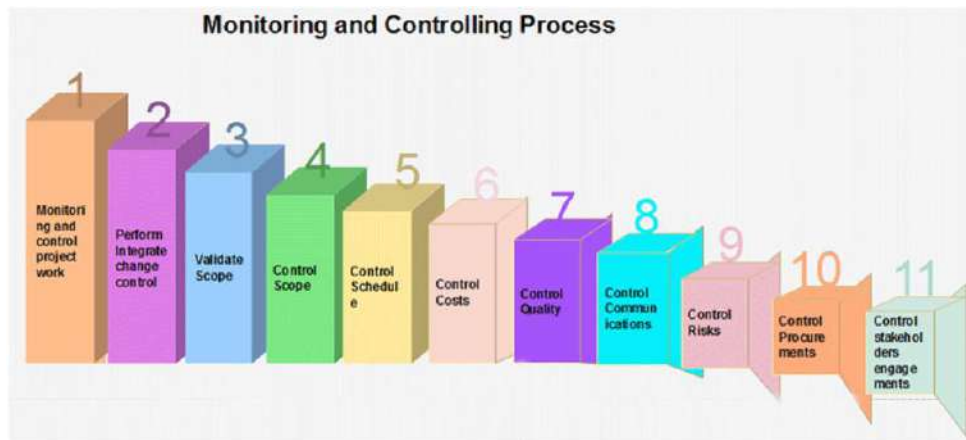
Project control includes the tools, process, people skills and experience, when integrated provide the right information at the right time to enable the right decision to be made. It mainly focusses on attributes such as Why, What, When, Where, and How.

Project monitoring helps to track project performance and progression using key performance indicators (KPIs) agreed during project planning.

- **Project monitoring and control**

The methods of tracking, reviewing, and regulating the project's performance are known as monitoring and controlling. It also detects any places where adjustments to the project management methodology are necessary and starts making those adjustments.

Eleven processes make up the Monitoring & Controlling process group, and they are as follows:



- 1] Monitor and control project work: The first stage, known as "monitor and control project work," is the umbrella step for all further monitoring and regulating operations.
- 2] Perform integrated change control: The procedures necessary to modify the project plan. The program is modified and reapproved by the project sponsor if adjustments to the schedule, budget, or any other aspect of the project management plan are required.
- 3] Validate scope: The procedures necessary to obtain project deliverable approval.
- 4] Control scope: Making sure that the project's scope does not change and that no unapproved actions are taken in accordance with the plan (scope creep).
- 5] Control schedule: The activities involved in making sure that project work is carried out in accordance with the schedule and that project deadlines are reached.
- 6] Control costs: The activities necessary to guarantee that the project expenses adhere to the approved budget.
- 7] Control quality: Assuring the project deliverables meet the quality standards outlined in the project management strategy.
- 8] Control communications: Attending to each project stakeholder's communication demands.
- 9] Control risks: preventing unforeseen occurrences that could have a detrimental influence on the project's budget, schedule, stakeholder requirements, or any other criterion for project success.
- 10] Control procurements: Ensuring that the project's vendors and subcontractors achieve the project's objectives.
- 11] Control stakeholder engagement: The activities necessary to guarantee that each project's stakeholders are happy with the outcome.

SUMMARY

A system's design is a strategy for a course of action that, if carried out, will satisfy the system's requirements and maintain its architectural integrity. The detailed design explains the processing logic of modules, whereas the module-level design identifies the modules that must exist in the system to execute the architecture.

If each module in a system has a clear abstraction and changes to one module have little effect on other modules, the system is said to be modular. Cohesion and coupling are two factors that are taken into account while assessing a design's modularity. Cohesion is a measurement of the degree to which the various components of a module are connected, whereas coupling depicts how dependent modules are on one another. In a design, coupling should typically be reduced and cohesiveness should be increased. The open-closed principle, which states that modules should be available

for extension but closed for alteration, should also be supported by the design.

According to the structured design technique, a design should be created (shown as a structure chart) so that the modules have a low amount of coupling and a high level of cohesiveness. In order to accomplish this, the technique divides the system into a number of subsystems, one for managing each significant input, one for managing each major output, and one for managing each major transformation. This neatly divides the system into sections that each independently address various issues.

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UNIT END EXERCISES

- 1] Explain the concept of system/ software design.
- 2] Write a note on architectural design.
- 3] Discuss on coupling.
- 4] Write a note on cohesion.
- 5] Illustrate the comparison between function-oriented and object-oriented approach.
- 6] Write a note on design specification.
- 7] Explain the concept of verification for design.
- 8] Define control and monitoring. Explain in brief the eleven steps involved in project monitoring and control process.

SOFTWARE MEASUREMENT AND METRICS

Unit Structure :

- 4.0 Objectives
- 4.1 Introduction
- 4.2 Product Metrics – Measures, Metrics, and Indicators
- 4.3 Function-Based Metrics
- 4.4 Metrics for Object-Oriented Design
- 4.5 Operation-Oriented Metric
- 4.6 User Interface Design Metrics
- 4.7 Metrics for Source Code
- 4.8 Halstead Metrics Applied to Testing
- 4.9 Metrics for Maintenance
- 4.10 Cyclomatic Complexity
- 4.11 Software Measurement: Size-Oriented Metrics
- 4.12 Function-Oriented Metrics
- 4.13 Metrics for Software Quality
 - 4.13.1 Measuring quality
 - 4.13.2 Defect removal efficiency

Summary

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Unit End Exercises

4.0 OBJECTIVES

- To understand the applicability of metrics in software engineering
- To get familiar with how the real time entities are associated with metrics and measurement
- To understand how metrics are used to evaluate the product's quality
- To get real time indication of effectiveness of test cases

4.1 INTRODUCTION

Measurement is a crucial component of every engineering process. You can evaluate the qualities of the engineered goods or systems you produce using metrics for knowing the characteristics of system you develop. SE however, is not based on fundamental rules of science of matter, unlike other

engineering fields. In the domain of software, direct measurements are rare. Metrics and measures are debatable since they are frequently indirect. Fenton speaks to this matter when he says:

Measurement is the process through which the characteristics of real-world entities are given numerical or symbolic values in order to define them in accordance with predetermined guidelines. We can now measure qualities that were once believed to be immeasurable. Even though these were not as accurate as others used to support crucial judgements.

This chapter describes metrics that can be used to evaluate the product's quality as it is being engineered.

4.2 PRODUCT METRICS – MEASURES, METRICS, AND INDICATORS

Perhaps these terms are frequently utilized synonymously, it's crucial to be aware of their little variations. It can be difficult to define measure because it can be employed as a verb or a noun. A measure offers a numerical manifestation of degree, quantity, capability, magnitude of certain feature.

A measurement has been established once a individual datum has been gathered, such as amount of faults. The act of measuring results from the gathering of one or more data points.

A software engineer gathers data and creates metrics in order to produce indicators. An indicator offers perception into the s/w development procedure, a s/w project, or finished result. Indication offers information allowing to improve project, procedure, or system.

4.3 FUNCTION-BASED METRICS

A useful tool for assessing the functionality a system provides is the function point (FP) metric and is used for forecasting following:

- (1) the measure or endeavour necessary to describe, write & deploy programme;
- (2) quantitative error measurement to discover during deployment
- (3) measure of entity to predicted line of codes in the incorporated model.

A quantitative evaluation of software complexity and countable (direct) metrics are used to produce function points. The following definitions apply to information domain values:

The quantity of external inputs (EIs): They delivers unique control driven data and knowledge, whether it comes directly from a user or is sent from another application. It's common practise to reform internal logical files using i/p's (ILFs). It is important to distinguish between inputs and enquiries, that are measured individually.

The number of external outputs (EOs): Every EO is procured information from the domain giving the user instruction. External output acknowledges screens, document, fault measurement, etc. A report does not count every piece of data independently.

Number of external enquiries (EQs): It is a web-based i/p triggering an S/W reply through accessible outcome.

Number of internal logical files (ILFs): There are a certain nos. of ILFs, of which is a rational collection of information kept up to date by external inputs and located within the application's boundaries.

Number of external interface files (EIFs): It is a rational collection of information kept apart from the application but contains data that the application may find useful.

Fig 1 is finished & difficulty metric is assigned to every measure once these data have been gathered. Organizations that employ function point methodologies create standards for classifying entries as easy, medium & difficult. Assessment of difficulty is, nevertheless, rather arbitrary.

Information Domain Value	Count		Weighting factor			
			Simple	Average	Complex	
External Inputs (FIs)		×	3	4	6	=
External Outputs (EOs)		×	4	5	7	=
External Inquiries (EQs)		×	3	4	6	=
Internal Logical Files (ILFs)		×	7	10	15	=
External Interface Files (EIFs)		×	5	7	10	=
Count total						→

Figure 1: Computing function points

To calculate FP below equation is used:

$$FP = \text{Total count} \times [0.65 + 0.01 \times \sum (F_i)]$$

Where count total is the summation of all the FP entries that will be obtained from figure 1.

Value adjustment factors (VAF) F_i ($i = 1$ to 14) are determined by the answers to the following inquiries:

1. Is dependable backup and recovery required for the system?
2. Will the application need specialised data communications to send or receive information?
3. Do distributed processing operations exist?
4. Is performance a top priority?

5. Can the system operate in a current, highly trafficked operational environment?
6. Is online data entry required by the system?
7. Do numerous screens or activities need to be included into the input transaction for online data entry?
8. Are the ILFs recovered?
9. How complicated are i/p's, o/p's, binder, or investigations?
10. Is internal processing sophisticated?
11. Was the code created with reuse in mind?
12. Is installation and conversion taken into account in the design?
13. Can the system be installed more than once in various organisations?
14. Is the programme created with the user's ability to alter and use it easily in mind?

Answers to all the above set of questionnaires are given on scale from 0 (not useful) to 5 (very useful).

4.4 METRICS FOR OBJECT-ORIENTED DESIGN

As the size and complexity of an OO design model increase, a more impartial assessment of the design's attributes can be advantageous to both the experienced designer and the beginner designer by providing them with information about the design's quality that they would not otherwise have. Whitmire offers nine different and measurably observable properties of an OO design in a thorough examination of S/W:

- **Size:** Four perspectives - population, volume, length, and functionality are used to define size. A fixed measure or actions, is used to determine population. Volumetric measurements is similar to populace measurements gathered at specific moment. A chain of related design elements can be measured by their length & is used as a metric of length. Functionality measurements offer a hazy picture of the value an OO application brings to the consumer.
- **Complexity:** Similar to size, there are many different opinions on what constitutes complexity in software. Whitmire analyses the relationships between classes in an OO architecture to understand complexity in terms of structural traits.
- **Coupling:** In an OO system, this is represented through interlinks across components of the architecture.
- **Sufficiency:** From perspective of the current application, sufficiency is defined by Whitmire as "extent to which an extraction incorporates the characteristics expected". In other words, we search for: "Which qualities is required to have for me finding it essential?" Fundamentally, a design element is enough if it accurately captures

each the characteristics of modelling process, i.e., if the abstraction (class) has all of the features that are necessary.

- **Completeness:** "The characteristic set through which we assess the extraction or architectural module" is only distinction between completeness and sufficiency. According to the current use, sufficiency compares the abstraction. Completeness takes into account several viewpoints and poses the following query: "What qualities are necessary to fully represent the issue domain object?" This indirectly implied by the criterion for completeness' consideration of many points of view.
- **Cohesion:** An OO module must be created in such a way that every computation cooperates to fulfil individual, clear goal, just as its analogue in traditional software. The extent of "the collection of qualities it holds is proportion of difficulty or architecture framework" is used to assess a class's cohesion.
- **Primitiveness:** This implies along with operations; classes are a quality akin for simplicity. It describes how atomic an operation is, how easily it cannot be created from a series of other actions found within a class. A class with a lot of primitive behaviour only contains primitive operations.
- **Similarity:** This measure indicates how similar multiple objects are in accordance of their structural formulation and its functionality, behaviour, or requirements.
- **Volatility:** Architectural modifications might take place when necessities are altered or alterations take place in areas necessary in adaption of the questioned design component. An OO design component's volatility gauges how likely a change is to occur.

4.5 OPERATION-ORIENTED METRIC

By looking at typical characteristics for approaches, some new information can be discovered (operations). According to Lorenz and Kidd, three straightforward measurements are pertinent:

- **Average operation size (OS_{avg}):** The amount of lines of program forwarded through manipulations can be used to calculate the average operation size (OS_{avg}). It is probably the case that duties have not been fairly distributed within a class when the volume of messages delivered by a single operation increase.
- **Operation complexity (OC):** Any complexity measure suggested for traditional software can be used to calculate an operation's complexity. The designer should make an effort to keep OC as low as feasible since operations should be restricted to a single task.
- **Average number of parameters per operation (NP_{avg}):** Complexity of object collaboration increases with the number of operation parameters. NP_{avg} is generally maintained at lower values.

4.6 USER INTERFACE DESIGN METRICS

There is a dearth of data on the metrics that would reveal the interface's usability and quality.

Layout Appropriateness (LA), according to Sears, is valuable development measure for articulation. Conventional GUI aids users in executing tasks by using layout items. Client using a GUI must switched from one format to another in order to complete a job.

According to a research of Web page metrics, the layout's simple qualities can also have a big impact on how well the architectural pattern is received. Amount of text, references, pictures, colours, and typefaces (among other features) on a Web page determine how sophisticated and high-quality the page is regarded to be.

The choice is influenced by measures like LA, but user feedback based on GUI prototypes should be the ultimate arbitrator. According to Nielsen and Levy, "if one selects amongst interface [designs] based simply on users' opinions, one has a relatively large likelihood of success. There is a strong correlation between a user's subjective happiness with a GUI and their average task performance.

4.7 METRICS FOR SOURCE CODE

The first analytic "laws" for computer software were proposed by Halstead's "software science" hypothesis. Halstead used a collection of crude measurements that is determined after program is written or calculated after completion of architectural pattern to create the firmware. These are as follows:

n1: the number of unique operators in a program

n2: the quantity of unique operands in a program

N1: overall operator occurrences

N2: total number of repetitions of the operand

Above fundamental measurements are used by Halstead to create formulations for the complete program.

Halstead shows that length N can be estimated using

$$N = n_1 \log_2 n_1 + n_2 \log_2 n_2$$

And program volume is defined as

$$V = N \log_2 (n_1 + n_2)$$

Where V denotes the amount of information (in bits) needed to express a programme, varies depending on the programming language.

Theoretically, a specific algorithm must have a minimal volume. According to Halstead, a volume L is proportion between the vol of a program's dense form and its actual volume. L must actually always be smaller than 1. Primitive measurements allow us to express the volume ratio as

$$L = [(2 / n_1) * (n_2 / N_2)]$$

4.8 HALSTEAD METRICS APPLIED TO TESTING

Utilizing metrics generated from Halstead measurements, testing effort can be calculated. Halstead effort e can be calculated as

$$PL = \frac{1}{(n_1/2) \times (N_2/n_2)}$$

$$e = \frac{V}{PL}$$

The following relationship can be used to estimate the proportion of deployment to be assigned to division k :

$$\text{Percentage of testing effort } (k) = \frac{e(k)}{\sum e(i)}$$

where denominator represents total Halstead effort put forth by all of the system's modules.

4.9 METRICS FOR MAINTENANCE

Both the creation & upkeep of latest firmware can make use of all the firmware measures discussed here. However, metrics specifically created for maintenance tasks have been put forth.

Software maturity index (SMI), which is recommended by IEEE Std. 982.1-1988 [IEE93], offers a sign of the solidity of a firmware legacy (required for modifications taking place for every version). The below details are discovered:

M_T = number of modules in the current release

F_c = number of modules in the current release that have been changed

F_a = number of modules in the current release that have been added

F_d = number of modules from the preceding release that were deleted in the current release

The software maturity index is computed in the following manner:

$$SMI = \frac{M_T - (F_a + F_c + F_d)}{M_T}$$

As SMI gets closer to 1, it starts to sustain. SMI can be utilized as statistic while scheduling firmware monitoring tasks. It is possible to create empirical models for maintenance effort and to associate the average pattern to generate a reveal of a firmware.

4.10 CYCLOMATIC COMPLEXITY

This measure offers numerical assessment of the logical difficulty of a programme. Graph theory serves as the basis for cyclomatic complexity, which offers you a very helpful software metric. One of three methods is used to compute complexity:

1] The number of regions of the flow graphs corresponds to cyclomatic complexity

2] Cyclomatic complexity $V(G)$ for a flow graph G is defined as

$$V(G) = E - N + 2$$

Where,

E: Number of flow graph edges

N: Number of flow graph nodes

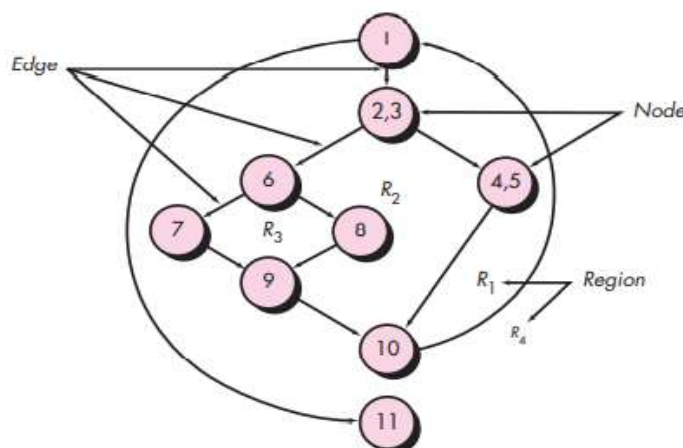
3] Cyclomatic complexity $V(G)$ for a flow graph G is also defined as

$$V(G) = P + 1$$

Where,

P: number of predicate nodes contained in the flow graph G

For example: Consider the flow graph as shown in the following figure



For this figure the cyclomatic complexity can be computed using each of the algorithms just noted

1] The flow graph consists of 4 regions

2] $V(G) = 11 \text{ edges} - 9 \text{ nodes} + 2 = 4$

3] $V(G) = 3 \text{ predicate nodes} + 1 = 4$

Therefore, the flow graph in Figure has a cyclomatic complexity of 4.

More importantly, the value for $V(G)$ gives you an upper constraint on the number of independent routes that make up the basis set, and thus, an upper bound on the number of tests that must be created and run to ensure that every programme statement is covered.

4.11 SOFTWARE MEASUREMENT: SIZE-ORIENTED METRICS

Size-oriented software metrics are created by averaging productivity and/or quality measurements while taking into account the size of the software that has been created. A table of size-oriented measurements, like the one in Figure 2, can be made if a software organisation keeps simple records. The table includes a list of all finished software development projects over the previous few years together with the relevant project measures. According to the table entry (Figure 2) for project alpha, \$168,000 was spent to create 12,100 lines of code over 24 person-months.

Project	LOC	Effort	\$(000)	Pp. doc.	Errors	Defects	People
alpha	12,100	24	168	365	134	29	3
beta	27,200	62	440	1224	321	86	5
gamma	20,200	43	314	1050	256	64	6
•	•	•	•	•	•		
•	•	•	•	•	•		
•	•	•	•	•	•		

Figure 2: Size-oriented metrics

It should be noted that the work and costs listed in the table cover all software engineering activities, not only coding, including analysis, design, coding, and testing. According to additional data for project alpha, 365 pages of documentation were created, 134 faults were discovered prior to the software's release, and 29 problems were found within the first year of operation after the software's release to the client. The software for project alpha was developed by three persons.

You can decide to use the number of lines of code as a normalisation variable in order to create metrics that can be combined with comparable metrics from other projects. A set of straightforward size-oriented measures may be constructed for each project from the basic data in the table:

- Errors per KLOC (thousand lines of code)
- Defects per KLOC
- \$ per KLOC
- Pages of documentation per KLOC

In addition, other interesting metrics can be computed:

- Errors per person-month
- KLOC per person-month
- \$ per page of documentation

Not everyone agrees that the best method to evaluate the software process is through size-oriented measures. The usage of lines of code as a crucial indicator is where the majority of the disagreement centres. The LOC measure's proponents assert that LOC is an easily countable "artefact" of all software development projects, that many current software estimation models employ LOC or KLOC as a crucial input, and that a substantial body of research and data based on LOC already exist. Opponents counter that LOC measures are dependent on the programming language being used, that they penalise well-designed but shorter programmes when productivity is taken into account, that they cannot easily accommodate nonprocedural languages, and that their use in estimation necessitates a level of detail that may be challenging to achieve (i.e., the planner must estimate the LOC to be produced long before analysis and design have been completed).

4.12 FUNCTION-ORIENTED METRICS

A measure of the functionality provided by the programme is used as a normalisation value in function-oriented software metrics. The function point is the most used function-oriented measure (FP). The information domain and complexity properties of the software are used to compute the function point.

Like the LOC measure, the function point is debatable. According to supporters, FP is more appealing as an estimation strategy because it is based on data that are more likely to be known early in the lifecycle of a project and is independent of programming language, making it perfect for applications employing traditional and nonprocedural languages. The method's detractors assert that it requires some "sleight of hand" because the computation is based on subjective rather than objective data, that it can be challenging to gather counts of the information domain (and other dimensions) after the fact, and that FP has no immediate physical significance – it's just a number.

4.13 METRICS FOR SOFTWARE QUALITY

Producing a high-quality system, application, or product in a timely manner that answers a market need is the primary objective of software engineering. You must use efficient techniques along with cutting-edge tools inside the framework of an established software process in order to accomplish this goal. If high quality is to be achieved, a competent software engineer (and effective software engineering managers) must measure.

A system, application, or product is only as good as its requirements, which outline the issue, design, which represents the solution, code, which creates an executable program, and tests, which put the software to the test to find bugs. As the software is being developed, measurement can be used to evaluate the quality of the test cases, source code, and requirements and design models that have been produced. You use product metrics to evaluate the quality of the work products produced by software engineering in order to complete this real-time review in an objective rather than subjective manner.

As the project advances, a project manager must also assess quality. Software engineers' private measurements are pooled to produce outcomes at the project level. The main focus at the project level is to measure mistakes and defects, despite the fact that various quality measurements can be gathered. Metrics derived from these measurements show how well both individual and group software quality assurance and control efforts are doing.

Metrics that measure the effectiveness of each of the actions implied by the metric, such as work product errors per function point, errors discovered per review hour, and errors discovered per testing hour, can be used. The defect removal efficiency (DRE) for each process framework activity can also be calculated using error data.

4.13.1 Measuring quality

Although there are numerous ways to gauge software quality⁸, the project team can utilize correctness, maintainability, integrity, and usability as valuable benchmarks. Gilb suggests definitions and measures for each

- **Correctness:** A program must function properly in order to be useful to its users. The degree to which the software fulfills its necessary purpose is known as correctness. Defects per KLOC, where a defect is defined as a validated lack of conformity to requirements, is the most popular metric for correctness. Defects are issues that a user of the program reports after the program has been made available for general use. These issues are taken into account when evaluating the overall quality of a software product. Defects are counted over a defined time period, usually one year, for quality evaluation purposes.
- **Maintainability:** Compared to other software engineering tasks, software maintenance and support need the most work. A program's

maintainability refers to how easily it can be fixed when an error occurs, adjusted when its environment changes, or improved when the client requests a change in requirements. Since maintainability cannot be measured directly, indirect methods must be used. Mean-time-to-change (MTTC), which measures the time required to study a change request, develop an acceptable modification, implement the change, test it, and distribute the change to all users, is a straightforward time-oriented statistic. For equivalent types of modifications, maintainable programs often have a lower MTTC than unmaintainable programs.

- **Integrity:** In the era of online hackers and terrorists, software integrity has grown in importance. This characteristic evaluates a system's resistance to security threats, both unintentional and intentional. Programs, data, and documentation are the three elements of software that are vulnerable to attacks.

Threat and security are two additional variables that must be defined in order to quantify integrity. Threat is the likelihood that an attack of a particular type will take place within a certain period of time (which can be estimated or inferred from empirical evidence). Security is the likelihood that an assault of a particular type will be thwarted, which can be calculated or determined from empirical evidence. Thus, the definition of a system's integrity is

$$\text{Integrity} = \Sigma [1 - (\text{threat} \times (1 - \text{security}))]$$

- **Usability:** Even if a program performs valuable functions, it is typically destined to failure if it is difficult to use. Usability is an attempt to measure usability.

4.13.2 Defect removal efficiency

Defect removal efficiency is a quality indicator that benefits both projects and processes (DRE). DRE essentially measures the effectiveness of quality assurance and control actions as they are applied throughout all activities governed by the process framework.

When taken into account for a project as a whole, DRE is described as follows:

$$\text{DRE} = [E / (E + D)]$$

where E is the number of mistakes discovered before to the software being delivered to the end user and D is the number of flaws discovered following delivery.

DRE should be set to a value of 1. In other words, the software has no flaws. Realistically, D will be bigger than 0, but as E rises for a particular value of D, the value of DRE can still get closer to 1. In reality, it is likely that the final value of D will decrease as E increases (errors are filtered out before they become defects). DRE urges a team working on software projects to use methods for locating as many errors as feasible before delivery if used

as a metric that shows the effectiveness of quality control and assurance efforts.

DRE may also be used inside to a project to evaluate a team's capacity to identify mistakes before they are forwarded to the following framework or software engineering activity. A requirements model, for instance, is created by a requirements analysis and may be checked over to identify and fix flaws. The design phase is where any errors that were not discovered during the requirements model review may or may not be discovered. DRE is redefined as follows in this context:

$$DRE_i = \frac{E_i}{E_i + E_{i+1}}$$

where E_i is the total number of mistakes made in software engineering action I and E_{i+1} is the total number of mistakes made in software engineering action $I + 1$ that can be linked to mistakes made in software engineering action i . Achieving DRE_i that is close to 1 is a quality goal for a software team (or a single software developer). In other words, faults ought to be caught before being passed on to the subsequent activity or action.

SUMMARY

You can evaluate quality before the product is produced thanks to software metrics, which offer a quantifiable technique to evaluate the quality of internal product attributes. Metrics give you the knowledge you need to produce effective requirements and design models, reliable code, and exhaustive tests. A software measure needs to be straightforward, calculable, compelling, consistent, and objective in order to be helpful in real-world settings. It should be independent of the programming language you're using and give you useful feedback.

Function, data, and behavior: the model's three component are the main metrics for the requirements model. Design metrics take into account concerns with architecture, component-level design, and interface design. Metrics for architectural design take into account the model's structural elements. By creating proximate measures for cohesion, coupling, and complexity, component-level design metrics give an indicator of module quality.

At the source code level, Halstead gives a fascinating collection of metrics. Software science offers a range of metrics to evaluate program quality based on the number of operators and operands contained in the code. There aren't many product metrics that have been directly suggested for use in software testing and maintenance. The testing process can be guided by a variety of additional product criteria, which can also be used to evaluate a computer program's maintainability. The testability of an OO system has been evaluated using a wide range of OO metrics.

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- 4] Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons.
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UNIT END EXERCISES

- 1] What are the aspects of product metrics?
- 2] Explain the terminologies: Measures, Metrics and Indicators.
- 3] What do you mean by function-based metrics?
- 4] Write a note on metrics for object-oriented design.
- 5] Explain operation-oriented metrics.
- 6] What do you mean by user interface design metrics?
- 7] Discuss on metrics for source code.
- 8] Explain the Halstead metrics applied to testing.
- 9] Write a note on metrics for maintenance.
- 10] What do you mean by cyclomatic complexity? Discuss with examples to find the cyclomatic complexity of the graph.
- 11] Explain size-oriented metrics.
- 12] Discuss on function-oriented metrics.
- 13] Write a note on metrics for software quality.
- 14] Explain the term: Measuring quality.
- 15] Discuss the concept of defect removal efficiency.



SOFTWARE PROJECT MANAGEMENT

Unit Structure :

5.0 Objectives

5.1 Introduction

5.2 Estimation in Project Planning Process

5.3 Software Scope and Feasibility

5.4 Resource Estimation

5.4.1 Human resources

5.4.2 Reusable software resources

5.4.3 Environmental resources

5.5 Empirical Estimation Models – COCOMO II

5.6 Estimation for Agile Development

5.7 The Make/Buy Decision

5.7.1 Creating a decision tree

5.7.2 Outsourcing

Summary

List of References

Unit End Exercises

5.0 OBJECTIVES

- To understand the process involve in project planning
- To get acquaint with the scope and feasibility related to the software
- To get familiar with different estimation model and their workflow

5.1 INTRODUCTION

Project planning, a collection of related tasks, serves as the foundation for software project management. The software team must determine how much work will need to be done, what resources will be needed, and how much time it will take for completing the reckon before it can start. After completing these steps, the firmware management group must create a project schema outlining the firmware highlights, assigns accountability for each job, and details any inter-task dependencies that could significantly affect progress.

Steve McConnell offers a practical perspective on project planning in his outstanding manual for "software project survival":

Many technical personnel would prefer to do technical tasks than to prepare. Many technical managers lack the technical management training necessary to be confident that their planning will enhance the success of a project. No one wants to plan; thus, it frequently doesn't get done.

Efficient organization is required for handling issues upstream than downstream at high expense. However, failing to prepare is one of the most crucial mistakes a project can make. Rework, or correcting errors from earlier in the project, takes up an average of 80% of a project's time.

5.2 ESTIMATION IN PROJECT PLANNING PROCESS

Goal is to give the manager a complete schema so they can estimate resources, costs, and schedules in a fair manner. In order for project outcomes to be bounded, estimates should also make an effort to specify best scenarios and worst phase situations. The firmware group starts out on objectives formed as a result of these occupants, despite fact that there is a certain amount of inherent unpredictability. Therefore, as the project advances, the schema should be modified and refurbished.

Iterative planning begins with the creation of a starting schema in the launching stage. Fig 1 depicts a project planning process' framework. Plans will inevitably alter. You should routinely amend to subjective necessities, plan of action, and threaten measures as additional details about the module and the group come to light for the execution stage. Project plans alter as a result of shifting corporate objectives. Any initiatives that are affected by shifting corporate objectives may need to be rescheduled.

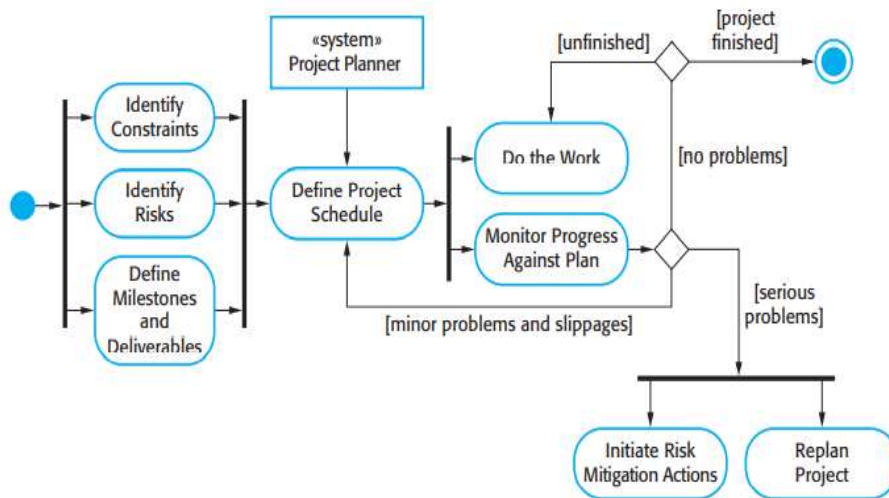


Figure 1: Project planning process

You should evaluate the project's limits before commencing a planning process. These limitations include the deadline for delivery, the number of employees on hand, the overall budget, the tools at hand, and others. One must specify the glimpses and highlights in conjunction with this. Milestones are dates on the timetable that can be used to gauge progress, such as when the system is turned over for deployment.

The procedure loops back on itself. You create an estimated project timetable, and the tasks outlined in it are started or given the go-ahead to continue. You should examine your work after certain time stamp & make notice of any deviations from the original timeline. Few of the changes are common and one must need to modify the actual framework because early estimations of project parameters are inherently approximate.

When drafting a project plan, it's crucial to be practical. During a project, some sort of issue almost always arises, and this might cause project delays. So, instead of being optimistic, your first assumptions and scheduling should be pessimistic. Your plan should include enough contingency restrictions through the cycle.

You must start risk mitigation steps if any substantial issues with the enlargement task expected causing a considerable detain in order to lower the risks of project failure exists. Along with these steps, the project needs to be replanned. Renegotiating the project's restrictions and deliverables with the client may be necessary for this. Additionally, a new timeline for when the job should be finished must be devised and approved by the client.

You should set up a formal project technical review if the measures are insufficient. The goals of this review are to discover a different strategy enabling the task to proceed & to determine whether the task, its estimate, the customer's aim, and the firmware goals are in alignment.

A review may result in the recommendation to halt a task. This could be the outcome of managerial or technological errors but frequently results from outside changes that have an impact on the project. Large software projects can take several years to create. The business's goals and priorities will unavoidably alter during that time. These adjustments can indicate that firmware is not necessary or that the original needs are insufficient.

5.3 SOFTWARE SCOPE AND FEASIBILITY

The term "software scope" refers to a system's performance, limitations, interfaces, and dependability as well as the features and functions that must be provided to users as well as the i/p & o/p information along with the "content" the users see as a result of using the system. One of two methods is used to define scope:

1. Following discussions with all stakeholders, a chronicle explanation of the firmware span is created.
2. End users create a collection of use cases.

Prior to the start of estimation, the functions outlined in the context assessed and, in few of the instances, improved in offering information. Due to functional orientation estimations, some level of decomposition is frequently helpful. Processing and reaction times are taken into account while evaluating performance. Constraints are boundaries imposed on the software by other systems already in place, available memory, or external hardware.

After the scope is determined (with the customer's approval), it's appropriate in inquiring, "Can we design firmware to satisfy the described

projection? Can it be completed? Frequently managers force software engineers to skip through these questions, which leads to them being bogged down in a project that is doomed from the start. When they write, Putnam and Myers address this problem.

No matter how ephemeral it might seem to outsiders, not everything that can be imagined is possible, not even in software. Contrarily, software viability has four dependable dimensions:

- **Technology:** Using current technology, can a project be completed? Is it up to date with technology? Can flaws be minimized to a level appropriate for the application?
- **Financial viability:** Is it possible? Can the cost of development be kept within the means of firmware company, its user, or the space captured?
- **Time:** Will the project's time to market outperform that of the competition?
- **Resources:** Has the company acquires necessities for gaining profits and capturing the market?

Although sometimes disregarded, these are important step in the estimating process.

5.4 RESOURCE ESTIMATION

Estimating the necessities required for completion of the software development project is the second planning step. Figure 2 shows the development environment, reusable software components, and people as 3 main criteria of SE (hardware and S/W tools). Four features are listed for each resource: a detail illustrating the requirement, a list of available quantities, the time required for resource estimation, & the number of instances it get used. You might think of the final two attributes as a time frame. The availability should be determined as soon as is practically possible.

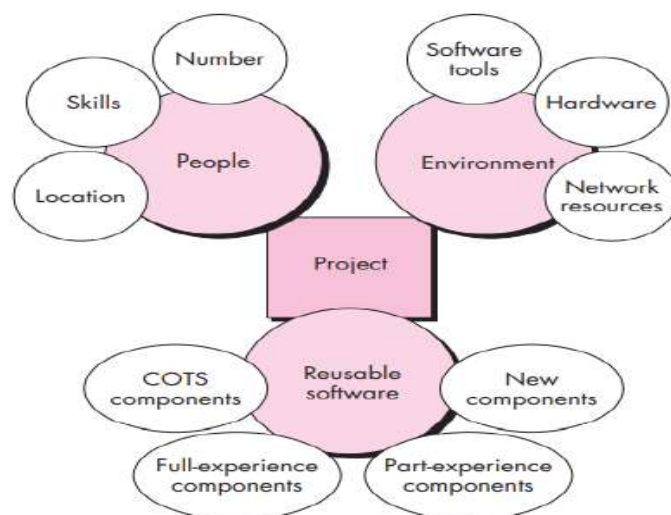


Figure 2: Project resources

5.4.1 Human resources

One must start through assessing the firmware extent and choosing required talents necessary for finishing the deployment. Twain organisational orientation and the specificity are mentioned. One person may do all software engineering activities consulting with experts as needed. The software crew may be geographically scattered over several distinct sites for larger projects. As a result, each human resource's location is given. Only once a development effort estimate (e.g., person-months) is developed can the required staff for a software project be estimated.

5.4.2 Reusable software resources

Reusability - the production and usage of software building blocks is emphasised by component-based software engineering (CBSE). Such building blocks, also known as components, need to be standardised for easy use, validated for easy integration, and catalogued for easy reference. As planning moves forward, Bennatan recommends taking into account the following four categories of software resources:

Components available from stores: existing software that is available from a previous project or from a third party. Components that are COTS (commercial off-the-shelf) are bought from arbitrator, completely vetted, and prepared for usage on the present project.

Full experience elements: Past projects' specifications, designs, codes, or test data comparable to firmware that is developed for present task. Protuberance of the ongoing firmware development group has extensive circumstance in the domain they represent. As a result, the chance of adjustments needed will be reduced.

Fragmentary experience modules: Partially developed requirements, frameworks, codes, or deployment information that are connected to the software to be developed for the present project but will need to be significantly modified. The current software team has only a little amount of expertise working with the application domain that these components represent. Therefore, there is a moderate amount of risk associated with adjustments needed for partial-experience components.

New components: The software team must create new software components expressly to meet the demands of the ongoing framework.

Recyclable firmware modules, ironically frequently overlooked across planning but addresses a top priority later in the firmware development procedure. Early software resource requirements definition is preferable. This allows for the technical assessment of the alternatives and prompt procurement.

5.4.3 Environmental resources

Software engineering environment (SEE), which enables firmware projects, combines both hardware and software. The firmware needed for creating the entities is a result of strong SE practise are supported by hardware. One

should specify the formulation range necessary for H/W and S/W & ensure its availability. Software Project Management

The S/W group can need approaching to H/W pieces created by different group members. For instance, as part of the validation test phase, S/W used in a production environment could need particular robot according to its operation intended to perform. Planning must include the specification of each hardware component.

5.5 EMPIRICAL ESTIMATION MODELS – COCOMO II

To aid in estimating the effort, timing, and expenses of a software project, a number of models have been put forth. An empirical model called COCOMO II was created by compiling data from numerous software applications. These data were examined in order to identify the formulas that best suit the observations. These equations related the effort to construct the system to the system's size as well as to project, team, and product factors. A well-documented and open-source estimating model is COCOMO II.

Earlier COCOMO cost estimating models, which mostly relied on original code creation, served as the foundation for COCOMO II. The COCOMO II model takes into account more contemporary methods of software development, including component-based development, quick development using dynamic languages, and database programming. The spiral model of development is supported by COCOMO II, which also incorporates sub models that result in ever-more-detailed estimations.

As shown in the figure 3, the sub models that are a part of COCOMO II model are:

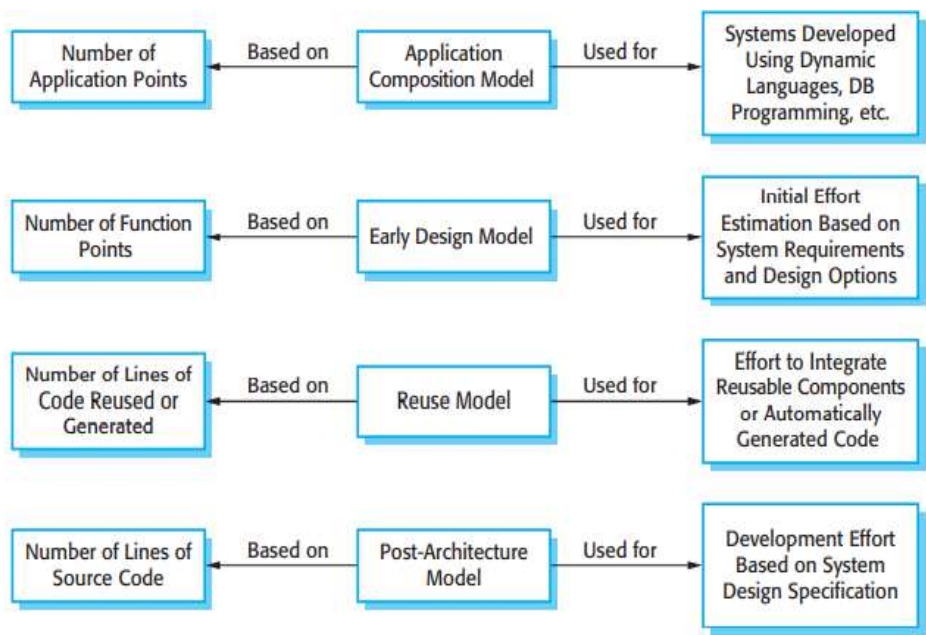


Figure 3: COCOMO estimation models

- 1] An application-composition model: This represents the effort needed to design systems made up of scripting, database programming, or reusable components. Application points are utilised to evaluate software size, and a straightforward size/productivity calculation is employed to calculate the work needed. A program's application points are a weighted average of the number of distinct screens that are shown, the number of reports generated, the number of modules in imperative programming languages (like Java), and the number of lines of scripting language or database programming code.
- 2] An early design model: After the requirements have been identified, this model is employed in the early stages of the system design. With a condensed set of seven multipliers, the estimate is based on the common estimating formula I covered in the introduction. The number of source code lines are translated from function points, on which the estimates are based, into function points. A language-independent method of measuring programme functionality is using function points. You can determine how many external inputs and outputs, user interactions, external interfaces, and files or database tables that the system uses by counting or estimating them.
- 3] A reuse model: It is used to determine how much work is involved in integrating reusable parts and/or automatically generated computer code. It frequently functions in tandem with the post-architecture model.
- 4] A post-architecture model: After the system architecture is created, it is possible to determine the software size with more accuracy. It includes a larger set of 17 multipliers that reflect project, product, and personnel aspects.

Of However, with huge systems, not every component needs to be estimated with the same level of precision because different system components may have been designed using various technologies. In such circumstances, you can combine the findings to get a composite estimate by using the appropriate sub model for each component of the system.

Following the determination of complexity, the number of screens, reports, and components is weighted in accordance with the table shown in Figure 4. The object point count is then calculated by averaging the overall object point count after multiplying the initial number of object instances by the weighting factor in the figure. The object point count is updated and the percent of reuse (%reuse) is estimated when component-based development or generic software reuse is to be used:

$$NOP = (\text{object points}) \times [(100 - \%reuse)/100]$$

Where, NOP = new object points

Object type	Complexity weight		
	Simple	Medium	Difficult
Screen	1	2	3
Report	2	5	8
3GL component			10

Figure 4: Complexity weighting for object types

To derive an estimate of effort based on the computed NOP value, a “productivity rate” must be derived

$$\text{PROD} = \frac{\text{NOP}}{\text{person-month}}$$

for different levels of developer experience and development environment maturity.

Once the productivity rate has been determined, an estimate of project effort is computed using

$$\text{Estimated effort} = \frac{\text{NOP}}{\text{PROD}}$$

In more advanced COCOMO II models, a variety of scale factors, cost drivers, and adjustment procedures are required.

5.6 ESTIMATION FOR AGILE DEVELOPMENT

Due to the fact that an agile project's needs are established by a collection of user scenarios (such as the "stories" in Extreme Programming), it is possible to create an estimation method that is informal, moderately disciplined, and useful for project planning for each software increment. Agile projects estimate using a decomposition method that includes the following steps:

- 1] For estimation purposes, each user scenario - the project's equivalent of a miniature use case created by end users or other stakeholders at the outset is taken into account separately.
- 2] The collection of software engineering tasks that will be necessary to create the scenario are broken down.
- 3a] Each task's effort requirement is estimated separately. Note: An estimation may be supported by empirical modelling, historical facts, or "experience."
- 3b] Alternatives include estimating the "volume" of the scenario in LOC, FP, or another volume-oriented measure (e.g., use-case count).

- 4a] To build an estimate for the scenario, the estimates for each task are added up.
- 4b] Alternatively, using historical data, the volume estimate for the scenario is converted into effort.
- 5] The effort estimates for a given software increment is created by adding the work estimates for all of the scenarios that need to be implemented.

This estimation approach serves two functions because the project length needed to produce a software increment is fairly brief (usually three to six weeks):

- (1) to ensure that the number of scenarios included in the increment is in accordance with the resources available, and
- (2) to create a framework for dividing up work as the increment develops.

5.7 THE MAKE/BUY DECISION

It is frequently more economical to buy software than to produce it in many software application domains. Software engineering managers must decide whether to make or buy, which can be compounded further by a variety of acquisition options:

- (1) Off-the-shelf software can be purchased (or licenced),
- (2) Software components with "full-experience" or "partial-experience" may be purchased, modified, and combined to fulfil particular demands, or
- (3) A third option is for an outside contractor to create software specifically to the buyer's requirements.

The criticality of the software to be purchased and the final cost determine the phases involved in software acquisition. In some circumstances (such as low-cost PC software), it is less expensive to make a one-time purchase and experiment than it is to carry out a thorough study of available software options. In the end, the choice to make or buy is dependent on the following factors:

- (1) Will the software product's delivery date be earlier than the date for internally generated software?
- (2) Will the price of customisation and acquisition be less than the price of in-house software development?
- (3) Will external support (such a maintenance contract) be cheaper than internal support? Each of the acquisition possibilities is subject to these requirements.

5.7.1 Creating a decision tree

Statistical methods like decision tree analysis can be added to the just-described procedures. Figure 5 shows a decision tree for software-based system X as an illustration. The software engineering organisation can in this situation

- 1) build system X from the scratch,
- 2) To build the system, reuse existing partial-experience components,
- 3) Purchase a pre-existing software item and change it to match local requirements, or
- 4) assign the software development to a third-party contractor

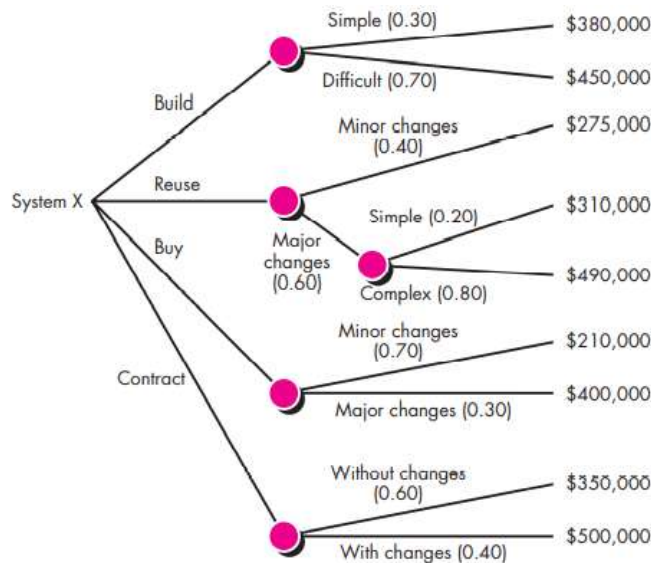


Figure 5: Decision-tree to support the make/buy decision

A 70% chance exists that the task of creating the system from scratch will be challenging. The project planner calculates that a challenging development endeavour will cost \$450,000 using the estimation approaches. The anticipated cost of a "basic" development project is \$380,000. Calculated along any decision tree branch, the predicted value for cost is

$$\text{Expected cost} = \sum (\text{path probability})_i \times (\text{estimated path cost})_i$$

where i is the decision tree path. For the build path,

$$\text{Expected cost}_{\text{build}} = 0.30 (\$380\text{K}) + 0.70 (\$450\text{K}) = \$429\text{K}$$

Following other paths of the decision tree, the projected costs for reuse, purchase, and contract, under a variety of circumstances, are also shown. The expected costs for these paths are

$$\text{Expected cost}_{\text{reuse}} = 0.40 (\$275\text{K}) + 0.60 [0.20 (\$310\text{K}) + 0.80 (\$490\text{K})] = \$382\text{K}$$

$$\text{Expected cost}_{\text{buy}} = 0.70 (\$210\text{K}) + 0.30 (\$400\text{K}) = \$267\text{K}$$

$$\text{Expected cost}_{\text{contract}} = 0.60 (\$350\text{K}) + 0.40 (\$500\text{K}) = \$410\text{K}$$

The "purchase" option has the lowest predicted cost based on the probability and projected costs shown in Figure. It's crucial to remember, though, that while making a purchase, a variety of factors more than just price must be taken into account. A few factors that could influence whether to build, reuse, buy, or contract include availability, experience of the developer, vendor, or contractor, compliance to specifications, local "politics," and the chance of change.

5.7.2 Outsourcing

Every business that creates computer software eventually wonders the same fundamental question: "Is there a way we can get the software and systems we need for a lesser price?" The answer to this question is not straightforward, and the heated debates that follow the subject always come down to one word: outsourcing.

Outsourcing is quite straightforward in theory. A third party is hired to perform software engineering tasks at a reduced cost and, ideally, a higher standard. A company's internal software development is really just contract management.

The choice to outsource might be tactical or strategic. Business managers analyse whether a sizable fraction of all software work may be outsourced at the strategic level. A project manager decides whether subcontracting the software work is the most effective way to complete all or a portion of a project at the tactical level. Regardless of the scope of the decision, outsourcing is frequently a financial one.

On the bright side, lowering the number of software employees and the infrastructure (such as computers) that supports them typically results in cost savings. On the down side, a business loses some control over the necessary software. A business risks the danger of entrusting a third party with the fate of its competitiveness because software is a technology that distinguishes its systems, services, and products.

Without a doubt, the trend toward outsourcing will persist. The only way to stop the trend is to acknowledge how fiercely competitive software work is at all levels. The only way to survive is to match the outsourcing providers' level of competition.

SUMMARY

Before a project starts, a software project planner must make three estimations: how long it will take, how much work it will require, and how many people it will involve. The planner must also forecast the risk involved as well as the resources (hardware and software) that will be needed.

Various graphical representations of the project plan are created as part of the scheduling process. The most popular schedule representations are bar charts, which display activity duration and staffing timelines.

A project milestone is an expected result of a task or series of tasks. A documented report of progress should be given to management at each milestone. A deliverable is a piece of work that is given to the project's client.

We also talked about how the COCOMO II costing model is an advanced computational cost model that incorporates project, product, hardware, and employee attributes when estimating costs.

At least two of the three aforementioned methods are often used to produce accurate project estimates. The planner is more likely to arrive at an accurate estimate by comparing and reconciling estimates created using several methodologies. Although software project estimation will never be a precise science, it can be made more accurate by using a combination of reliable historical data and methodical procedures.

LIST OF REFERENCES

- 1] Software Engineering, A Practitioner's Approach, Roger S, Pressman (2014).
- 2] Software Engineering, Ian Sommerville, Pearson Education.
- 3] Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI.
- 4] Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons.
- 5] A Concise Introduction to Software Engineering, Pankaj Jalote, Springer.

UNIT END EXERCISES

- 1] Explain the estimation in project planning process.
- 2] Write a note on software scope and feasibility.
- 3] Discuss on resource estimation.
- 4] What are the factors included in human resources?
- 5] Explain in brief the concept of reusable software resources.
- 6] What are environmental resources?
- 7] Discuss COCOMO II model in detailed.
- 8] What are the fundamentals of estimation for agile development?
- 9] Explain the process of make/buy decision.
- 10] How will you create a decision tree. Explain using concept of make/buy decision.
- 11] Explain the outsourcing involved in make/buy decision.



PROJECT SCHEDULING

Unit Structure :

6.0 Objectives

6.1 Introduction

6.2 Basic Principles

6.3 Relationship Between People and Effort

6.4 Effort Distribution

6.5 Time-Line Charts

Summary

List of References

Unit End Exercises

6.0 OBJECTIVES

- To understand the workflow involved in project scheduling
- To get familiar with the principles involved in software engineering
- To get acquainted with the relationships and their interconnectivities with respect to the project scheduling
- To know the steps and the outline procedure associated with project scheduling

6.1 INTRODUCTION

When software projects run behind schedule, Fred Brooks was once questioned about it. One day at a time, was his profound though understated reply.

The actual scenario of a technological task is that thousands of minor jobs must be completed in order to achieve a greater goal, whether it is developing an operating system or building a hydroelectric facility. Some of these jobs are not commonplace and can be completed without worrying about how it will affect the project's deadline. On the "critical route," there are other tasks. The project's overall completion date is in peril if these "essential" tasks are delayed.

As a opportunity team leader, the goal is in declaring all the modules and its sub components, develop a strong connections describing the interrelationships, analyse the modules that are most important & combat the achievable. To achieve all the above-mentioned criteria's, one should

maintain a detailed timetable so that the outcomes can be measured at every time stamp.

S/W project scheduling is the process of distributing estimated effort by assigning the effort to particular software engineering jobs over the course of the anticipated project duration. But it's crucial to remember that the schedule changes throughout time. A macroscopic timetable is created in the initial stages of project planning. This kind of schedule lists all significant activities that make up the process framework. Each item on macroscopic timetable is transformed into a detailed schedule as the project progresses. Here, precise software tasks and actions that must be completed in order to complete an activity are scheduled.

There are two very distinct ways to approach scheduling for software engineering projects. In the first, a final release date for a desktop-based model has been decided upon (& cannot be changed). The S/W company confines at allocating resources cross the allotted framework. Another perspective presupposes the broad sequential constraints that are negotiated, but SE organisation sets the end date. An end date is established after comprehensive examination of the programme and distribution of effort is made to make the greatest use of available resources. Sadly, the first circumstance arises multiple times than the later scenario.

6.2 BASIC PRINCIPLES

Software project scheduling is governed by a few fundamental rules, just like all other aspects of software engineering:

- **Project compartmentalization:** The project needs to be broken down into a number of doable tasks and activities. The process and the product are both improved to achieve compartmentalization.
- **Interdependence:** It is necessary to assess the interdependence of each segregated task or activity. While certain jobs must be completed in order, others can be completed concurrently. Some tasks can't start until someone else's finished result is accessible. Other things can happen on their own.
- **Time assignment:** Every module that needs to be managed must be given a certain amount of grind measure in terms of time. Additionally, every module needs to be given a beginning and an end period that rely on the alliance & if the task be done on time.
- **Validating attempt:** The software team for each project consists of a specific number of individuals. You must make sure that allotted nos. of person are organized and managed at particular moment as assigned. Take a forecast with 3 S/W engineers as an example. Seven concurrent tasks must be completed on any given day. It takes 0.50 person-days to complete each activity. There are more persons assigned to the task than there are available workers.

- Assigned liability: Each subsystem organized ought to be given a particular group leader.
- Assigned objectives: Each work that is organized must be clearly stated objective. The end result of software projects often consists of a product or its counterpart. Deliverables frequently integrate sub modules.
- Declared highlights: Each module, or set of modules, must be connected to specific glimpse or highlights. When multiple by-products have undergone a qualitative evaluation & approval, a milestone is reached.

6.3 RELATIONSHIP BETWEEN PEOPLE AND EFFORT

One person can evaluate requirements, carry out design, create code, and run tests in small S/W expansion system. A project requires more participation as it grows in size. (We hardly ever have the splendour of doing a 10-people attempt with a single individual doing for 10 yrs)

Many managers in charge of software development projects still hold fast to the popular misconception that "if we are way back than our timeline, we recruit more employees and try to come up to the level of meeting the specifications". Unintentionally, employing more personnel at the end of a project frequently disrupts it and pushes back deadlines. The newly added individuals must learn the system, and those who were performing the work are also the ones who are instructing them. Since no work is done while lecturing, the project is further behind schedule.

Many employees escalate the amount of divulgence pathways & the difficulty of conveyance in a system, which adds to the effort & schedule set required to master the modules. Although effective communication is crucial for the creation of good software, every new communication line involves more work, which adds time.

Project timetables are flexible, as shown by empirical data and theoretical study over time. In other words, a planned project completion date can be somewhat shortened (by adding more resources). It makes feasible in postponing a deadline (by making less use of materials).

A software project's association between endeavour put out and time required to achieve a specified outcome is depicted by the Putnam-Norden-Rayleigh (PNR) Curve. Figure 1 depicts a variant of the curve that plots project effort against delivery time. It shows minimal quantity t_0 indicating least delivery expenditure. The curve climbs nonlinearly moving towards left side of t_0 (i.e., striving hard to speed up dispatch process).

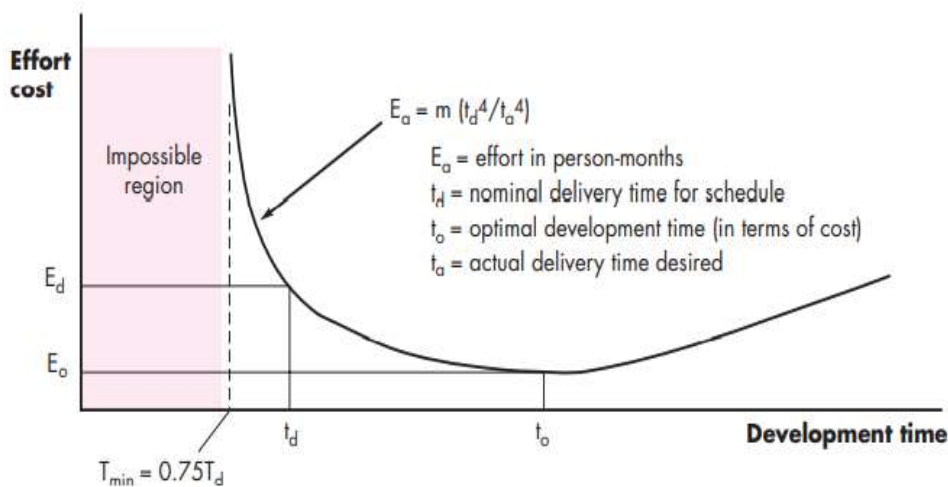


Figure 1: Association of effort & dispatch time

Assume that a manager involved in the task has calculated the amount of endeavour E_d necessary in accomplishing a usual dispatch time t_d which is ideal with respect to the schedule and resource availability. Although delivery can be sped up, the graph increases quite abruptly towards left of t_d . In reality, the PNR curve suggests that beyond $0.75t_d$, the amount of quantifiable outcome measurement is significantly reduced. The project enters "the impracticable domain" and the chance of collapse increases if we attempt any further compression. The PNR curve also shows that $t_o = 2t_d$ is the least expensive delivery choice. The implication is that postponing project completion can drastically lower expenses. Of course, this needs to be compared to the lost revenue caused by the obstruction.

The S/W formulation, obtained from through PNR curve, illustrates extremely unpredictable and irregular association between the amount of time required to accomplish a task chronologically & the amount of labour put into it. The following equation relates effort and development time to the supplied lines of code (source statements), L :

$$L = P \times E^{1/3} t^{4/3}$$

where P is a productivity measure that reflects a number of elements that contribute to high-quality software engineering work (average values for P vary between 2000 and 12,000), E is development effort in person-months, and t is the project duration in calendar months.

The above S/W formulation can be rearranged to yield an objective function and a mathematical formulation for enhancement endeavour E :

$$E = \frac{L^3}{P^3 t^4}$$

In above scenario t implies development period in terms of years and E is the endeavour put forth during a course of the software development and maintenance life cycle. By including a encumber labour cost component (\$/person-year), the formulation for enhancement endeavour and cost will be connected.

This produces some intriguing outcomes. Assume a challenging real-time S/W task that would require 12 person-years and 33,000 LOC. The project can be finished in roughly 1.3 years if the project team consists of eight persons. The grater uncertain and unpredictable character of the systeml stated in the aforementioned formulation, however, results in:

$$E = \frac{L^3}{P^3 t^4} \sim 3.8 \text{ person-years}$$

This suggests that we can lower the number of participants from eight to four by delaying the finish date by six months! The veracity of these results is debatable, but it is evident that using fewer people for a little bit longer to achieve the same goal can be advantageous.

6.4 EFFORT DISTRIBUTION

The work units (such as person-months) necessary to finish software development are estimated using each of the software project estimation approaches. The 40-20-40 rule is a recommended way to distribute effort throughout the software development lifecycle. The front-end analysis and design portion of the project receives 40% of the total effort. Back-end testing uses a comparable percentage. You are correct to assume that deemphasis on code development (20% of work) is present.

Only use this effort distribution as a general reference. The distribution of work is determined by the specifics of each project. Unless the plan commits an organisation to significant expenditures with high risk, work put into project planning rarely accounts for more than 2 to 3 percent of effort. 10 to 25% of the project effort may be devoted to customer interaction and requirements analysis. The amount of effort put into analysis or prototyping should grow in direct proportion to the size and complexity of the project. Typically, software design requires 20 to 25 percent of the labour. You must also take into account the time needed for design review and future iterations.

The work put into software design should make it reasonably easy for code to follow. It is possible to attain a range of 15 to 20 percent of total effort. Debugging after testing might take up to 40% of the time spent developing software. The quantity of testing necessary is frequently determined by the software's criticality. Even higher percentages are normal if software is human graded, meaning that failure of the software could lead to fatalities.

6.5 TIME-LINE CHARTS

The work breakdown structure is the first collection of tasks you use to start a software project schedule. The work breakdown is entered as a task network or task outline if automated technologies are employed. Next, each task's effort, duration, and start date are entered. Tasks may also be delegated to particular people.

A time-line chart, often known as a Gantt chart, is produced as a result of this input. For the entire project, a timeline chart can be created. As an alternative, distinct flowcharts can be created for each project function or for each person involved.

The structure of a time-line chart is shown in Figure 2. It shows a section of a software project schedule that places emphasis on the work of concept scoping for a word-processing (WP) software application. The left-hand column contains a list of all project tasks (for concept scoping). The horizontal bars show how long each activity took. Task concurrency is implied when multiple bars appear on the calendar at the same time. Milestones are marked with diamonds.

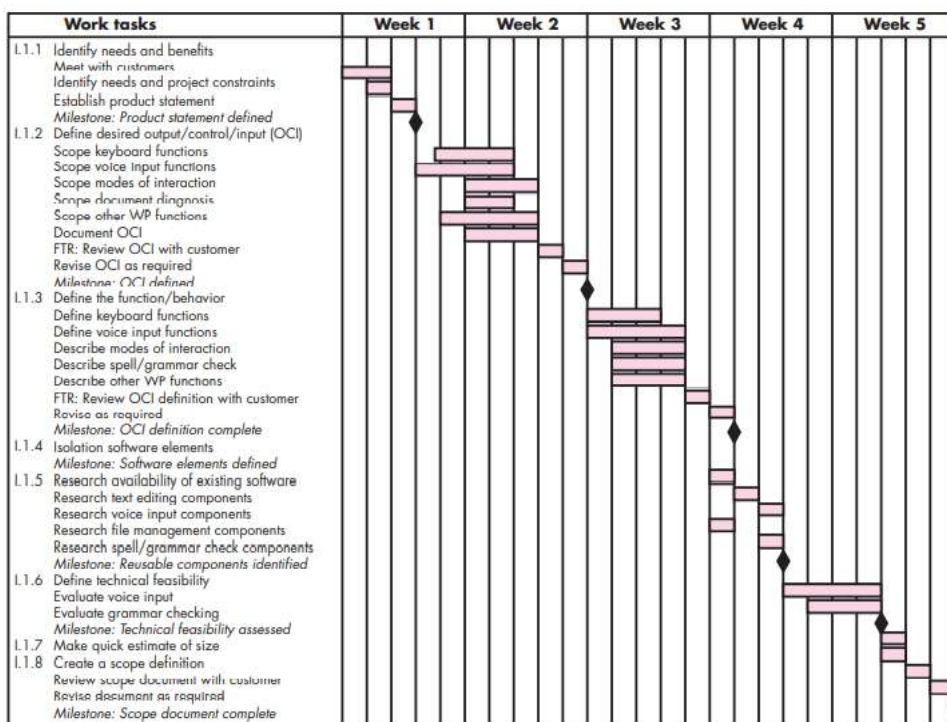


Figure 2: An example time-line chart

The majority of software project scheduling tools create project tables, a tabular listing of all project tasks, their planned and actual start and end dates, and various related information, once the data required for the creation of a time-line chart has been provided (Figure 3). You may monitor development by using project tables in conjunction with the timeline graphic.

Work tasks	Planned start	Actual start	Planned complete	Actual complete	Assigned person	Effort allocated	Notes
I.1.1 Identify needs and benefits							
Meet with customers	wk1, d1	wk1, d1	wk1, d2	wk1, d2	BLS	2 pd	Scoping will require more effort/time
Identify needs and project constraints	wk1, d2	wk1, d2	wk1, d2	wk1, d2	JPP	1 pd	
Establish product statement	wk1, d3	wk1, d3	wk1, d3	wk1, d3	BLS/JPP	1 pd	
Milestone: Product statement defined	wk1, d3	wk1, d3	wk1, d3	wk1, d3			
I.1.2 Define desired output/control/input (OCI)							
Scope keyboard functions	wk1, d4	wk1, d4	wk2, d2		BLS	1.5 pd	
Scope voice input functions	wk1, d3	wk1, d3	wk2, d2		JPP	2 pd	
Scope modes of interaction	wk2, d1		wk2, d3		MLL	1 pd	
Scope document diagnostics	wk2, d1		wk2, d2		BLS	1.5 pd	
Scope other WP functions	wk1, d4	wk1, d4	wk2, d3		JPP	2 pd	
Document OCI	wk2, d1		wk2, d3		MLL	3 pd	
FTR: Review OCI with customer	wk2, d3		wk2, d3		all	3 pd	
Revise OCI as required	wk2, d4		wk2, d4		all	3 pd	
Milestone: OCI defined	wk2, d5		wk2, d5				
I.1.3 Define the function/behavior							

Figure 3: An example project table

SUMMARY

The conclusion of a planning activity, which is a crucial part of software project management, is scheduling. Scheduling provides the project manager with a roadmap when used in conjunction with estimating techniques and risk assessments.

Decomposing the process is the first step in scheduling. A suitable task set is modified based on the project's characteristics and the work that has to be done. Each engineering task, together with its dependence on other activities and its anticipated length, is represented by a task network. The critical route, a time-line chart, and other project data are computed using the task network. You may monitor and manage each phase of the software development process using the timetable as a reference.

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- 1] Software Engineering, A Practitioner's Approach, Roger S, Pressman (2014).
- 2] Software Engineering, Ian Sommerville, Pearson Education.
- 3] Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI.
- 4] Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons.
- 5] A Concise Introduction to Software Engineering, Pankaj Jalote, Springer.

UNIT END EXERCISES

- 1] Explain the term project scheduling.
- 2] What are the basic principles involved in software project scheduling?
- 3] Explain the terms: Project compartmentalization, Interdependence and time allocation.
- 4] Discuss the term validating effort associated with project scheduling.
- 5] What do you mean by Defined responsibilities, defined objectives and defined milestones.
- 6] Write a note on relationship between people and effort.
- 7] With the help of suitable diagram explain the relationship between effort and delivery time.
- 8] What do you mean by effort distribution?
- 9] What are time-line charts? Illustrate with suitable figure



RISK MANAGEMENT

Unit Structure :

7.0 Objectives

7.1 Introduction

7.2 Software Risks

7.3 Risk Identification

7.4 Risk Projection and Risk Refinement

7.5 RMMM Plan

Summary

List of References and Bibliography and further Reading

Model Questions

7.0 OBJECTIVE:

After going through this unit, you will be able to:

- Understand what Software Risk is?
- Define risk projection and risk refinement.
- Know about RMMM

7.1 INTRODUCTION:

Risk is a problem that could origin some loss or hover the progress of the project, but which has not happened yet. These possible issues might harm cost, schedule or technical attainment of the project and the quality of our software device, or project team confidence. Risk Management is the system of recognising addressing and abolishing these problems before they can damage the project. We need to distinguish risks, as potential issues, from the current problems of the project.

7.2 SOFTWARE RISKS

A software project can be alarmed with a large variety of risks. In order to be proficient to systematically identify the substantial risks which might affect a software project, it is necessary to classify risks into diverse classes. The project manager can then check which risks from each class are applicable to the project.

Software Risk Management is the process of identifying, evaluating, and mitigating potential risks that may affect the success of a software development project. The goal of software risk management is to reduce the negative power of risks and to ensure that the project is delivered on time, with the desired quality within budget and functionality.

There are three main classifications of risks which can affect a software project:

1. Project risks
2. Technical risks
3. Business risks

7.2.1. Project risks: Project risks concern different forms of resource, schedule, budgetary, personnel, and customer-related problems. A vibrant project risk is plan slippage. Since the software is intangible, it is very hard to monitor and resist a software project. It is always very tough to control something which is difficult to be identified. For any engineering program, such as the manufacturing of cars, the plan executive can identify the product taking shape.

7.2.2. Technical risks: Technical risks apprehend potential method, maintenance issue, testing, implementation, and interfacing. It also consists of an uncertain specification, inadequate specification, altering specification, technical ambiguity, and technical obsolescence. Most technical risks look like due to the development team's inadequate knowledge about the project.

7.2.3. Business risks: This type of risks (losing budgetary or personnel commitments, etc.) cover risks of building an excellent product that no one needs.

7.2.4 Additional Risk categories:

- a. **Schedule Risks:** These risks are associated to the timeline of the project. This type covers potential for postponements or missed deadlines.
- b. **Resource Risks:** These risks are related to the obtainability and sharing of resources, such as personnel, funding, or equipment.
- c. **Quality Risks:** These risks are associated to the quality of the software being developed, including the probability for bugs, security weaknesses, or user experience issues.
- d. **Regulatory and Legal Risks:** These risks are related to legal and regulatory agreement issues, i.e. data privacy, intellectual property, or export controls.
- e. **Identified risks:** This type of risks can be exposed after careful valuation of the project program, the business and technical

environment in which the plan is being developed, and more reliable data sources (for example impractical delivery date)

- f. **Expected risks:** Those risks that are assumed from previous project experience.
- g. **Unpredictable risks:** These type of risks that can, and do occur, but are tremendously tough to identify in advance.

7.2.5 Methods for Identifying Risks:

There are some methods to plan for risk management:

- **Transfer the risk:** This method comprises the risky element developed by a third party, i.e. buying insurance cover, etc.
- **Avoid the risk:** This may take numerous ways such as discussing with the client to change the requirements to decrease the scope of the work. To give incentives to the resources to avoid the risk of human resources throughput, etc.
- **Risk decline:** This means scheduling method to include the loss due to risk. For example, if there is a risk that some key personnel might leave, new recruitment can be planned.

It is significant for software development teams to recognize and evaluate these risks, and to put justification strategies in place to minimize their effect on the project. This can include contingency planning, regular risk assessments, and risk management processes.

7.3 RISK IDENTIFICATION:

The first step in software risk management is to find probable risks that may influence the project. This may include technical risks, schedule risks, resource risks, quality risks, business risks, and legal and regulatory risks. Actual risk management begins with detecting and assessing risks, including vulnerabilities and potential threats, and arranging them based on their potential impact and prospect.

Previously, there were no easy procedures available that will surely detect all risks. But currently, there are some supplementary approaches available for classifying risks. Some of approaches for risk identification are as follows:

1. **Checklist Analysis** – Checklist Analysis is type of method generally used to detect or find risks and manage it effectively. The specification is basically developed by listing items, steps, or even tasks and is then further examined against criteria to just classify and determine if process is completed correctly or not. It is list of risk that is just found to happen regularly in progress of software project. Below is the list of software development risk by Barry Boehm-modified version.

Risk	Risk Reduction Technique
Personnel Shortages	Various methods include training and career development, job-matching, teambuilding, etc.
Unrealistic time and cost estimates	Various techniques include incremental development, standardization of methods, recording, and analysis of the past project, etc.
Development of wrong software functions	Various techniques include formal specification methods, user surveys, etc.
Development of the wrong user interface	Various techniques include user involvement, prototyping, etc.

2. **Brainstorming** – This procedure provides and gives free and exposed methodology that usually increases each and every one on project team to add. It also results in better sense of ownership of project risk, and team usually committed to dealing risk for given time period of project. It is creative and exclusive technique to gather risks freely by team members. The team members identify and govern risks in ‘no wrong answer’ atmosphere. This technique also delivers chance for team members to always improve on each other’s ideas. This technique is also used to define best possible solution to difficulties and issue that rises and develop.
3. **Casual Mapping** – It is method that shapes or develops on replication and review of failure factors in reason and result of the diagrams. It is very useful for assisting learning with an organization or system simply as method of project-post assessment. It is also crucial tool for risk assessment.
4. **SWOT Analysis** – Strengths-Weaknesses-Opportunities-Threat (SWOT) is very important and helpful technique for identifying risks inside greater organization context. It is generally used as scheduling tool for analysing business, its resources, and also its atmosphere simply by looking at inside strengths and weaknesses, opportunities and threats in outer environment. It is technique often used in preparation of strategy. The suitable time and effort should be spent on thinking completely about faults and threats of organization for SWOT analysis to more effective and effective in risk identification.
5. **Flowchart Method** – This method permits for go-ahead process to be diagrammatically denoted in paper. This method is generally used to represent actions of process graphically and serially to simply identify the risk.

7.4 RISK PROJECTION AND RISK REFINEMENT

There are two essential steps in the course of software risk management - Risk Projection and Risk Refinement.

Risk Projection contains historical data and expert conclusion to estimate the prospect and impact of potential risks that may impact the software development project. This helps to arrange the risks and to assign resources and effort to address the most acute risks.

Risk Refinement involves apprising and refining the risk projections based on new information, changing situations, and the implementation of risk mitigation strategies. This helps to ensure that the risk management plan remains significant and effective during the software development lifecycle.

Risk Refinement may include reviewing the possibility and impact of risks, updating risk mitigation approaches, and re-evaluating the urgency of the risks. It may also involve observing the implementation of the risk management plan and gathering feedback from stakeholders to detect areas for improvement.

Risk Projection and Risk Refinement are serious to the success of software risk management because they support to ensure that the risk management plan remains related and effective throughout the software development lifecycle. By frequently updating and refining the risk managing plan, organizations can better formulate for potential risks and reduce the negative impact of risks on the project.

7.5 RMMM PLAN

RMMM (Risk Management, Monitoring, and Mitigation) Plan is a all-inclusive plan that summaries the method for assessing, identifying, and mitigating risks in software development projects. The RMMM plan helps as a roadmap for managing risks during the software development lifecycle and delivers a structured approach for certifying that risks are succeeded efficiently.

The RMMM plan usually includes the below components:

7.5.1 Risk Identification: This component outlines the procedure for identifying possible risks that may affect the software development project. This may include technical risks, schedule risks, resource risks, quality risks, business risks, and legal and regulatory risks.

7.5.2 Risk Assessment: This component shapes the process for evaluating and analysing the identified risks to control their impact and likelihood. This information is used to arrange the risks and to distribute resources and effort to report the most critical risks.

7.5.3 Risk Mitigation: This component summaries the strategies and arrangements to be taken to moderate the risks, such as decreasing the likelihood of the risk happening or reducing the influence if it does occur.

This may include developing possibility plans, allocating further resources, or altering the project method or schedule.

7.5.4 Risk Monitoring: This element plans the process for constantly monitoring and revising the risks to ensure that they are being managed excellently and to identify new risks as they rise. This may include regular risk assessments, stakeholder communication, and risk management reports.

7.5.5 Risk Evaluation: It supports the process for evaluating the RMMM plan after the project is completed to regulate its effectiveness and to find opportunities for improvement in upcoming projects.

The RMMM plan should be reviewed and restructured regularly during the software development lifecycle to certify that it remains appropriate and effective.

SUMMARY

Software development is an advanced activity that works a wide range of technological developments. Every software development project comprises elements of ambiguity due to these and other factors. The amount of risk connected with each project activity governs the success of a software development project. It is not enough to just be aware of the threats. To achieve success, project management must assess, prioritize, identify, and manage all foremost risks.

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MODEL QUESTIONS:

- What is Software Risk? Explain different categories of Risks.
- How to identify Risk? Explain different techniques of risk Identification.
- Explain Risk Projection and Risk Refinement
- Describe RMMM Plan in detail.

SOFTWARE QUALITY ASSURANCE

Unit Structure :

- 8.0 Objectives
- 8.1 Introduction
- 8.2 Elements of SQA
- 8.3 SQA Tasks
- 8.4 Goals and Matrices
- 8.5 Formal Approaches to SQA
- 8.6 Six Sigma
- 8.7 Software reliability
- 8.8 The ISO 9000 Quality Standards
- 8.9 Capability Maturity Model

Summary

List of References and Bibliography and further Reading

Model Questions

8.0 OBJECTIVES

After going through this unit, you will be able to:

- Understand what Software Quality Assurance is?
- Understand about task and Matrix of SQA.
- Know about ISO 9000 Quality standards and CMM.
- Apprehend Six Sigma.

8.1 INTRODUCTION

Quality states to any measureable characteristics such as accuracy, reliability, efficiency, maintainability, portability, testability, usability, integrity, reusability, and interoperability.

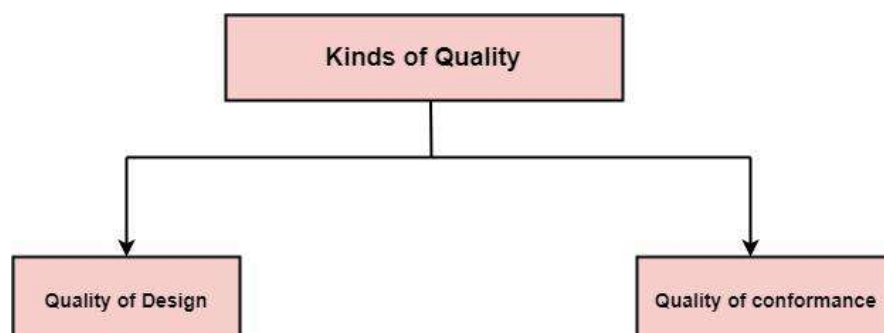
Software quality assurance is a strategic and systematic plan of all actions required to provide suitable confidence that an item or product conforms to create technical requirements. A set of activities considered to calculate the method by which the products are developed.

8.2 ELEMENTS OF SQA

Software quality assurance focus on the management of software quality using following elements.

- **Standards:** The ISO, IEEE and other standards groups have produced a broad range of software engineering standards and associated documents. Standards may be approved freely by a software engineering. The job of SQA is to certify that standards that have been approved are followed and that all effort products follow to them.
- **Reviews and audits:** Technical evaluations are a quality control activity executed by software engineers for their intent is to expose errors. Audits are a type of evaluation performed by SQA staffs with the intent of certifying that quality strategies are being followed for software engineering work.
- **Testing:** Software testing is a quality regulator function that has one primary goal “to find errors”. The work of SQA is to certify that testing is conducted correctly and efficiently.
- **Error/defect collection and analysis:** SQA collects and analyses error and defect data to well understand how errors are familiarised and what software engineering activities are best suited to abolishing them.
- **Change management:** Change is one of the most unruly features of any software project. If it is not properly succeeded, change can lead to misunderstanding, and confusion practically leads to poor quality.
- **Education:** Every software organization wants to increase its software engineering practices. A vital contributor to upgrading is education of software engineers, their managers, and stakeholders.
- **Security management:** With the increase in cyber-crime and new government guidelines regarding privacy, every software group should institute policies that shelter data at all levels, establish firewall security for Web Apps, and ensure that software has not been damaged with internally.
- **Safety:** Because software is almost always a crucial component of human graded system. SQA may be responsible for calculating the impact of software failure and for originating those steps required to reduce risk.
- **Risk management:** SQA organization confirms that risk management actions are properly directed and that risk-related exigency plans have been established.

8.2.1 There are two kinds of Quality:



- **Quality of Design:** It refers to the characteristics that inventors specify for an item. The status of materials, acceptances, and performance provisions that all contribute to the quality of design.
- **Quality of conformance:** This is the degree to which the design specifications are followed during work. Greater the degree of conformance, the higher is the level of quality of conformance.
- **Software Quality:** Software Quality is distinct as the conformance to clearly state functional and performance supplies, clearly documented development standards, and natural characteristics that are projected of all professionally developed software.
- **Quality Control:** Quality Control comprises a series of inspections, reviews, and tests used during the software process to certify each work product meets the requirements place upon it. Quality control consist of a feedback loop to the process that formed the work product.
- **Quality Assurance:** Quality Assurance is the anticipatory set of activities that provide greater assurance that the project will be completed successfully.

8.2.2 Importance of Quality

As we expect the quality to be a concern of all manufacturers of goods and services. However, the distinct characteristics of software and in particular its intangibility and complexity, make superior demands.

- **Growing criticality of software:** The final customer or user is naturally worried about the general quality of software, especially its reliability. This is aggregate in the case as organizations become more dependent on their computer systems and software is used more and more in safety-critical areas.
- **The intangibility of software:** This makes it stimulating to know that a particular task in a project has been completed adequately. The results of these tasks can be made concrete by demanding that the developers produce 'deliverables' that can be inspected for quality.

8.3 SQA TASKS

Software Quality Assurance (SQA) comprises a number of tasks that are performed to confirm that software products meet the stated quality standards and requirements. Some of the crucial SQA tasks include:

- **Quality Planning:** This involves the development of a quality plan that summaries the activities, processes, and procedures that will be used to confirm software quality.

- **Requirements Analysis:** This includes the review and evaluation of the software requirements to ensure that they are complete, accurate, and steady.
- **Test Planning:** This involves the improvement of a test plan that outlines the testing activities, test cases, and test procedures that will be used to verify that the software meets the identified requirements.
- **Test Case Design:** This consist of the creation of test cases that are used to validate that the software works as planned.
- **Test Execution:** This involves the effecting of test cases to identify flaws in the software.
- **Test Reporting:** This implicates the documentation of test results and the identification of defects that need to be determined.
- **Defect Resolution:** This involves the purpose of defects identified during testing and the execution of corrective actions.
- **Configuration Management:** This involves the identification and control of the software artifacts and structures to ensure that the accurate versions are being used.
- **Process Evaluation:** This involves the estimate of the software development processes to ensure that they are actual and efficient.
- **Process Improvement:** This involves the implementation of continuous improvement events to enhance software excellence over time.
- **Audits:** This involves the free review of software processes to confirm that they adapt to the specified quality standards.
- **Metrics Collection and Analysis:** Involves the collection and exploration of software quality data to recognize areas for improvement.

8.4 - GOALS AND MATRICS

Following table shows Software quality goals, attributes, and metrics:

Goal	Attribute	Metric
Requirement quality	Ambigully	Number of ambiguous modifiers (e., many, large, human–friendly)
	Totality	Number of TBA, TBD
	Understandability	Number of sections/subsections
	Volatility	Number of changes per requirement Time (by activity) when change is requested
	Traceability	Number of requirements not traceable to design/code

	Model clarity	Number of UML models Number of descriptive pages per model Number of UML errors
Design quality	Architectural integrity Component completeness Interface complexity Patterns	Existence of architectural model Number of components that trace to architectural model Complexity of procedural design Average number of pick to get to a typical function or content Layout appropriateness Number of patterns used
Code quality	Complexity Maintainability Understandability Reusability Documentation	Cyclomatic complexity Design factors (Chapter 8) Percent internal comments Variable naming conventions Percent reused components Readability index
QC effectiveness	Resource allocation Completion rate Review effectiveness Testing effectiveness	Staff hour percentage per activity Actual vs. budgeted completion time See review metrics Number of errors found and criticality Effort required to correct an error Origin of error

8.5 - FORMAL APPROACHES TO SQA:

There are several formal approaches to Software Quality Assurance (SQA) that organizations can use to ensure the delivery of high-quality software products. Some of the most commonly used formal approaches include:

- ISO/IEC 15504 (SPICE)
- CMMI (Capability Maturity Model Integration)
- ITIL (Information Technology Infrastructure Library)
- Six Sigma
- Agile Methods

Each of these formal approaches to SQA has its own strong point and faults, and organizations can choose the method that best fits their necessities based on the size and complexity of their software projects and their overall

organizational culture and goals. By using a formal method to SQA, organizations can certify that their software development procedures are well-defined, effective, and efficient, and that they distribute high-quality software products to their customers.

8.6 - SIX SIGMA

Six Sigma is the procedure of improving the quality of the production by identifying and eliminating the cause of faults and reduce variability. The maturity of a manufacturing process can be defined by a sigma rating indicating its percentage of defect-free products it creates.

8.6.1 Characteristics of Six Sigma

The Characteristics of Six Sigma are as follows:

1. Statistical Quality Control
2. Methodical Approach
3. Fact and Data-Based Approach
4. Project and Objective-Based Focus
5. Customer Focus
6. Teamwork Method to Quality Management

8.6.2 Six Sigma Methodologies

Six Sigma projects carries two project methodologies:

1. DMAIC
2. DMADV
1. DMAIC

It states a data-driven quality strategy for enlightening processes. This methodology is used to enhance an existing business process.

The DMAIC project methodology has five phases:

1. **Define:** It covers the process plotting and flow-charting, project approval development, problem-solving tools.
2. **Measure:** It includes the principles of measurement, continuous and discrete data, and scales of measurement, an outline of the principle of variations and repeatability and reproducibility (RR) studies for continuous and discrete data.
3. **Analyze:** It covers creating a process baseline, how to determine process improvement goals, knowledge discovery, including descriptive and exploratory data analysis and data mining tools, the basic principle of Statistical Process Control (SPC), specialized control charts, process capability analysis,

correlation and regression analysis, analysis of categorical data, and non-parametric statistical methods.

4. **Improve:** It covers project management, risk assessment, process simulation, and design of experiments (DOE), robust design concepts, and process optimization.
5. **Control:** It covers process control planning, using SPC for operational control and PRE-Control.

2. DMADV

It specifies a data-driven quality approach for designing products and processes. This method is used to generate new product designs or process designs in such a way that it results in a more expectable, mature, and discover free performance.

The DMADV project methodology has five phases:

1. **Define:** The problem or project goal that needs to be addressed.
2. **Measure:** It measures and defines the customer's needs and provisions.
3. **Analyze:** It analyses the method to meet customer needs.
4. **Design:** It can design a procedure that will meet customer needs.
5. **Verify:** It can verify the design presentation and ability to meet customer needs.

8.7 SOFTWARE RELIABILITY

Software Reliability means **Operational reliability**. It described as the capability of a system or component to accomplish its required functions under static conditions for a specific period.

Software reliability is also defined as the prospect that a software system fulfils its assigned task in a given atmosphere for a predefined number of input cases, assuming that the hardware and the input are free of error.

Software Reliability is a necessary connect of software quality, composed with functionality, usability, performance, serviceability, capability, install ability, maintainability, and documentation. It is hard to achieve because the complexity of software turn to be high. While any system with a high degree of complexity, containing software, will be hard to reach a certain level of consistency, system developers tend to push complexity into the software layer, with the speedy growth of system size and ease of doing so by advancement the software.

8.8 THE ISO 9000 QUALITY STANDARDS

ISO (International Standards Organization) is a group or consortium of 63 countries established to plan and fosters standardization. ISO declared its 9000 series of standards in 1987. It serves as a reference for the contract between independent parties. The ISO 9000 standard determines the guidelines for maintaining a quality system. The ISO standard mainly addresses operational methods and organizational methods such as responsibilities, reporting, etc. ISO 9000 defines a set of guidelines for the production process and is not directly concerned about the product itself.

8.8.1-Types of ISO 9000 Quality Standards

The ISO 9000 series of standards is based on the hypothesis that if a proper stage is followed for production, then good quality products are bound to follow spontaneously. The types of industries to which the various ISO standards apply are as follows.

1. **ISO 9001:** This standard relates to the organizations involved in design, development, production, and servicing of goods. This is the standard that applies to most software development organizations.
2. **ISO 9002:** This standard applies to those organizations which do not design products but are only involved in the production. Therefore, ISO 9002 does not apply to software development organizations.
3. **ISO 9003:** This standard applies to organizations that are involved only in the installation and testing of the products. For example, Gas companies.

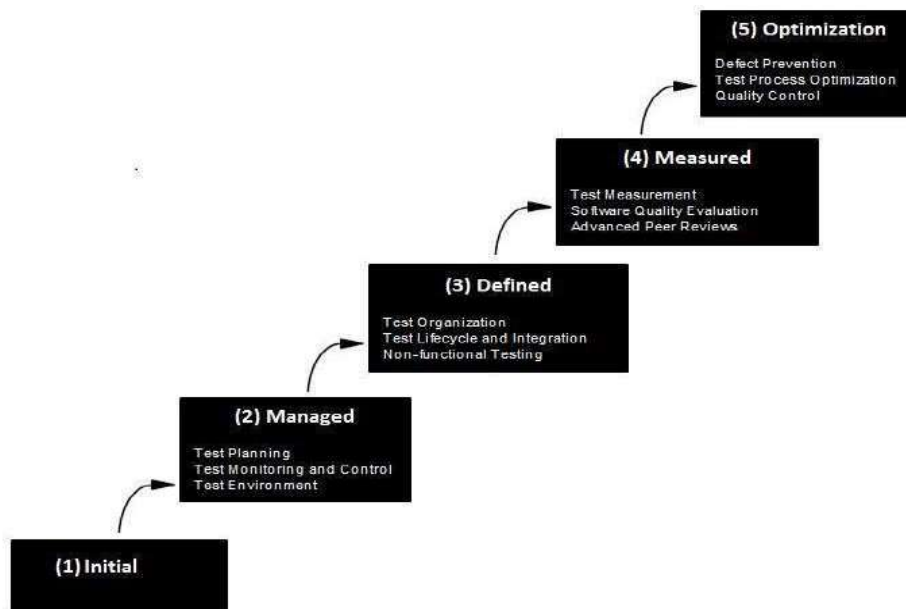
8.8.2 Steps to get ISO 9000 Certification:

An organization decides to obtain ISO 9000 certification applies to ISO registrar office for registration. The process involves of the following stages:

Application -> Pre-Assessment -> Document review and Adequacy of Audit -> Compliance Audit -> Registration-> Continued Inspection.

8.9 CAPABILITY MATURITY MODEL

The Software Engineering Institute (SEI) Capability Maturity Model (CMM) states an increasing strings of levels of a software development business. The higher the level, the improved the software development process, therefore reaching each level is a costly and time-consuming method.



- **Level 1: Initial** - The software process is considered as unpredictable, and irregularly even disordered. Defined processes and standard practices that exist are unrestricted during a crunch. Success of the organization majorly be determined by on an individual effort. The heroes finally move on to other organizations taking their prosperity of knowledge or lessons learnt with them.
- **Level 2: Repeatable** - This level of Software Development Organization has a basic and steady project management procedures to track cost, schedule, and functionality. The process is in place to repeat the earlier achievements on projects with similar applications.
- **Level 3: Defined** - The software process for both management and engineering actions are documented, standardized, and integrated into a usual software process for the entire organization and all projects crosswise the organization use an approved, custom-made version of the organization's typical software process for developing, testing and maintaining the application.
- **Level 4: Managed** - Management can efficiently control the software development effort using specific measurements. At this level, organization set a quantifiable quality objective for both software process and software maintenance.
- **Level Five: Optimizing** - The Main characteristic of this level is fixing on continually improving process performance through both incremental and inventive technological improvements.

SUMMARY

Software Quality Assurance (SQA) is a set of activities for certifying quality in software engineering procedures. It ensures that developed

software happens and fulfils with the defined or standardized quality provisions. SQA is an ongoing process within the Software Development Life Cycle (SDLC) that regularly checks the developed software to confirm it meets the anticipated quality measures.

LIST OF REFERENCES AND BIBLIOGRAPHY AND FURTHER READING:

- <https://www.javatpoint.com/six-sigma>
- <https://www.computersprofessor.com/2017/09/sqa-tasks-goals-attributes-and-metrics.html>

MODEL QUESTIONS

- What is the purpose of Software Quality Assurance?
- What are the elements of a SQA process?
- What are some common SQA activities and tasks?
- What is the role of metrics in SQA?
- What is the purpose of software quality standards (e.g., ISO 9001)?
- What is the Capability Maturity Model (CMM), and how is it used in SQA?
- What is the difference between verification and validation in the context of SQA?
- What is the purpose of software reliability engineering, and how does it relate to SQA?

SOFTWARE TESTING

Unit Structure :

- 9.0 Objectives
- 9.1 Introduction
- 9.2 Verification and Validation
- 9.3 Introduction to Testing
- 9.4 Testing Principles,
- 9.5 Testing Objectives
- 9.6 Test Oracles
- 9.7 Levels of Testing
- 9.8 White-Box Testing/Structural Testing
- 9.9 Functional/Black-Box Testing
- 9.10 Test Plan
- 9.11 Test-Case Design

Summary

List of References and Bibliography and further Reading

Model Questions

9.0 OBJECTIVES

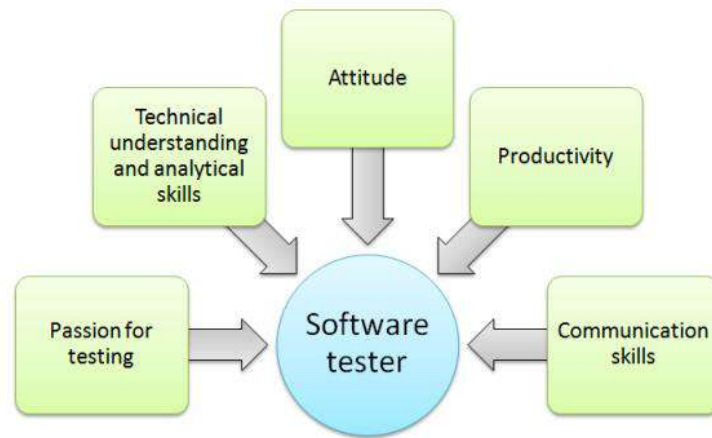
After going through this unit, students will be able to:

- Study fundamental concepts in software testing.
- Understand different levels and types of software testing.
- Understand the distinctions between software verification and software validation.

9.1 INTRODUCTION

Software testing is not anything but an art of examining software to ensure that its quality under test is in line with the requirement of the client. Software testing is carried out in an organized manner with the resolved of finding defects in a system. It is required for evaluating the system.

Software testing is now a very major and essential part of software development. Ideally, it is best to introduce software testing in every segment of software development life cycle. Actually, a common of software development time is now spent on testing.



9.2 VERIFICATION AND VALIDATION

Verification and validation are important concepts in software testing.

Verification refers to the process of calculating the software design and implementation to regulate whether it meets the listed requirements. Verification is a anticipatory process that aims to identify any defects and errors early in the software development lifecycle, before they become more tough and costly to fix. Verification activities include activities such as code assessments, design reviews, walkthroughs, and static analysis.

On the other hand, **Validation**, is the process of estimating the software during or at the end of the development process to regulate whether it satisfies the specified requirements. Validation is a remedial process that aims to identify defects and errors that may have been hosted during the implementation phase. Different types of Validation activities include unit testing, integration testing, system testing, and acceptance testing.

It's important to note that verification and validation are balancing processes and both are essential to ensure software quality. Verification helps to identify possible defects and errors early in the development process, whereas validation helps to identify faults and errors that may have been introduced later in the method. Effective verification and validation help to confirm that software meets the specified requirements, is free of faults and errors, and is suitable for its intended purpose.

9.3 INTRODUCTION TO TESTING

Testing is an important part of the software development process. It is the process of calculating a software system or its components with the determined to identify any defects or errors and to consider its functionality. The primary goal of testing is to ensure that the software meets the specified requirements and works as anticipated.

The choice of testing methods and techniques will depend on the specific needs and purposes of the software project, as well as the development methodology being used.

Effective testing involves a thorough understanding of the software requirements, as well as the development and testing methods. It's also important to develop a well-designed test plan, comprising a clear definition of the testing objectives, testing methods, and estimated outcomes. Effective testing is essential to ensure software quality and to minimize the risk of defects and errors in the final product.

Testing can be performed with the use of automated testing tools or manually. Automated testing can increase the proficiency and accuracy of the testing process, but it also requires a important investment of time and resources to develop and maintain.

9.4 TESTING PRINCIPLES

There are some principles that form the base of effective software testing:

- **Early Testing:** Testing should start early in the software development lifecycle and continue all over the process. This helps to identify defects and errors timely, when they are easier and less costly to fix.
- **Defect Prevention:** The focus should be on defect prevention rather than defect detection. This can be achieved by using proven software development methodologies, following best practices for software design and coding, and performing regular code reviews and walkthroughs.
- **Testing Throughout the Development Life Cycle:** Testing should be performed at all stages of the development life cycle, from requirements gathering and design through to implementation, testing, and deployment.
- **Test Planning and Design:** A well-designed test plan is essential for effective testing. The test plan should include a clear definition of the testing objectives, testing methods, and expected outcomes.
- **Independent Testing:** Testing should be performed by an independent team or individuals to ensure objectivity and to minimize the risk of bias.
- **Test-Driven Development:** Tests should be developed and executed before the implementation of the software components. This helps to ensure that the software meets the specified requirements and reduces the risk of defects.
- **Automation:** Automated testing can be an effective way to increase the efficiency and accuracy of the testing process. However, it's important to use automation appropriately and not rely solely on automated testing methods.
- **Continuous Testing:** Testing should be an ongoing process, not a one-time event. Continuous testing helps to ensure that changes to the software are tested and validated throughout the development life cycle.

In summary, these principles provide a framework for effective software testing and help to ensure that the software meets the specified requirements, is free of defects and errors, and is fit for its intended purpose.

9.5 TESTING OBJECTIVES

The objectives of software testing can vary depending on the specific needs of a software project. However, some common testing objectives include:

- **Verifying requirements:** Ensure that the software meets the detailed requirements and works as intended.
- **Finding defects:** Identify and separate defects and errors in the software.
- **Improving quality:** Improve the overall quality of the software by recognizing and fixing defects and successful the design and implementation.
- **Increasing confidence:** Increase confidence in the software by providing evidence that it meets the specified requirements and works as intended.
- **Evaluating risk:** Evaluate the potential risk associated with the software, including the risk of defects and the risk of security vulnerabilities.
- **Demonstrating compliance:** Demonstrate compliance with regulatory and industry standards, such as ISO 9001 or PCI DSS.
- **Improving reliability:** Improve the reliability of the software by reducing the frequency and severity of defects and errors.
- **Improving performance:** Improve the performance of the software by identifying and fixing performance bottlenecks and optimizing resource utilization.
- **Supporting maintenance:** Support ongoing software maintenance by providing information about the software's behavior and performance.

In summary, the objectives of software testing are to ensure that the software meets the specified requirements, works as intended, and is of high quality. Testing also helps to minimize the risk of defects and errors, improve performance, and support ongoing software maintenance.

9.6 TEST ORACLES

It is a mechanism, different from the program itself, that can be used to test the accuracy of a program's output for test cases. Conceptually, we can consider testing a process in which test cases are given for testing and the program under test. The output of the two then compares to determine whether the program behaves correctly for test cases. This is shown in figure.

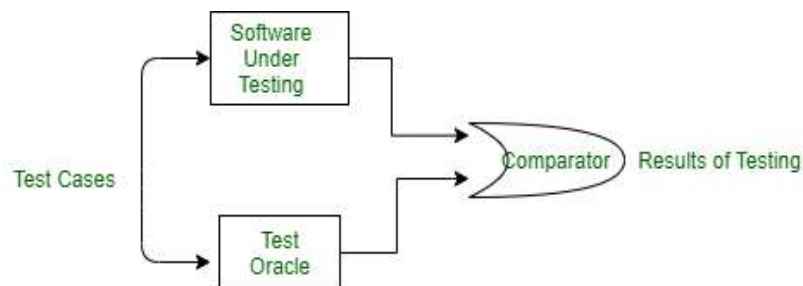


Figure - Testing and Test Oracles

Testing oracles are required for testing. Ideally, we want an automated oracle, which always gives the correct answer. However, often oracles are human beings, who mostly calculate by hand what the output of the program should be. As it is often very difficult to determine whether the behavior corresponds to the expected behavior, our “human deities” may make mistakes. Consequently, when there is a discrepancy, between the program and the result, we must verify the result produced by the oracle before declaring that there is a defect in the result.

The human oracles typically use the program’s specifications to decide what the correct behavior of the program should be. To help oracle determine the correct behavior, it is important that the behavior of the system or component is explicitly specified and the specification itself be error-free. In other words, actually specify the true and correct behavior.

There are some systems where oracles are automatically generated from the specifications of programs or modules. With such oracles, we are assured that the output of the oracle conforms to the specifications. However, even this approach does not solve all our problems, as there is a possibility of errors in specifications.

As a result, a divine generated from the specifications will correct the result if the specifications are correct, and this specification will not be reliable in case of errors. In addition, systems that generate oracles from specifications require formal specifications, which are often not generated during design.

9.7 LEVELS OF TESTING

Testing can be divided into several levels, each of which serves a specific purpose and focuses on different aspects of the software. It is an important process in software development that helps ensure the quality and trustworthiness of a software product. Some most common levels of testing are as follows:

- **Unit Testing:** This is the first level of testing and involves testing individual components or units of code to ensure that each one functions as proposed. Unit tests are typically automated and are performed by developers.
- **Integration Testing:** This level of testing focuses on testing the interactions between different components or units of code. Integration testing helps to identify any issues that may arise from the integration of individual components.
- **System Testing:** System testing focuses on testing the entire software system as a whole, to ensure that it meets the specified requirements and behaves as expected. This level of testing may include functional testing, performance testing, and security testing.
- **User Acceptance Testing (UAT):** User Acceptance Testing is the final stage of testing, in which the software is tested by end-users or customers. The purpose of UAT is to ensure that the software meets the business requirements and satisfies the needs of the customers.
- **Performance Testing:** Performance testing is a type of testing that focuses on measuring the performance and scalability of a software system under different conditions, such as heavy load or high traffic. The goal of performance testing is to identify and resolve performance bottlenecks and ensure that the system can meet the expected performance requirements.

- **Security Testing:** Security testing is a type of testing that focuses on identifying and mitigating security vulnerabilities and threats in a software system. This level of testing includes vulnerability scans, penetration testing, and security assessments.

These levels of testing can be performed at different times during the software development lifecycle, and the exact testing process will depend on the specific requirements and constraints of the software project. However, it is generally recommended to perform testing at each level to ensure the quality and reliability of the final product.

9.8 WHITE-BOX TESTING/STRUCTURAL TESTING

Structural testing also known as White box testing, or code-based testing, is a type of software testing that emphasizes on the internal structure and design of a software program. It involves testing the individual components, functions, and modules of the code, as well as their collaborations with each other.

The goal of white box testing is to identify and correct any errors, bugs, or other issues in the code, and to ensure that it meets the specified requirements and design specifications. White box testing is often performed by developers and requires a detailed understanding of the code and how it works.

During white box testing, the tester has access to the source code and can test it at a low level, such as checking for proper syntax, data flow, and control flow. This type of testing is also used to validate the implementation of algorithms and data structures, as well as to test error handling and exception management.

White box testing complements other types of testing, such as black box testing and gray box testing, and is typically performed early in the software development lifecycle, before the software is released to the end-users. It is an important part of the software development process, as it helps to identify and resolve problems in the code, and ensures that the software is of high quality and reliable.

9.9 FUNCTIONAL/BLACK-BOX TESTING

Functional testing, also known as black box testing, is a type of software testing that focuses on verifying that the software meets the functional requirements and behaves as expected. Unlike white box testing, which focuses on the internal structure of the code, functional testing is performed from the perspective of an end-user, and does not require access to the source code.

The goal of functional testing is to validate the functionality of the software, including its inputs, outputs, and behavior. This type of testing focuses on testing the software's features and functions, and verifying that they work as intended.

Functional testing typically involves creating test cases and test scenarios that simulate real-world scenarios and interactions with the software. This can include manual testing, automated testing, or a combination of both.

Black box testing is performed at different stages of the software development lifecycle, and can be used to test the software as a whole, or individual components and functions. This type of testing is essential for ensuring that the software meets the user requirements and behaves as expected, and can help identify and resolve issues early in the development process, before the software is released to end-users.

In summary, functional testing is a crucial part of the software development process, and helps to ensure the quality and reliability of the software product. By performing functional testing, developers can validate that the software meets the specified requirements and behaves as expected, and can identify and resolve issues before the software is released to the end-users.

9.10 TEST PLAN

A test plan is a document that outlines the testing strategy, approach, and resources for a software project. It provides a roadmap for testing activities and helps ensure that the testing process is consistent, comprehensive, and aligned with the project requirements.

A typical test plan includes the following information:

- **Introduction:** A brief overview of the purpose and scope of the test plan.
- **Objectives:** The objectives of the testing process, such as verifying that the software meets the functional requirements, verifying the quality and reliability of the software, and identifying any issues or defects in the software.
- **Scope:** The scope of the testing process, including the components and functions that will be tested, and any areas or functionality that will not be tested.
- **Test approach:** The approach and methodology for testing, including the types of testing that will be performed (e.g., functional testing, performance testing, security testing, etc.), the testing tools and techniques that will be used, and the testing schedule.
- **Test environment:** The specifications and details of the testing environment, including the hardware, software, and network configurations, and the test data that will be used.
- **Test cases:** The test cases that will be used to verify the functionality and behavior of the software, including the steps, inputs, expected results, and pass/fail criteria.

- **Test schedule:** The testing schedule, including the start and end dates, the testing milestones, and the responsibilities of the testing team.
- **Test resources:** The resources required for testing, including the testing tools, personnel, and budget.
- **Risks and assumptions:** A description of the risks associated with the testing process and any assumptions that have been made.
- **Approval:** The approval process and sign-off criteria for the test plan.

The test plan is an important document that helps to ensure that the testing process is well-planned, well-organized, and consistent with the project requirements. It serves as a reference for the testing team and stakeholders, and helps to ensure that the testing process is completed on time, within budget, and with high quality.

9.11 TEST-CASE DESIGN

Test case design is the process of creating a set of tests to validate that the software functions as intended. Test cases are used to verify the functionality and behavior of the software, and to identify any issues or defects in the software.

Test case design involves several steps:

- **Identify requirements:** Start by identifying the functional requirements for the software and understanding what the software is expected to do.
- **Determine test conditions:** Based on the requirements, determine the conditions under which the software will be tested, such as different inputs, scenarios, and edge cases.
- **Design test cases:** Based on the test conditions, design test cases that will verify the functionality and behavior of the software. A test case should include a clear and concise description of the test steps, inputs, expected results, and pass/fail criteria.
- **Prioritize test cases:** Prioritize the test cases based on the risk and impact of each test. High-priority test cases should be designed and executed first, as they are more likely to uncover critical issues and defects.
- **Execute test cases:** Execute the test cases to verify the functionality and behavior of the software. Document the results and any issues or defects that are identified.
- **Update test cases:** Update the test cases based on the results of the testing, and make any necessary changes to the software. Repeat the testing process until all the test cases have been executed and the software meets the specified requirements.

Test case design is an iterative process that requires careful planning and organization. It is important to design test cases that are comprehensive, effective, and efficient, and to prioritize the test cases based on the risk and impact of each test. A well-designed set of test cases helps to ensure that the software functions as intended and is of high quality and reliability.

SUMMARY

- Software testing is required to check the reliability of the software
- Software testing ensures that the system is free from any bug that can cause any kind of failure
- Software testing ensures that the product is in line with the requirement of the client
- It is required to make sure that the final product is user friendly
- At the end software is developed by a team of human developers all having different viewpoints and approach. Even the smartest person has the tendency to make an error. It is not possible to create software with zero defects without incorporating software testing in the development cycle.
- No matter how well the software design looks on paper, once the development starts and you start testing the product you will find lots of defects in the design.

You cannot achieve software quality without software testing. Even if testers are not involved in actual coding, they should work closely with developers to improve the quality of the code. For best results it is important that software testing and coding should go hand in hand.

LIST OF REFERENCES AND BIBLIOGRAPHY AND FURTHER READING

- "Software Testing: A Craftsman's Approach" by Paul Jorgensen
- "Effective Software Testing: 50 Specific Ways to Improve Your Testing Process" by Elfriede Dustin, Thom Garrett, and Bernie Gauf
- "Introduction to Software Testing" by Paul Ammann and Jeff Offutt
- "Exploratory Software Testing: Tips, Tricks, Tours, and Techniques to Guide Test Design" by James A. Whittaker
- "Software Testing: An ISTQB-BCS Certified Tester Foundation Guide" by Rex Black, et al.

MODEL QUESTIONS

- What is software testing and why is it important?
- What are the different types of software testing?
- What is the difference between white box testing and black box testing?
- What is the purpose of test case design?
- What is the difference between functional testing and non-functional testing?
- What is the importance of test planning in software testing?
- What is the difference between verification and validation in software testing?
- What is the purpose of test automation and why is it important?
- What is the difference between bug and defect in software testing?
- What is the difference between static testing and dynamic testing?
- What is the difference between acceptance testing and user acceptance testing?
- What is the importance of test documentation in software testing?



"SOCEN - 2023"

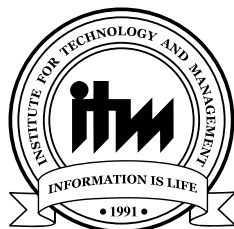
International Research Conference on
the theme

Social and Environmental Sustainability - A Management Perspective (SOCEN'23)

Dates: 4th, 5th, & 6th October 2023
Kharghar, Navi Mumbai

Organised by

ITM BUSINESS SCHOOL KHARGHAR
NAVI MUMBAI



Published by **ITM Business School**

25 & 26 Institutional Area, Sector - 4, Kharghar (E), Navi Mumbai 410 210

ISBN : 978-93-5967-434-6

Message from the Convenor

The concept of sustainability has pervaded the world, and society at large. Numerous authors have written on the topic, each expressing unique ideas of where sustainability might lead society and how it can help entities. Among the various dimensions of sustainability (Human, social, economic and environmental) social sustainability has not been discussed much (Eizenberg and Jabareen 2017). The social dimension is key to the concept of sustainability as it emphasizes on the well-being of humans (Janker 2020). On the other hand environmental sustainability has become the pressing need of the hour.

Keeping in view the importance of Social and environmental sustainability in today's world, ITM Business School, Kharghar organized three days International Research Conference "SOCEN-2023" on 4-6th October, 2023. This conference seeks to bring ideas and thoughts on social and environmental sustainability from a management perspective to create a better tomorrow.

The conference was great success witnessing 110 papers from India and overseas. Renowned researchers from across the globe shared their insights as key note speakers. These included :

Dr Paurav Shukla : University of Southampton, UK

Dr Sunil Sahadev : University of Brighton, UK

Dr Stephen Wilkinson : UNOWD, Dubai

Dr Festus Victor Bekun: Istanbul University, Turkey

Dr Narasingha Das : Lebanese American University, Lebanon

Dr Avik Sinha : MDI Gurgaon

Prof P.J Mathew : Chief Mentor

The conference proceedings consists of abstracts and papers of all three dates. My best wishes to the participants and happy reading.

Dr Sangeeta Trott

Convenor

Message from the Director

SOCEN is an expression of the fact that the earth is common to all, and we need to plan and act on preserving it for our future generations! This theme of our conferences propelled researchers to probe deeper into social and environmental sustainability and create awareness and a sense of care for nature which has always been generous to mankind.

I extend my heartfelt congratulations to Dr Sangeeta Trott and the team on the successful publication of the conference proceedings for SOCEN 23. This marks a significant milestone for our institute and showcases the culmination of the hard work and dedication put forth by all involved in the Research Department team and is a testament to the institute's commitment to excellence. The conference witnessed 110 papers that were presented in the three days by students, academicians and corporates. The proceedings encapsulate cutting-edge research, innovative ideas, and diverse perspectives presented during the conference. Thanks to all the guests from academia and corporate who made remarkable references on how we can save the planet from further plunder.

I encourage everyone to spread the word about the publication and to explore the contents of the proceedings. Thank you, Researchers, for your outstanding contributions, and we look forward to celebrating many more successes together in the future.

Wishing all the best and happy reading.

Regards

Dr Lakshmi Mohan

Pro Vice Chancellor- ITM Skills University

Director- ITM Business School

Message from the Dean

It is my pleasure to congratulate all participants of the conference hosted by ITM Business School, ITM Skills University, Kharghar. The conference brought together scholars, researchers, and industry practitioners from diverse fields to engage in interdisciplinary dialogue and exchange of ideas. The theme of the conference was Social and Environmental Sustainability - A Management Perspective which reflects our commitment to addressing pressing challenges and advancing knowledge in the field of sustainability and green economy. Through a series of keynote presentations, panel discussions, and paper presentations, we had the opportunity to explore innovative approaches, share best practices, and collaborate on solutions to some of the most pressing issues of society. I am particularly excited about the breadth and depth of topics that are covered in the conference proceedings. From cutting-edge research in sustainability to transformative initiatives in social empowerment, the diversity of perspectives represented in this forum underscores the richness and dynamism of our academic community. I would like to congratulate the conference organizers, committee members, and all those who have contributed to the planning and execution of this event. Special compliment to the team for bringing out this conference proceeding. The organizing committee's hard work and dedication have been instrumental in ensuring the success of this conference and the publishing of this conference proceedings and I appreciate your efforts. It is through such scholarly interactions of all of you that we could collectively advance our understanding of complex issues and drive positive change in our respective fields. I wish you all had a stimulating and productive conference experience. May this proceeding here be marked by fruitful insights and meaningful future research that will continue to inspire you and the intellectual community at large.

Best wishes!!!

Dr. Sarit Prava Das

Dean Academics

INTERNATIONAL RESEARCH CONFERENCE SOCEN 2023

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Status of E-Waste Management in India

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Abstract

E-Waste is electronic products that are unwanted, not working and nearing or at the end of their useful life. Computers, laptops, smartphones, televisions, stereos, copiers and scanners are everyday electronic products. Use of electrical and electronic equipment on a large scale in India has resulted in the accumulation of large amounts of e-waste. E-waste management in India faces many challenges such as the large size of e-waste, lack of awareness about handling and disposal of e-waste, insufficient space for segregation, storage and recycling of e-waste, lack of research in e-waste management etc. Thus, toxic materials from uncontrolled e-waste enter the environment and it leads to many adverse effects on human health, soil and water quality. On the other hand, as e-waste consists of many valuable materials, it is wasted due to the dumping of e-waste. With this background, this secondary data-based paper attempts to understand the current scenario of e-waste management and issues related to e-waste in India by adopting an explanatory approach.

Key Words: E-Waste, Management, Pollution, Status, India.

Introduction

Electronic waste or e-waste is used to describe all electrical appliances and electronic devices that are discarded for reuse, recycling, or dumped in the bin. E-waste can be classified into [three categories](#): large household appliances, also called white goods, such as refrigerators, washing machines and air conditioners; goods built on information technology and telecommunications, also known as grey goods, such as computers, laptops, mobile phones, printers; and consumer goods, also known as brown goods, like televisions, cameras and recorders (Pendharkar, V. 2018). The electronics industry is the world's largest and fastest-growing manufacturing industry (Radha, 2002; DIT, 2003) with the annual global estimated production of e-waste to surpass 50 million tons in 2020 (Baldé, C. P. et. al. 2017). The last decade has seen tremendous growth in the manufacturing and consumption of electronic and electrical equipment all over the world. As a consequence of this, combined with rapid product obsolescence, and lower costs, discarded electronic and electrical equipment or 'E-waste' is now the most rapidly growing waste problem in the world. Most companies today design their products for planned or perceived obsolescence. This is reinforced through marketing and retailing practices, and affordability and convenience have taken over from product durability as primary drivers (Jennifer, 2005). The e-waste problem has reached great proportions with an estimated 50 million tons of e-waste produced worldwide each year. The Indian market is flooded with huge quantities of electrical and electronic products and gadgets, with huge internal demand (Vibhute, N. et al. 2021). The disposal of e-waste is an emerging global environmental and public health issue, as this waste has become the most rapidly growing segment of the formal municipal waste stream in the world. (Dahl R. 2002). India is not an exception to this. In India, the quantity of 'e-waste' or electronic waste has now become a major environmental problem. With this background, the present study attempts to address the current scenario of e-waste management and issues related to e-waste.

Objectives

- To understand the current scenario of e-waste management in India.
- To study the issues related to E-waste in India.
- To suggest measures for coping with the problem of e-waste management in India.

Materials and Methods

The present paper utilizes the data and information obtained from secondary sources viz. government reports, NGO publications, research, and news articles. It adopts the exploratory method to arrive at the conclusion. Some of the information obtained from empirical evidence is also considered. The paper focuses on e-waste management and also suggests some measures to cope with the issues related to E-waste in India.

E-Waste Life Cycle

Electronic devices all over the world are always designed to resist decomposition. Materials found in e-waste like glass may take millions of years for its decomposition. Thus, it is always better to recycle them using certified facilities. As electronic and electrical materials are not easily decomposed, they need to be sorted, disassembled and separated according to their type. Metal, glass, plastics and other materials found in the e-waste can be recycled to produce new products to save valuable natural resources from further exploitation. Manufacturers, shopkeepers, buyers, dealers, exporters, disassemblers, scrap dealers, smelters and recyclers are major stakeholders in the e-waste supply chain. As e-waste contains both toxic materials including Mercury, lead, cadmium, polybrominated flame retardants, barium, lithium and valuable materials such as iron, aluminum, platinum, silver and gold in it, management of e-waste is one of the emerging problems, however, it offers the business opportunity. Consequently, E-waste recycling is a vital matter of waste treatment. It is also important as the valuable materials can be recovered from it. Nevertheless, the process of collection and recycling of e-waste is complex in its nature that involves various products, people, particularly producers, dealers, retailers, buyers, recyclers, enterprises, area, machinery, financial support etc.

E-Waste Management in India

Electronic waste in recent years has become a vital environmental and health concern. India being a major consumer of electronic products faces a substantial challenge in managing e-waste effectively. The rising use of electronic devices and the rapid pace of technological developments contribute to the growing e-waste problem in India. Inappropriate disposal of e-waste results in many risks to the environment and the health of human beings. Several electronic devices contain hazardous materials like lead, mercury, cadmium and brominated flame retardants which can contaminate soil, water and air if not disposed properly. In view of addressing this issue, the government of India has formulated policies and regulations to manage e-waste properly. The E-Waste (Management and Handling) Rules 2011 were made functional to ensure proper collection, recycling and disposal of e-waste in an eco-friendly manner. These rules impose responsibilities on manufacturers, producers and bulk consumers of electronic goods to manage their e-waste effectively. According to these regulations, manufacturers should compulsorily set up e-waste collection centers and implement recycling and disposal mechanisms. They also need to get Extended Producer Responsibility (EPR) authorization and become accountable for the complete lifecycle of their products with proper e-waste management.

The rules also necessitate producers to incorporate labeling on their products indicating the eco-friendly disposal options available.

The government has established e-waste management facilities across the country to encourage proper disposal and recycling of electronic waste. These facilities help in the safe handling and dismantling of e-waste where hazardous substances are segregated and disposed of acceptably. Public awareness campaigns and educational initiatives have also been taken to promote responsible e-waste management practices. People are encouraged to take their e-waste to authorized collection centers rather than disposing of them with regular household waste. Moreover, some initiatives have been undertaken to promote the reuse and restoration of electronic devices to extend their lifespan and minimize e-waste generation. One of the primary challenges is the lack of awareness and knowledge among consumers about proper disposal and recycling methods. Many people still dispose of their electronic waste through informal networks which can lead to environmental and health hazards. The informal sector involved in recycling e-waste also faces challenges like insufficient infrastructure, lack of training and exposure to hazardous substances. To cope with these challenges, large investment is needed to build robust e-waste management systems, improve infrastructure and enhance the capacity of stakeholders involved in the recycling process. In short E-waste management is a persistent issue in India due to the increasing usage of electronic devices. The government has taken steps to regulate e-waste management through policies and regulations and public awareness campaigns have been launched to promote responsible practices. Yet, additional efforts are needed to address the challenges and build a sustainable e-waste management framework in the country.

Intricacy in E-Waste flows

E-waste in India generates from various sources and is characterized by its complex nature. It consists of both toxic as well as valuable substances. Thus, segregation of it has become a tedious process. As e-waste goes through many steps, from its generation to recycling, a number of interlinked stakeholders are involved in the value chain of e-waste. Consequently, e-waste follows different paths viz. formal recycling sector, informal recycling sector and semi-formal recycling sector. Interaction between these sectors is not established well. Most of the E-waste ends up with scrap traders and dealers who, for economic reasons, commonly transfer it into the informal sector.

Issues Related to E-Waste

There are several issues of e-waste in India.

E-Waste as a complex cocktail

E-waste involves a complex mix of unsafe and toxic materials. It consists of precious metals like silver (Ag), gold (Au), palladium (Pd) and platinum (Pt). One can find more than 50 elements from the periodic table in electronic equipment. Electronic devices are an alternative source of base metals such as copper (Cu) and tin (Sn) as well as special metals such as cobalt (Co), Indium (In) and antimony (Sb). It also consists of some toxic substances such as lead (Pb), mercury (Hg), cadmium (Cd), arsenic (As) and flame retardants.

1. Lack of awareness

India is lacking in public awareness, public legal education and also in legal e-waste literacy. People

are not fully aware of the ways to reduce and control e-waste. This has resulted in a very low recycling rate of e-waste. Customers of electronic devices and materials do not know the hazardous effects of e-waste. They have less legal knowledge about the penalties for inappropriate disposal of e-waste and are unaware of efforts being made by Non-Government Organizations (NGO's), local government bodies, state and central governments for effective e-waste management.

1. Imports of E-Waste

Cross-border flow of waste equipment into India- 80 percent of E-waste in developed countries meant for recycling is sent to developing countries such as India, China, Ghana and Nigeria. (Lundgren, 2012).

2. Lack of financial incentives

Most of the cities in India are lacking in a number of e-waste collection and recycling centers where households, establishments and industries can willingly drop e-waste. The majority of the urban population is accustomed to selling e-waste. They get a discount in exchange for the old product while purchasing any new electrical/electronic products from the retail market. Lack of financial incentives for the best e-waste management and proper e-waste disposal practices results in inappropriate disposal of e-waste.

3. Size of E-Waste generated

India is the fifth biggest producer of e-waste in the world; discarding 1.7 million tonnes (Mt) of electronic and electrical equipment in 2014 (Economic Times, 2015). It produces nearly 12.5 lakh MTs of e-waste every year, (ASSOCHAM, 2014).

4. Dearth of legal knowledge

Lack of legal knowledge on e-waste handling and disposal is one of the root causes of inappropriate management of e-waste. No clear guidelines on e-waste handling and disposal are available. The legal information on the handling and disposal of e-waste is not available on common platforms.

5. Dearth of Infrastructure

Infrastructure developed for the collection, handling, segregation, storage, transportation, disposal and recycling of e-waste in many Indian cities is not copious. Cities are not having sufficient space for conducting these activities. The high cost of e-waste recycling technology and machinery, high prices of land to be purchased for conducting e-waste management and related activities, inefficient collection and transportation facilities are the major hurdles in e-waste management in India.

6. Health-related risks

Since e-waste consists of several hazardous and toxic substances, it poses health-related risks. Improper disposal of e-waste pollutes soil and groundwater. Exposure to such pollution and unscientific handling of e-waste leads to the occurrence of various health issues like vomiting, eye irritation, headache, sickness etc. Persons involved in the process of recycling e-waste may suffer from damage to vital organs like liver and kidneys. Exposure to toxic e-waste for longer periods may lead to the occurrence of cancer, miscarriage and neurological illnesses.

7. Issue of child labor

In India, about 4.5 lakh child laborers in the age group of 10-14 are found to be engaged in various E-waste activities and that too without adequate protection and safeguards in various yards and recycling workshops. So, there is an urgent need to bring out effective legislation to prevent the entry of child laborers into E-waste market- its collection, segregation and distribution. (ASSOCHAM, 2014)

8. Unwillingness of authorities

Improper coordination among authorities accountable for the disposal and management of e-waste is one of the reasons behind the inappropriate management of e-waste in India. The concerned authorities are not always willing to conduct their duties and responsibilities. It is found that, several times the local government bodies in many cities do not take initiatives for appropriate e-waste management.

9. Improper security

Although India barred the import of e-waste under the E-Waste management rules, 2016, a substantial quantity of e-waste still ends up in the country's informal market from abroad.

10. Research paucity

India has long been known for its talent in the fields of science and technology. However, despite having a pool of talented researchers and engineers, the country is lagging behind in research and development. The situation is even more concerning when compared to other emerging economies like China, Brazil and Russia. According to the World Bank, India spends only 0.7% of GDP on research and development, compared to the global average of 2.2% (Godse, S. 2023).

11. High cost of e-waste recycling

In India, the cost of e-waste recycling is high. As there is a lot of uncertainty in the supply of e-waste, no investors are willing to invest in this field. Thus, about 90 to 95% of e-waste recycling is done in the non-formal sector, PCBs are treated in primitive methods to remove components and valuable metals. Burning cable and unwanted electrical/electronic materials to recover copper takes place in the open air leading to the leaching of chemicals and heavy metals into landfills and the recovery yield is also poor.

Suggestions

1. People should be made aware of e-waste collection, handling, storage, transportation, recycling and its overall management.
2. Efforts should be taken to integrate the organized and unorganized sectors working in the field of e-waste management.
3. Incentives should be provided in the form of financial support and boost morale as well as attract and retain talent.
4. Punitive actions should be taken for violating guidelines, rules and regulations regarding e-waste management.
5. Faster Clearance should be given to the projects related to e-waste management.

Limitations of the Study

This is a primary-level study in a descriptive form that involves qualitative scrutiny of the available

literature. It does not involve on-ground or on-site assessment, quantitative analysis and survey components of knowledge, attitude and practices in the environment.

Conclusion

The study reveals that the generation of e-waste in India is huge. Lack of awareness of e-waste management and legal knowledge, high cost of e-waste recycling techniques and machinery, lack of research, high risk in e-waste handling, complexity and toxic nature of e-waste are some of the major issues. Public awareness, integration of organized and unorganized sectors, provision of incentives, implementation of the e-waste-related legislature and faster clearance of e-waste recycling projects are some of the measures that should be undertaken for efficient e-waste management in India.

Acknowledgment

The authors are thankful to the skilled and unskilled workers, authorities, researchers and government employees involved in e-waste management for sharing their views and opinions.

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ISBN: 978-81-959050-4-1

**NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS
SUSTAINABLE DEVELOPMENT**



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Dr. Manisha S. Pawar**

NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS SUSTAINABLE DEVELOPMENT



Fern International Publication Pune
Govt. Regd. No. UDYAM-MH-32-0072613
Malshiras, Dist-Solapur (MS), India
and
Sr.No.-48/60/1/3, Swapnapurti Niwas Yerwada Vasti, Vadgaon
Budruk, Pune, Pin-411041
Email- fppune2003@gmail.com



Price-750

Natural Sciences and Environmental Awareness towards Sustainable Development

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Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

E-mail: fppune2003@gmail.com

Publisher Address

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras,
Solapur, 413107

Mob- 888454089

and

Amitsons Digital Copier, Pune Swargate

106, Paras Chamber, 1st Floor, Above Bank Of

India, Near Laxminarayan Theatre, Swargate, Pune- 411009

Mob-7058486065

Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
India, Near Laxminarayan Theatre,
Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

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Publication Date: 20/10/2023

Price: 1000

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The Future of Agriculture in India

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Abstract

Agriculture in India is still providing a livelihood to the majority of the country's population and is the backbone of India's self-sufficiency in food grains. However, the last two decades have seen India go through a severe farming crisis and record lower-than-expected agricultural growth. Considering this fact, the present paper attempts to investigate the current scenario of Indian agriculture, the constraints of agricultural development and it also anticipate the decisive trends in the agricultural sector. The paper, based on both primary information and secondary data, reveals that, though efforts are being taken to improve the agricultural conditions in India, there is an urgent need to accept a holistic approach to the development of this sector.

Keywords: Future, India, Agriculture, Sustainable, Technology.

Introduction

Agriculture is a diverse sector and its major sub-sectors are crops, livestock, fishery and forestry (GoI, 2023 a). In India, the agricultural industry is significant (Saini P. et. al. 2022). It is the backbone of India's national economy and a mainstay of livelihood for the majority of households; thus, it can never be underrated. It is agriculture that feeds the country's population (Bethu, S. 2016). Though the contribution of agriculture to the gross domestic product has declined over decades, it shows remarkable growth. Nevertheless, agricultural production is still expected to increase so that the population of the country should be well nourished. The demand for agricultural produce has risen throughout time as the country's population has grown and the need for food security has increased (Biswas, S. 2022). The rapid growth of population and the rising purchasing capacity of individuals in the country have created a large demand for nutritious food. In addition, globalization has allowed the supply of agricultural produce to the international market. This has placed tremendous pressure on the country's

agricultural sector. India's agricultural economy has undergone structural changes; the GDP share of agriculture has fallen. This isn't because of the reduced importance of agriculture, or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and non-agricultural sectors in India (Sharma, B. 2016). India is bestowed with vast arable land which is characterised by a variety of soils and agro-climatic conditions making the country capable of producing numerous crops. Today, the country has been recognized as a top producer of certain agricultural products including milk, spices, pulses, tea, cashews and jute, while it is the second-largest producer of rice, wheat, oilseeds, fruits, vegetables, sugarcane and cotton. Regardless of all these facts, the productivity of many crops in the country is low if compared with the productivity in many developed countries. Furthermore, India's population in 2023 stands at 142.86 crore, according to the United Nations Population Fund data. India has overtaken China, which has 142.57 crore, to become the most-populous country in the world. Providing quality and nutritious food for such a huge population has now become a major issue for India. Today, the majority of Indian farmers are facing a variety of glitches including high input costs, low productivity, low-income levels and weak agricultural marketing. Whereas, the concept of agricultural marketing includes many activities starting from the production process to its retailing (Yakanna, A. 2017). In India, both public and private sectors are making efforts to improve the conditions of agriculture. India's membership and commitment to the World Trade Organization (WTO) in 1995 was a clear sign of India's intention to take advantage of globalization and face the challenge of accelerating its economic growth (Mahadevan, 2003). Today, there are four main sources of demand for agricultural produce including food for human population, feed and fodder for livestock, feedstock for energy and raw material for industrial and non-agricultural uses (GoI, 2023 b). All these sources should be taken into account while planning for sustainable agriculture. With this background, an attempt has been made in this paper to discuss the futuristic trends in Indian agriculture.

Objectives

1. To understand the present scenario of Indian Agriculture.
2. To recognize the major constraints of Agricultural Development in India.
3. To anticipate decisive trends in the Agricultural Sector

Data and Methodology

The present study is based on both primary information and secondary data. Government reports, private publications, news articles and research papers were referred to as secondary sources of data. While, farming respondents were interviewed to obtain primary information.

Result and Discussion

Major constraints of agricultural development

Though most of the Indian population is dependent on agriculture, this sector of the national economy has multiple constraints. Agriculture in India is dependent on the vagaries of Monsoon and the average size of land holding in the country is small. Thus,

most of the farmers are either small or marginal. The agriculture in India is mainly intensive substance type. It is labor-dependent and characterized by several annoying anomalies including soil erosion and salinization, locust infestation, outbreak of diseases, low agricultural productivity, harmful effects of climate change, high cost of agriculture inputs, price fluctuation of agricultural produce, inadequate access to credit supply, less value addition, lack of commercialization and shortage of monetary investment. In India, high risks involved in the process of crop cultivation are pushing farmers out of the agriculture sector. Thousands of farmers, particularly in the states of Maharashtra, Telangana, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh have committed suicide due to financial losses. There is inadequate monetary investment in agricultural education, research and extension. Agricultural infrastructure including transportation and storage facilities, electricity supply, marketing and credit support system is not well-organized. The shortage of agro-processing services in the country has resulted in the wastage of agricultural produce and the country experiences huge post-harvest losses. Several agro-processing industries in India are not working efficiently, some of the sugar factories, cotton textile and spinning mills are closed down. There are some agro-based industries in the country that are not in a position to pay reasonable prices for the agricultural produce being used as raw materials by these industries. Agro-based industries in India are not yet developed up to the extent of their full potential. If developed properly, these industries may provide substantial employment opportunities, especially to the rural youth. Loss of agricultural produce during the process of harvesting, transportation and storage is one of the usual problems, the farmers of India face. There is a dearth of low-cost farm technology and the majority of the farmers have less access to advanced technology.

Anticipation of Decisive Trends in Agriculture

The paradigm shift in agriculture will set decisive trends in agricultural development in the near future. Some of the futuristic trends are given below.

1. In India, where ever possible, efforts will be made to bring barren lands under cultivation. The available resources will be used judiciously and efficiently by adopting appropriate technology. The use of non-conventional energy resources including solar, wind, hydroelectricity and biomass energy will be increased.
2. As a part of the time-saving strategy, people will be giving priority to processed, ready-to-eat, affordable and packaged food material, which will lead to the establishment of more agro-processing industries.
3. Rising preferences for healthy, pure and nutritious food would lead to the growth of sustainable agricultural practices including organic farming.
4. Research, technological improvements and protected cultivation of high-value crops will be strengthened.
5. There will be an introduction and widespread use of new technology in agriculture including harvesters, sugarcane-cutting machinery, efficient irrigation systems etc.
6. Improvement in the standard of living, reduction in poverty, effects of globalization and increasing health consciousness in India have led to the changing demand for

agricultural produce. Demand for non-grain food items including milk and milk products, eggs, meat, fish, vegetables and fruits will increase over the course of time.

7. Biotechnology will be used efficiently to develop drought-tolerant, high-yielding, eco-friendly and disease-resistant crop varieties and nutritious food will be produced. This will need sound investment in agricultural research.

8. Competition among the private and government companies will bring innovative and low-cost products, improved seed varieties, high-quality fertilizers, customized farm equipment and nutritious cattle feeds to the market.

9. Most of the retail trade in agriculture will be digitalized. Online Shopping of agricultural products including food items and items required in the form of agricultural input including Seeds, Fertilizers, Pesticides, Plant Growth Regulators, Irrigation and Farming Tools and Equipment with reasonable Prices, Customer Support and free home delivery will be ensured.

10. In view of making agriculture easy, gainful and environmentally friendly, efforts will be made by the government, Farmer's Producer Organizations (FPO), private companies, corporate and cooperatives to bring preciseness in farming using computer-aided technology (CAT), Electronic Commerce (e-Commerce), Artificial Intelligence (AI), Remote Sensing (RS), Global Positioning System (GPS), Geographic Information Systems (GIS), Internet of things (IoT), Nano Technology, drones and robots. Soil testing-based decisions will be taken while selecting a variety of crops to be grown and scheduling the application of water and fertilizers. This will ensure the efficient use of agricultural inputs, minimize the wastage of agricultural products, increase food production and enhance food quality and food safety.

11. Digital connectivity in the near future will play an important role in creating awareness among farmers. It will be successfully helpful in information sharing and implementation of government schemes. Digital technology will also increase farmers' connectedness with different stakeholders.

12. Efforts will be made to balance the supply of Agri-inputs with the demand for it. Prices of Agri-inputs will be stabilized by using crop-specific small equipment, avoiding food wastage, providing cheap and speedy transportation facilities, increasing the number of warehouses, establishing linkages between private and public sectors, developing local markets and stabilizing the market prices of agricultural products.

The future of agriculture in India is a cause of concern for administrators, planners, politicians and agricultural scientists of the country. Government, Non-Governmental Organizations (NGO's), Management and Research Institutions are making efforts to address the crucial challenges of agriculture in the country counting per capita less availability of arable land, sub-standard processing of agricultural products, inefficient and broken supply chain, inadequate use of farm technology, lack of infrastructure to support the efficient use of natural and human resources and inadequate market facilities. There is an utmost need to work on the development of cost-effective technologies ensuring environmental protection and conserving natural resources. Liberalization, Privatization and Globalization (LPG) are the strategies that were adopted

by the government of India under its new economic policy in 1991 which has affected the input markets rapidly. Reforms in agricultural marketing have made changes in the promotion of agricultural products, as permission for private investment and contract farming were granted. In addition, the developments in information technology, the introduction of advanced farm technology, investments in research and development by private agencies and the efforts taken by the government to invigorate the cooperative movement in the country to address the problems of agriculture sectors and crop cultivators are changing the appearance of Indian agriculture. Many startups related to logistics services, cold storage facilities, supply of farm fresh food to urban residents, production of organic food, promotion of commerce between buyers and sellers, weather prediction, delivering information on fertilizers and pesticides, providing technical support, resource planning in agriculture by youth shows that now they are capable of appreciating the importance of putting efforts and money in the agriculture sector. The development of technology in the near future will definitely improve the functioning of Indian agriculture. Limitations of the agriculture sector make the yields and outputs complex, however; still there is a wide scope for tapping untouched potential in the country to enhance the agricultural industry. Useful weather and soil conditions, growing demand for food and other agricultural products, unexploited opportunities in farming, subsidies and financial incentives provided by the government, development and maintenance of infrastructure, marketing and export promotion are attracting a large number of individuals, big multinational companies, startups and entrepreneurial ventures to ensure required investments in innovations, development of new technology, research, training and extension in the field of agriculture. Efforts are being made by the central and state governments, NGOs, private firms, research laboratories, management institutions and cooperative sectors to transform challenges faced by agriculture into opportunities. This transformation taking place across the country will ensure the bright future of Indian agriculture.

Suggestions

1. In India, high crop productivity should be ensured by adopting new technology and effective management systems.
2. Enhancement of soil quality and improvement in soil fertility has to be given priority
3. Rational use of resources, irrigation augmentation and its efficient management have to be guaranteed.
4. The agricultural credit system and crop insurance schemes should be strengthened.
5. Attention should be paid to the enhancement of market system.
6. Reasonable prices should be ensured for the agricultural produce.

Conclusion

In India, the growing population, increasing per capita income, reduction in poverty, improved standard of living and the effects of globalization have posed the rising demand for nutritious and a variety of good quality food materials in abundance. The holistic approach if adopted towards agricultural development including the enhancement in agricultural productivity, production of good quality food, resource

conservation, strengthening of the storage system, provision of finance, use of suitable marketing strategies and efficient, reliable, secured transportation facilities will definitely brighten the future of Indian agriculture.

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Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges



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Title	: Sustainable Development Goals in SAARC Countries: Key Issues, Opportunities and Challenges
Editor Name	: Dr. Lal Mervin Dharmasiri, Dr. Praveen G. Saptarshi, Prof. Dr. S. D. Shinde, Dr. F. M. Nadaf, Dr. Bhimashankar. M. Bhanje, Dr. Jyotiram More, Dr. Harish. B. Tipe Dr. Babalola Ayodele Samuel, Santosh P. Mane
Publishing Agency	: Jyotikiran Publication, Pune
Publisher Address	:Santosh Pandurang Mane Sr. No. 204, Sahajeevan Society, Bhekrinagar, Hadpsar, Pune-8 Mob- 8888454089 Email- jyotikiranpublicationpune@gmail.com
Printed By	:Amitsons Digital Copier 106, Paras Chamber, 1st Floor, Above Bank Of India, Near Laxminarayan Theatre, Swargate, Pune- 411009
Edition Details	:I st
ISBN	: 978-93-94819-34-4
Copyright	: © Santosh P Mane
Publication Date	: 15/06/2023

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AGRICULTURAL SUSTAINABILITY IN INDIA

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DOI- 10.5281/zenodo.8094068

Abstract

The rapid growth of population in India has put a heavy demand on food production and has compelled us to go for sustainable development of agriculture. Thus, there is an urgent need to shift from production-oriented to profit-oriented sustainable farming. The equilibrium between economic return and environmental concern within the context of efforts for sustainable agriculture can be achieved through cautious evaluation of input and output. It is quite challenging; however, the efforts being made in this context should be balanced in a more practical way. Considering this fact, the present secondary data based study summarizes the necessity of sustainable agriculture and suggests the measures to be implemented.

Keywords: Agriculture, Development, Food Security, Sustainable, India

Introduction

Despite some remarkable achievements of international cooperation and national success stories of development, decades of development cooperation and nations' efforts have not resulted in the eradication of severe poverty from substantial parts of the world's population and the establishment of sustainable economic growth in the Global South (de Vries and Jochemsen, 2019). There is still no silver bullet for economic growth, let alone a recipe of how to pave the way for sustainable development. Interestingly, even though agriculture played a dominant role in almost all traditional economies, most of the developing countries have neglected agriculture in development as a key sector for sustainable development (Hwa 1989, Pingali et. al. 2019). Agricultural production in low-income countries is oftentimes characterized by slow production due to internal difficulties such as a limited skill base, and external difficulties such as the high vulnerability to instabilities of the often-primary commodities they export, high fluctuations in production, and high state dependency (ibid.). Moreover, agricultural land in developing countries often characterized by degraded natural resources and land-use conflicts (IPBES 2019). Agriculture has changed dramatically, especially since the end of the Second World War. Food and fibre productivity soared due to new technologies, mechanization, increased chemical use, specialization and government policies that favoured maximizing production. India also witnessed a change in the agriculture system after independence. We had the challenge to produce enough food for the growing population. Hence,

we went for green revolution by adopting high-yielding varieties, fertilizers, pesticides etc. This combination of high-yielding production technology has helped the country develop a food surplus (Nagar et al., 2013). Today, agriculture in India goes beyond just meeting the food requirement of the country. However, it plays an important role in the national economy and employs nearly half of the country's population. Green revolution has helped India transform its status from a food-deficit to a food-secure nation. However, today, the positive impacts of green revolution are getting saturated and its fallouts have become apparent in recent past.

Green revolution has truly increased agricultural production on a global level, but it has done so at the cost of the degradation of the environment and natural resources (Jouzi et al., 2017). Modern agricultural technologies aim at maximization of productivity/unit area/unit time and promote the cultivation of high-yielding varieties, hybrids or genetically modified plants with intensive use of fossil-fuel-based energy, synthetic chemical fertilizers, pesticides and irrigation water, which are leading to degradation of natural resource base, emergence of soil-nutrient disorders, soil and environmental degradation, loss of bio-diversity, development of new biotypes of pathogens and pests, chemical contamination of soil and water bodies and finally human and animal health hazards (Prasad and Gill, 2009). With this background, the present study attempts to find the need for sustainable agriculture in India and also suggests some measures to fulfil the same.

Materials and Methods

The present study is based on secondary data obtained from various sources viz. Government publications, research articles, reports of agencies, etc. Some empirical evidences have also been taken into consideration to arrive at the conclusion.

Results

Necessity for Agricultural Sustainability

Agriculture is the mainstay of India's national economy and the country is known as a global agricultural powerhouse. It is the world's largest producer of milk, pulses and spices and has a large area under wheat, rice and cotton. It is the second-largest producer of rice, wheat, cotton, tea, sugarcane, fruits, farm fish and vegetable. However, agriculture in India is facing numerous problems like loss of soil fertility, fragmentation of land holdings, uncertain and erratic rainfall at some places, outbreak of pests and diseases, low financial investment and rising input cost. Thus, the practice of sustainable agriculture in India is of great help to overcome these issues, as it restores and nourishes the soil and works in harmony with nature, conserves energy, protects and rejuvenates environmental resources, values bio-diversity, boosts food chain productivity, improves people's wellbeing and economic growth, provides resilience in the world of climate change and supports local communities for their socio-economic and overall development. Sustainable agriculture is good for people, the planet, and it is profitable.

Environmental Sustainability

Environmental sustainability includes making life choices that ensure an equal, if not better, way of life for future generations and it is aimed at improving the quality of human life without putting unnecessary strain on the earth's supporting systems. Environmental sustainability can be well understood by considering the status of following aspects:

Soil Fertility

Loss of soil fertility is one of the major problems that agriculture in India is facing today. Soil erosion due to surface runoff, deforestation, high wind velocity, over-irrigation, overgrazing, excess use of chemical fertilizers and pesticides are some of the causative factors of soil degradation and loss of its fertility. Sustainable agricultural practices, especially protecting environmental resources are of great help in this context.

Water Resources

Overuse of water resources in domestic, industrial and agricultural sector, contamination

of surface and groundwater due to improper disposal of sewage and industrial effluents, uneven distribution of water in many parts of the country etc. are some of the water-related issues that Indian agriculture is facing today. As sustainable agriculture ensures water conservation, it is desired.

Agricultural Biodiversity

Farmers in many parts of the country practice monoculture farming, which is a most disputable issue. This type of agriculture is responsible for the loss of biodiversity that leads to loss of soil efficiency. The practice of monoculture farming may result into the outburst of pests and diseases. Sustainable agriculture increases the variety of plants, animals and micro-organisms that enrich biodiversity and thereby improves the agricultural productivity.

Environmental Pollution

The overuse and inappropriate handling of chemicals in the form of fertilizers, pesticides, weedicides, fungicides and herbicides is one of the common problems of Indian agriculture, that contaminates air, water and soil. Priority given to the use of organic manure in sustainable agriculture is of great help to cope with the environmental pollution taking place in the agriculture sector.

Existing Landscape

Faulty agricultural practices and deforestation in rural parts of the country pose adverse effects on rural environment and it reduces the carrying capacity of soil resources. People from such areas tend to migrate towards urban zones in search of employment. Such a population cannot afford the cost of housing in cities and they prefer to reside in slums, causing nuisance in urban environment. Sustainable agriculture on the other hand creates a favourable environment for people in rural areas and decreases rural to urban migration.

Climate

Conventional agriculture is a significant contributor to the emission of greenhouse gases like carbon dioxide, methane, sulphur dioxide, nitrous oxide and so on. On the other hand, sustainable agriculture promotes the use of non-conventional energy resources and thus, plays an important role in global warming induced climate change mitigation by reducing the emission of greenhouse gases.

Economic Sustainability

Economic sustainability refers to the practices that support long-term economic growth without negativity impacting social, environmental and cultural aspects of the

community. Sustainable agriculture encourages justifiable economic practices to protect long-term profitability of agriculture.

Export-oriented policies

The government often promotes the export of agricultural produce so that farmers can get a reasonable price for their produce. However, it involves the hidden cost of transportation and maintenance. Instead, the agricultural produce if sold in the local market, will cut the expenditure on transportation and maintenance. It will result into the availability of agricultural produce to the local people at fair prices. Sustainable agriculture focuses on the needs and development of local people and helps in this context.

Agricultural Debt

Today, the cost of agricultural inputs viz. seeds, fertilizers, pesticides, wages, transportation etc. has increased noticeably. The application of advanced technology, particularly in case of irrigated agriculture could increase the yield. However, it has adversely affected the small and marginal farmers. Sustainable agriculture as an eco-friendly practice, could cut the input cost and free small and marginal farmers from the vicious cycle of debt.

Agricultural Risk

Fluctuations and frequent drop-downs in the prices of agriculture produce pose high risk of financial losses. If climatic conditions are favourable, farmers enjoy a bumper crop which leads to a decline in market prices. On the other hand, Meagre crop production during adverse climatic conditions reduces crop yield and thereby farmers' income, further it pushes them into the cobweb phenomenon. Sustainable agriculture stabilizes the prices of agricultural produce and assures good returns.

Employment

Today, a large segment of Indian population is dependent on agriculture for employment. However, as mechanization and modernization of agriculture have reduced the demand for skilled and unskilled laborers, it has now become essential to ensure the well-being of these unemployed people. Sustainable agriculture may accommodate some of such population by promoting labour-intensive activities.

Inclusiveness

The inclusive approach adopted in sustainable agriculture may yield holistic development of society. It may reduce rural poverty by finding suitable ways.

Political Support

Sustainable agriculture needs government support to succeed. Economic policies framed by

the government should cater to removing any or all obstacles faced by farmers in adoption of sustainable agriculture. One such obstacle is lack of finance, as Indian farmers are largely poor and do not have much savings to rely on. Hence, government can try to establish new institutions and strengthen existing institutions to provide easier financial options to the farmers for accepting the changes brought through sustainable agriculture. Another major obstacle is poor agricultural marketing. If government can strengthen the linkages in the marketing channels and build a well-connected marketing infrastructure, the benefits of sustainable agriculture can be enjoyed by both farmers as well as consumers; and the role of middlemen can be minimized.

Local acceptance

As science and technology is rapidly developed in the recent past, it has also been introduced in various sectors. However, the use of technology needs suitable knowledge and skills. In addition, due to the influence of religion, traditions and customs, people particularly in rural parts of the country are not ready to willingly accept the innovations in science and technology. As sustainable development promotes the use of locally developed technology in agriculture, it search for more attention.

Indigenous Skills and Knowledge

Indian farmers have been transferring their art and knowledge of crop cultivation from generations to generations. They are well aware of their environment, weather conditions, natural resources, local breeds, animal wealth and human resources. Thus, they have developed their own skills, knowledge and technology to be used in agriculture. Sustainable development of agriculture takes all these aspects into consideration.

Gender Equality

In agrarian community, it is often seen that; men are enjoying comparatively more economic benefits from family earnings. Sustainable agriculture promotes gender equality, equal share of burden and ensures equal economic benefits to the men and women, thereby it safeguards equal financial independence for men and women.

Food Security

Farmers in majority of the Indian states have adopted traditional methods of crop cultivation, resulting into the low agricultural productivity. In addition to this, lack of knowledge, prevalence of poverty, impact of religion and non-commercialization of agriculture

are also some of the reasons behind low agricultural production in the country. In India, priority has been given to the cash crops in commercialization of agriculture. Thus, the area under food crops has decreased. It has resulted into the lack of balanced diet available to the masses. Thus, it is essential to cultivate a variety of food crops to cope with this problem. Sustainable agriculture is one of the appropriate solutions for the same.

Participation

Diversity in religion and caste is one of the important characteristics of Indian population. People with good financial positions and those who belong to upper castes enjoy the benefits of agriculture. Small, marginal and low-caste farmers in the country are still away from the mainstream of development. The holistic development approach adopted in sustainable agriculture will be of great help in this context.

Suggestions

According to a study by the Council on Energy, Environment and Water (CEEW), less than 4 percent of Indian farmers have adopted sustainable agricultural practices and systems (Economic Times 2021). However, reversing these figures is not difficult, if we can adopt proactive measures and strategies that can launch sustainable agriculture as a best practice across India. Some of the suggestions are mentioned below.

Adaptation of Organic Farming

Organic farming was initiated as a part of a larger solution to the environmental sufferings caused by excess use of chemical fertilizers and pesticides. It has been developed as a response to the environmental harms caused by faulty agricultural practices. This type of farming has numerous ecological benefits. It avoids excessive use of chemical fertilizers and promotes the application of organic manure, reduce soil erosion and prevents nitrates from leaching into the ground. Organic farming improves soil health and recycles animal wastes.

Improvement in existing cropping patterns

Indian farmers give priority to the cultivation of a specific crop in a particular area. Crop diversification in such area will be of some help to produce a variety of food crops to provide a balanced diet to the masses. Priority should be given to wheat, rice, jowar, bajra, soybean, barley, peas, gram, oil seeds, ground nut, seasonal fruits, vegetables, and fodder crops while selecting the crops for sowing.

Adaptation of advanced farm practices

The innovations in science and technology plays an important role in the growth and development of agricultural system. It ensures improvement in agricultural production, generates employment, reduces poverty and promotes equitable and sustainable growth of agriculture. Adaptation of biotechnology, appropriate use of fertilizers and pesticides, selection of improved crop and livestock varieties, application of drip and sprinkler irrigation, adaptation of risk management practices, use of green energy resources are some of the measures with the help of which one can ensure the sustainable development of agriculture in India.

Improved Protection for Natural Resources

Natural resources like soil and water being used in the agricultural sector are losing their quality, either due to their over utilization or pollution. Soils are getting eroded due to faulty agricultural practices like deep ploughing, ploughing along the slope, over grazing, over irrigation and excessive use of chemicals in the form of synthetic fertilizers and pesticides. Surface and ground water resources are getting contaminated due to leachate. Resource protection by adopting suitable methods of conservation like reduce, reuse and recycle may help in this connection.

Enhancement of Resource Efficiency

Enhancement of resource efficiency stands for the efficient use of natural resources and the relationship between the natural raw materials or techno-economic materials and benefits gained from their use whether in production or consumption. The main aim of the enhancement of resource efficiency is to maximise the benefits of products or services while minimizing consumption and waste which may help in sustaining agricultural sector.

Strengthening research in agriculture

Agricultural research in India should be focused on adequate food production, food safety and security, energy needs, sustainable use of natural resources, educational, scientific and computer literacy as well as rural-urban interdependence.

Improvement in agro processing

As agro-processing refers to the set of techno-economic activities carried out for conservation and handling of agricultural produce and to make it usable as food, fibre, fuel or industrial raw material, it offers multiple benefits. Thus, the establishment of agro-processing industries should be given priority.

Discussion

Sustainable development of agriculture in India is possible through organic farming. selection of appropriate cropping pattern, adaptation of advanced farm practices, conservation of natural resources, improving resource efficiency, strengthening agricultural research, optimizing system to reduce post-harvest losses and improvement in food processing system

Acknowledgments

Authors are thankful to the administrators, planners and researchers working in the field of agriculture for sharing their views and opinions on the current scenario of Indian Agriculture.

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POST COVID-19 ECONOMIC RECOVERY IN SAARC COUNTRIES

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Abstract:

The Covid 19 pandemic of 2020 had a severe and drastic impact on the socio-economic development of SAARC nations. The economic growth and development suffered, with countries struggling from negative output, unemployment, poverty, healthcare challenges, labour migrations, reversing of SDG attainments, etc. Towards the end of 2021 onwards, the SAARC nations were able to make a gradual comeback to economic recovery on the back of growth of global trade, supportive macro-economic policies, resurgence of international tourism, and successful vaccination initiatives. However, the growth and economic recovery has remained fragile, imbalanced and uncertain. While India, Bangladesh and Maldives saw output and real GDP rise to near pre-pandemic levels, growth was more subdued in Bhutan and Nepal. On the other hand, Pakistan, Sri Lanka and Afghanistan had to deal with country specific economic and political crisis that negatively impacted their growth trajectories. The current study summarizes the post pandemic economic recovery of SAARC countries through study of secondary data available in the form of periodic reports, research articles, databases and other literature published by international organisations.

Keywords: Economic recovery, SAARC, Development, GDP growth, Covid 19, SDG

Introduction: The SAARC group of countries comprising of the South Asian nations of India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan, Maldives and Afghanistan was founded in 1985 in Dhaka, Bangladesh. Besides sharing a geographical identity as part of the South Asian region, and cultural and historical roots, defined by a rich ancient and medieval heritage giving way to British Colonialism in the 19th and 20th centuries, SAARC nations share similar economic features and challenges. They fall towards the middle and lower half of the economic development spectrum. Though all SAARC nations are considered as emerging and developing economies by IMF, (World Economic Outlook Database, April 2022), the SAARC nations of Afghanistan, Bangladesh, Bhutan and Nepal are included in the 'Least Developing countries' (as of December 2022) list by the Committee for Development Policy, United Nations, and UN DESA, whereas Afghanistan is also included in the list of 'Heavily indebted poor countries' (World Bank and IMF, World Economic Situation and prospects (WESP), 2022).

According to another classification by World Bank based on per capita GNI, most of the SAARC nations fall in the Lower Middle Income category except Afghanistan and Maldives which come under Low Income and Upper Middle Income category respectively. (See Table 1). This shared economic destiny presents similar challenges to the SAARC nations in terms of poverty, illiteracy, unemployment, energy needs, human development, etc. The Covid 19 pandemic that originated in Wuhan in China and spread throughout the world has had a particularly severe impact on SAARC nations. The already burdened healthcare infrastructure was tested to the extreme, whereas their economies struggled to withstand the global economic shocks arising from lockdowns, shutting down of factories, disruption in supply chain and trade and falling growth rates across the world. (World Development Report, 2022). The current study looks at the post-covid economic recovery in the SAARC countries. We discuss the economic fall-out of the pandemic on the SAARC nations and their post-covid recovery.

Table 1: Classification of SAARC Nations by World Bank on the basis of GNI Per Capita in Current USD.

Upper Middle Income (GNI: 4096 - 12695)	Lower Middle Income (GNI: 1046 – 4095)	Low Income (GNI: < 1045)
Maldives	India	Afghanistan
	Pakistan	
	Bangladesh	
	Sri Lanka	
	Nepal	
	Bhutan	

Extracted from World Bank Data accessed from World Population Review (2023).

<https://worldpopulationreview.com/country-rankings/saarc-countries>

Methodology: The study is based on secondary data gathered from periodic reports, and literature published by international institutions like Department of Economic and Social Affairs, United Nations, UN DESA, World Bank, International Monetary Fund, SAARC Chamber of Commerce and Industry, UNCTAD, WEF, etc. Study reports, articles and databases from various sources have been studied for the purpose of research.

General overview of SAARC Economy: The total population across the eight SAARC countries as of 2019 was upwards of 1.7 billion comprising 21% of the world's total population whereas the combined area of SAARC states put together stands at 2 million sq. miles i.e. 3% of world's area. From the 1980s to 2008, South Asian countries experienced a higher GDP growth rate than the global average. During 1980-1999, the average growth rate in GDP was 5.4%, and from 2000-2008 it increased to an average of 6.8%. (Rajeev Jain and J. B. Singh, 2009). According to the data published by the SAARC Chamber of Commerce and Industry, the combined GDP of SAARC nations in 2017, was US\$ 3291.74 billion, with India's share being

US\$2597.49. As such, India plays a leading role in driving the economic growth in SAARC. According to the World Bank report in 2017, forecasting on the economic prospects in South Asia, it was one of the fastest growing regions in the world, with economic growth expected to accelerate from 7.1 percent in 2016 to 7.3 percent in 2017. The report further observed that South Asia remained 'resilient' amidst a 'turbulent' global economy. However, SAARC has not fully realised the potential available within the intra-SAARC trade and investment space. The intra – regional trade among SAARC nations as a percentage of their world trade has grown from 2.3% in 2007 to 5.37% in 2017 which stands in sharp contrast to other regional Blocs like ASEAN which has an intra- regional trade of 22.68%, whereas the EU and NAFTA boast of intra-regional trade of 60.38% and 40.27% respectively (SAARC Statistical Yearbook, Pg. 136, 2017). In terms of foreign investment, the share of SAARC countries in global FDI inflow in 2021 year was only 3.31% i.e. US\$ 52.417 billion with India's share being US\$ 44.735. (WESP, 2022) This pales in comparison with ASEAN, comprising of South – East Asian countries whose share of the global FDI inflows in the world was 11% in 2018-19 (pre-pandemic) and increased to 12% in 2020-21 (US\$172 billion) (UNCTAD)

Figure 2: Growth of Real GDP: South Asia*, US, China and India (Annual percentage change)**



Source: Data extracted from World Economic Situation and Prospects, 2023 (pg. 128)

1. In WESP, 2023 report 'South Asia' includes India, Pakistan, Bangladesh, Sri Lanka,

Nepal, Bhutan, Maldives, Afghanistan and Iran.

2. 2022 : Partly estimated; 2023 and 2024: Baseline scenario forecasts partly based on UN DESA World economic Forecasting Model.

Economic impact of Covid 19 on SAARC countries:

The South Asian countries were severely impacted by the pandemic and its economic spillover with the region experiencing GDP contraction. World Economic Situation and Prospects (mid 2021, pg. 21) report notes that *'the economic growth in 2021 will be insufficient to undo the 6.7% loss in GDP per capita in the previous year.'* All countries in the region saw a spike in the number of infections of Covid 19. India was one of the hardest hit countries, experiencing a devastating second wave of Covid in the early months of 2021 which was attributed to the B.1.1.7 Variant of Covid 19 and a third wave in 2022 triggered by the Omicron variant. The economic fall-out was severe and devastating for the region with increasing number of households collapsing into poverty. The pandemic resulted in shutting down of businesses, job losses, overburdened health care infrastructure, growing inequality gaps, and increasing poverty, cumulatively contributing towards reversing the SDG achievements. The developing economies also had to struggle with inflation, poor health infrastructure, unemployment, inadequate access to vaccines and overall economic distress. The pandemic has directly affected the realisation of the following SDG goals: Goal 1. End poverty in all its forms everywhere, Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture, Goal 3. Ensure healthy lives and promote well-being for all at all ages, Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, Goal 5. Achieve gender equality and empower all women and girls, Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation besides have an indirect impact on the attainment of other SDG goals.

The impact of the pandemic was particularly severe in case of informal employment comprising of low skilled and unskilled workers. In South Asia, more than 70% (74.7%) of the total employment is in the informal

sector. (World Economic Situation and Prospects, 2022) Also, out of the total women employed, a majority of them work in the informal sector. This section of the society was most adversely impacted as they are usually devoid of labour welfare provisions like job security and social security benefits. Vulnerable groups including women, low skilled workers and youth were the major victims of Covid 19 related unemployment. The closure of contact intensive sectors of the economy, shut down of schools and places of employment and continued lockdowns had a disproportionate impact on women. This lead to increase in poverty and reversing of the SDG achievements in the areas of gender equality, health care access to women, girls' education, employment of women and non-discrimination.

Discussion:

Post Covid 19 recovery of SAARC economies:

The post Covid 19 economic recovery for the world including SAARC nations was uncertain, fragile and imbalanced. While developed countries in general particularly USA and China were already on the path of recovery by mid-2021, the situation was far more dire and uncertain for several countries in South Asia, Sub-Saharan Africa, Latin America and the Caribbean. While manufacturing-based economies recovered quickly on the back of increased demand for electronic equipment, medical supplies and other manufactured products, trade in services was would recover more slowly. Trade in services would pick up speed and attain pre – pandemic levels only in 2022 when the total services trade grew by over 17% in the second quarter on 2022 compared to the same time period in 2021. Fear of international travel, emerging variants of Covid 19 and phased uplifting of sanctions affected the travel and tourism sector dependent economies (and island states) such as Maldives, Sri Lanka and Nepal. The recovery was further complicated by the disparity in vaccine availability across countries and regions. The World Economic Situation Report (2022) by the United Nations noted that while there was a contraction of 3.4% in the world economy in 2020, it expanded by 5.5 % in 2021 heading towards a recovery. The economic growth has been projected to decelerate from an estimated 3% in 2022 to only 1.9% in 2023 and pick up momentum in 2024 but at a reduced rate of 2.5%. (WESP, 2023). The recovery was also impacted by the uneven vaccination rates in different parts of the globe during the initial days of the vaccine roll out. While USA, UK and European Union reported a

vaccination rate of 68.2, 67.1 and 28.9 per 100 people in early 2021 respectively, rate of doses administered in India was 10.0 per 100 people during the same period. (WESP, Mid -2021, pg. 2). However, the vaccination efforts have been vastly improved since then, and by December 2021, 64.2% of adults in India had been fully vaccinated and 89.4% had received their first dose. In October 2021, India attained a milestone of administering 1 million Covid 19 Vaccine doses. By December 2022, around 65% of the population in South Asia was fully vaccinated. (WESP 2023, Pg. 30)

By January 2021, merchandise trade had recovered surpassing the pre-pandemic levels. Trade in goods and services which was projected to increase by 9.4% in 2021 and 5.7% in 2022, increased by 11% in 2021 surpassing expectations (WESP, 2022). From 2022 onwards, the trade in services, which had initially been slow to recover, experienced rapid growth. International tourism, also registered a strong rebound driven by “improved economic conditions, pent-up demand, and the gradual lifting of pandemic-related restrictions.” (WESP, mid 2023). United Nations World Tourism Organization (UNWTO) had projected the total revenues from international tourism to reach \$1.2 trillion to \$1.3 trillion in 2022, a significant increase of 60% to 70 % compared to the figures in 2021 but still below the \$1.8 trillion recorded in 2019. (WESP 2023) While Tourism in Maldives had recovered to pre pandemic levels by 2022, India and Nepal also witnessed gradual growth in number of tourist arrivals. In South Asia, the average GDP in 2023 is projected to be 18.4% above its 2019 levels. The GDP output growth of the region has expanded by 7.5% in 2021 whereas it is projected to moderate from 5.6% in 2022 to 4.7% in 2023 and revert to 5.8% in 2024 according to WESP, Mid 2023.

In 2023, the average regional consumer price inflation in South Asia is expected to be 11%, and it is projected to decrease to 9.4% in 2024. While inflation rates are expected to remain at high levels in Pakistan, Sri Lanka, Bangladesh and Afghanistan due to various country specific factors, India's inflation rate has fallen from 7.8% in April 2022 to 7.0 % in August 2022 and further declined to 5.7% in December 2022 due to timely and adequate policies by the Government and the Reserve Bank of India. (PIB, 31 JAN 2023). Central Banks in South Asia, have already started adopting monetary measures to bring inflation under control. The WESP 2023 notes that food

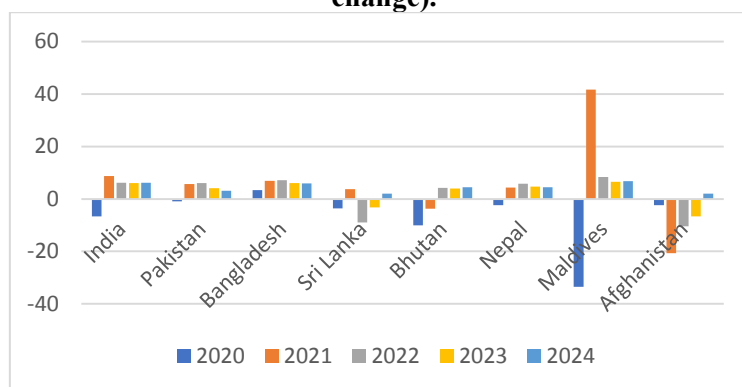
insecurity has increased in the South Asian countries of Bangladesh, Pakistan, Afghanistan and Sri Lanka owing to extreme climate events, damage to agricultural crops and livestock losses. To support its agricultural sector, Bangladesh has implemented several measures including reducing rice import tariffs, increasing fertilizer subsidies, and allocating more funds to the sector in its budget whereas Pakistan has used targeted subsidies and increased social protection to counter high prices. (WESP 2023)

Debt servicing was another major concern for several developing countries across the world including Sri Lanka, Maldives and Bhutan. In 2019, debt servicing accounted more than 45% of Government revenue for Sri Lanka whereas the figures were 30% for Maldives and 10 % for Bhutan. However these figures have ballooned to nearly 80% for Sri Lanka, 40% for Maldives and around 25% for Bhutan. (data extracted from graph in WESP 2023, Pg.50, Fig II.12). The G20 Debt Service Suspension Initiative (DSSI) was established in May 2020 in response to the COVID-19 pandemic. The G20 Debt Service Suspension Initiative aimed to provide relief to 73 low and lower-middle income countries by suspending their debt service payments to official bilateral creditors for a limited time, upon request. The initiative was supposed to help the countries concentrate their economic resources in tackling the pandemic and helping the vulnerable populations. However, the four South Asian countries that participated in this initiative – Afghanistan, Maldives, Nepal and Pakistan did not receive sufficient relief. On an average, relief accounted for less than 20% of debt service obligations or approximately 1.6% of GDP. (WESP 2022) As a percentage of GDP, gross external financing needs for Bangladesh, Pakistan, and Nepal was approximately 9%, 10.5% and 14% respectively whereas, it was around 22% for Sri Lanka in 2022. This figure includes current account deficit, short term external debt and amortization of long term external debt. (Data extracted from graph in WESP 2023, Pg 51, Fig II.13). When unsustainable levels of debt forces Governments to adopt austerity measures and implement cuts in public expenditure like health care and other benefits, the whole exercise inadvertently ends up affecting the vulnerable groups including women, children, disabled, low skilled and unskilled workers the most. It would adversely impact human development, increase poverty and inequality and push back sustainable

development. According to one study quoted in WESP 2022, the debt servicing payments for the 48 of the Vulnerable Twenty Group countries would reach 68.9 billion \$ in 2024. This grouping of 58 countries systematically vulnerable to climate change formed in 2015 includes all SAARC nations except India. Here, developed countries and groups such as IMF, World Bank, etc. should take active steps to mitigate the challenges faced by developing and distressed nations by enabling access to low-cost financing

through effective debt relief initiatives. The developing nations will face a crisis of choice in allocating their resources between debt refinancing, development needs, fighting climate change and SDG goals. The World Bank has setup two initiatives, namely, Global Shield Financing Facility and Global Shield Against Climate Risks that provide financial assistance to vulnerable countries to recover from climate risks and natural disasters.

Figure 3: Graph showing Real GDP growth of India, Bangladesh, Pakistan, Nepal, Sri Lanka, Maldives, Bhutan and Afghanistan for the years 2020, 2021, 2022 and 2023* (Annual percentage change).



Data extracted from World Economic Situation and Prospects, 2023

2022: Partly estimated; 2023, 2024 : Baseline scenario forecasts based partly on UN DESA forecasting model.

India: Recovering from a negative real GDP growth of -6.6% in 2020, India's real GDP expanded by 8.7% in 2021 and was estimated to grow at 6.2% in 2022 and expected to maintain strong growth at 6.0% in 2023, and further increase by 6.2% in 2024 owing to strong domestic demand. (WESP, 2023). The WESP Report, 2022 notes that while India is experiencing economic recovery due to several reasons such as improved vaccination coverage, ending of lockdown restrictions, restarting of economic activity, supportive macro-economic and fiscal policies, growth in exports, and stronger external position, what is required is attaining a - 'robust, sustained and inclusive growth.' Investments and exports could be negatively impacted by a combination of rising interest rates and a worldwide economic slowdown.

India's prudent efforts at battling covid especially during the second wave during the early months of 2021 has been commended at international level including WEF. Being a medical supplies and pharmaceuticals manufacturing hub, India was able to provide

critical medical supplies, equipment and assistance to more than 150 countries since the beginning of the pandemic. As part of Vaccine Maitri programme, till November 29th, 2021, India has provided 94 countries and 2 UN entities with a total of 723.435 lakh doses of the COVID vaccine through grants, commercial exports, or the COVAX initiative. (PIB, 07 Dec 2021) Overall, India has recovered quickly from the economic setback of the pandemic. However, challenges remain in terms of poverty alleviation and attaining inclusive and equitable growth. In a recent statement in June 2023, while releasing the Financial Stability Report, RBI Governor Shaktikanta Das reiterated that India's economy has made a strong recovery post covid and was among the fastest growing economies in the world. The director of Assocham (Associated Chambers of Commerce & Industry of India), Mr. Deepak Sood, in an article in The Hindu BusinessLine noted that Relaxation in FDI norms, increase in private investment, increase in hiring, strong capital expenditure spending by the Government and Government support like Emergency Credit Line Guarantee Scheme (ECLGS) through Covid – 19 financial relief package that supported the service sector of the country, has created business confidence and led to a better than expected recovery post pandemic.

Bangladesh: Bangladesh, one of the stronger economies in SAARC witnessed a real GDP growth of 6.9% in 2021 at US\$416.26 billion due to prudent economic policies, robust demographic dividend, ready-made garment (RMG) exports, remittance inflows, and stable macroeconomic conditions. The GDP of Bangladesh grew at 3.4% in 2020 and 6.9% in 2021 and is estimated to have grown by 7.2% in 2022 and is projected to grow by 6.0% in 2023 and 5.9% in 2024. It is interesting to note that among the SAARC nations, Bangladesh was the only one to avoid negative GDP growth rate in 2020 (WESP, 2023). By the first half of 2021 itself, Bangladesh's economy has started recovering on the back of increase in export and strong remittance inflows along with strong vaccination efforts, recovery of labour market, service sector growth and accelerating public investment. Industrial sector output including apparel production, manufacturing and pharmaceuticals recovered in 2021.

Sri Lanka: Sri Lanka's economy experienced a negative real GDP growth of -3.6% in 2020 and recovered to a growth of 3.7% in 2021. In early 2022, Sri Lanka suffered the one of the worst economic and political crisis in its history. The country defaulted on its debt for the first time in its history in May 2022 as it struggled to make interest payments on its sovereign bonds. During the time of default in April 2022, it had a massive debt pile towering more than \$50 billion and would later require a rescue package from the IMF and credit line extension from India. It's GDP growth contracted by -9% in 2022 and it is expected to maintain a similar negative growth of another -3.2% in 2023 and grow by 2% in 2024. (WESP, 2023) Its major challenges include food shortages, dwindling foreign reserves and sovereign debt risks along with political instability, and external financing constraints. IMF has agreed to lend Sri Lanka \$3 billion in addition to \$700 million support from World Bank. In addition to poor monetary and fiscal policies, unsustainable borrowing, excessive spending on large scale infrastructure projects, and the poorly conceived transition to organic farming, one of the causes for the economic crisis was Covid 19 pandemic and its spill-over effects on the Sri Lankan economy.

Maldives: Tourism sector constitutes almost one third of the GDP of Maldives. The impact of Covid 19 pandemic on international tourism was devastating. Maldives saw its economy nose dive in 2020 with a negative real GDP growth of -

33.5%. As a small island state dependent on tourism, the pandemic exposed its economic vulnerabilities, thereby threatening livelihoods, increasing food insecurity and weakening fiscal position. However, the economy of Maldives has recovered sharply on the back of sustained recovery in international tourism complemented with a successful nationwide vaccination campaign, which has led to growth of its real GDP by 41.7% in 2021. The tourism arrivals in Maldives in 2021 was 1.3 million and in 2022 was 1.68 million almost matching the pre-pandemic levels whereas the economic growth in real terms was estimated to be 12.2% (y-on-y) in 2022. Maldives' GDP growth in 2022 was estimated at 8.4% and it is projected to grow by 6.5% in 2023 and 6.8% in 2024. (WESP 2023). Limited structural diversification and heavy dependence on tourism remain two challenges for Maldives.

Pakistan: The Pakistani economy, already on shaky grounds in 2019, suffered a severe blow from the economic disruptions of the pandemic. The GDP that was growing by 3.1% in 2019, contracted by -0.9% in 2020. The twin challenges of fiscal and current account deficit had forced Pakistan to seek Extended Fund Facility (EFF) programme with the International Monetary Fund (IMF) in July 2019. But the economy recovered post pandemic with the real GDP growing by 5.7% in 2020 and 6.0% in 2021. In WESP, 2023 report, it was projected to grow by 4.1% and 3.1% in 2023 and 2024 respectively. The nation suffered from catastrophic floods, high inflation, and impacts of structural weaknesses, tight monetary stance and global economic conditions in 2022. Very recently, in June 2023, Pakistan needed another IMF bailout of \$3bn Stand-By Arrangement (SBA), as it faced an acute balance of payment crisis amid depleting foreign exchange reserves.

Nepal: Tourism and remittances form an important part of Nepal's economy along with agriculture. Nepal's economy was badly hit by the pandemic with the real GDP growth contracting to -2.4% in 2020. The real GDP of the country expanded by 4.3% in 2021 and was estimated to grow by 5.8% in 2022 and the further projected to grow by 4.7% in 2023 and 4.4% in 2024. The post pandemic recovery in Nepal has been decent with current account deficit narrowing in FY23 and increase in foreign exchange reserves. A major challenge for Nepal is to counter the adverse effects of global warming and climate change. In September 2021, Nepal adopted the Green,

Resilient and Inclusive Development (GRIP) approach, a long term vision focusing on Nepal's recovery from the economic crisis of Covid 19 pandemic with support from international institutional partners and developed nations through investments in sustainable development areas viz: sustainable tourism, renewable energy, biodiversity conservation, climate-smart agriculture, and inclusion of women, vulnerable and marginalised communities etc.

Bhutan: The tiny land surrounded country of Bhutan also experienced the adverse effects of Covid 19 as its economic growth deaccelerated from 5.8% growth in 2019 to -10.1% negative growth in 2020. Labour shortage owing to the pandemic-imposed lockdown, closing of borders and lower external demand affected agriculture, construction and export sector in addition to tourism. India's assistance in medical donations and supply of essential goods has been of tremendous help to Bhutan. The nation that measures Gross National Happiness is considered a success story as the country has been able to reduce poverty and improve human development indicators. The real GDP growth of Bhutan contracted by -3.7% in 2021 and is estimated to have recovered to 4.2% in 2021. It is further projected to grow by 4.0% and 4.5% in 2023 and 2024 respectively.

Afghanistan: Afghanistan's real GDP growth contracted to -2.4% in 2020 before worsening to -20.7% in 2021 when the armed insurgent group Taliban took over Kabul in August 2021, overthrowing the elected government. The overall situation in Afghanistan kept on deteriorating throughout the year that was marred by chaos and violence. The new Government formed by the insurgents passed regressive policies resisting women from education and participating in workforce. This coupled with decline of international aid and lack of access to offshore assets deteriorated the already precarious situation in Afghanistan. The GDP is estimated to have contracted by -10.4% in 2022 and is expected to contract by -6.6% in 2023.

The world economy, having recovered from the covid 19 setback and moving towards full recovery in 2021 struggled to maintain the momentum in later years due to several reasons like lingering effects of Covid 19, Ukraine-Russia war leading to soaring food and energy prices, high inflation and tightening global financial conditions. According to estimates and projections from UN DESA, global economy is projected to experience a slowdown in growth

from 3.1% in 2022 to 2.3% in 2023 and maintain a momentum of 2.5% in 2024 as compared to the 2000-2019 average growth rate of 3.1% in the global economy (WESP mid-2023, Pg.2). The above observation by WESP suggests that complete and sustainable recovery to pre – covid levels is still not completely realised. Outlier events like the Russia-Ukraine War and the Banking Sector crisis in United States and Europe in early 2023 (though contained by quick actions by the US and Swiss Governments and financial regulators that restrained it from having spill-over effects) could easily dent the post covid recovery.

Conclusion:

The impact of the Covid 19 pandemic has been particularly drastic for SAARC nations, who were already struggling with socio-economic, political, environmental, and developmental issues. The pandemic adversely impacted the growth trajectory of SAARC economies while exposing the structural weaknesses in the economy and presenting challenges in the form of inclusive healthcare, employment, economic development and sustainable growth. Large elements of the population in South Asia are still struggling with socio-economic problems that exuberated during the pandemic. Labour market recovery has been slow and inclusive growth remains elusive. Though SAARC nations witnessed momentum in economic recovery from 2021, supported by remittance inflows, broader mobility and supportive macroeconomic policies, the recovery has remained fragile and laden with risks. The challenges remain in the form of socio-economic difficulties faced by large section of populations, rise in poverty rate and inequality, setbacks in education attainment and health care due to the pandemic and macro-economic factors like inflation and debt. Global monetary tightening, tighter monetary policy, supply chain disruptions, slowing global demand, increased commodity prices etc. are expected to adversely impact the economic growth of the region in 2023. While the employment situation in India has improved by 2022 with unemployment reducing to pre – pandemic levels, Pakistan, Afghanistan and Sri Lanka experienced significant growth in unemployment due to country-specific issues.

While some of the SAARC economies have been able to recover and reach pre-pandemic levels of growth, viz India, Bangladesh, Maldives etc. others are still battling multiple challenges on their way to restoring economic development. However, these problems cannot be cited as an excuse to stray away from achieving SDGs.

Rather, it is imperative for these South Asian economies to devise strategies and come up with measures that will help them overcome the challenges and also achieve the targets set for them. Increasing intra-regional trade flows can be one of the starting points of co-operation for SAARC countries, which will reduce trade costs, provide access to new markets, attract FDI, and help in overall growth and development. In addition, these nations can devise a regional plan which contributes to overall environmental conservation and protection, thereby adhering to the global call for sustainability. The rebuilding efforts necessitated in the wake of the pandemic can prove to be an opportunity for SAARC as a regional Bloc to gain relevance as the member nations help and support one other in facing the common economic and social challenges.

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ISBN: 978-93-100-0564-6

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Publisher : Dr. Eknath Mundhe
S. M. Joshi College, Hadapsar, Pune-28
Maharashtra, India

Edition : 1st

Date : 15th September, 2023

Price : Rs. 100

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PREFACE

The book entitled: ***"The Wisdom of Bharat: An Exploration of the Indian Knowledge System"*** is focused on an interdisciplinary approach involving team members from different disciplines working collaboratively, with a common purpose, to set goals, make decisions and share resources and responsibilities.

This book is wholly a collective venture. In the vast tapestry of human history, few civilizations have left as profound an impact on the world as the ancient land of Bharat, known today as India. Nestled amidst diverse landscapes and enriched by a tapestry of cultures, India has been a cradle of wisdom and a reservoir of knowledge for millennia. From the spiritual insights of ancient sages to the advancements in science and philosophy, the Indian knowledge system stands as a timeless testament to the ingenuity and profundity of human thought.

"The Wisdom of Bharat: An Exploration of the Indian Knowledge System" embarks on a transformative journey, delving into the heart of this ancient civilization to unlock the secrets of its profound wisdom. Throughout the pages of this captivating book, we shall traverse through the corridors of time, exploring the multidimensional facets that have shaped Bharat's extraordinary tapestry of knowledge.

In our quest for understanding, we shall encounter the sacred scriptures that have illuminated the path of countless seekers – the Vedas, Upanishads, Bhagavad Gita, and more – their teachings resonating across centuries and inspiring generations to seek higher truths. We will witness the rise of great empires that fostered intellectual growth, leaving behind a legacy that has imprinted itself upon modern thought.

But "The Wisdom of Bharat" is not just a historical account; it is an exploration of the profound concepts that underpin Indian philosophy. We shall embark on a voyage to grasp the principles of karma and dharma, and the intricate interplay between the material and spiritual worlds. Through the eyes of ancient seers, we will gain insights into the eternal cycles of existence and the pursuit of self-realization.

Moreover, this book does not shy away from addressing the challenges and transformations that India's knowledge system has undergone through the ages. From the times of external invasions to the assimilation of foreign influences, we shall observe how the Indian intellect has remained resilient and adaptive, preserving its essence while embracing new ideas.

"The Wisdom of Bharat" does not seek to merely narrate historical events or philosophical treatises. It invites you, the reader, to embark on a personal journey of introspection, drawing parallels between ancient wisdom and the challenges of contemporary life. As we uncover the treasures of Bharat's knowledge system, we shall find profound lessons that resonate with the complexities of the modern world, offering guidance and solace to seekers from all walks of life.

Join us in this profound exploration as we unravel the timeless truths and ancient wisdom of Bharat. Let us embark on a quest to discover the wisdom that has endured the test of time, finding inspiration in the profound teachings that continue to guide humanity towards a more enlightened and compassionate existence. Welcome to "The Wisdom of Bharat: An Exploration of the Indian Knowledge System."

So, this is the right opportunity and platform for the academician, educationalist, readers, teachers & students to express their views and thoughts about the Indian Knowledge System through this book.

Editor

ACKNOWLEDGEMENT

The main objective of the book *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”* is to provide global virtual platform for discussing the new area of research and innovations in the field of the Indian Knowledge System. I would like to express my sincere gratitude to all the authors, researchers and reviewers, who provided their detailed research and views for: *“The Wisdom of Bharat: An Exploration of the Indian Knowledge System”*. This book is wholly a collective venture. This would not be possible without the great efforts paid by all the authors and we are sure their valuable contributions increased the significance of the book. This book chapter provides a premier interdisciplinary platform for researchers, practitioners, and educators to publish the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Indian Knowledge System.

Editor

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WISDOM FROM INDIAN ETHOS FOR CONTEMPORARY BUSINESS AND MANAGEMENT.

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Abstract: *Indian ethos draws its wisdom and values from the Vedas, the Upanishads, the Bhagwad Gita, the epics Ramayana and Mahabharatha and other ancient scriptures and philosophies from the various schools of thought and belief systems that originated and flourished in India. The principles and values of Indian Ethos like Vasudhaiva Kutumbhakam, Dharma, Nishkama Karma, Paraparo Devo Bhava, etc. address the concerns of modern business and management such as environmental sustainability, better employee-employer relations, diversity and inclusion, ethical value-based decision making etc. On the other hand, modern business organisations are now expected to look beyond immediate profits and narrow economic interests, and fulfil their responsibilities towards various stakeholders. Against this background, the present study attempts to synthesise the values derived from Indian ethos with the modern business practices and ideals resulting in holistic value-based management. The study is based on secondary sources of data such as research papers, journal articles and other sources of literature relevant to the topic.*

Keywords: *Indian Ethos, Value based decision making, holistic management, Indian Management, Vasudhaiva Kutumbhakam, Dharma.*

Introduction:

Ethos refers to the fundamental character or spirit of a community, its collected wisdom, guiding beliefs and ideals as reflected in its thoughts, culture and tradition, philosophy and practices. Cambridge dictionary defines ‘ethos’ as ‘the set of moral beliefs, attitudes, habits, etc., that are characteristic of a person or group.’ Indian ethos draws its values and principles from its rich philosophical texts such as the Vedas, Upanishads, the Puranas, the Bhagwad Gita, its epics such as the Ramayana and the Mahabharatha, the various philosophical schools of thought and its rich history comprising of the assimilation of diverse cultures and belief systems making it a melting pot of cultures of the East. These philosophical texts and epics contain wisdom and eternal truths that can provide answers to the modern-day issues and challenges in business and management.

The paradigm of business in contemporary times is changing with its profit-maximisation, maximum resource utilisation, highest return to shareholder approach being replaced by wealth creation for all, corporate social responsibility and stakeholder approach that are gaining importance in corporate governance practices. (J. Chandrashekhkar, Avinash Shivdas, 2014). Businesses are now expected to look beyond their immediate profits and contribute towards the broader aim of serving the society and its various stakeholders. Business actions and practices have come under increased scrutiny even as corporates have amassed greater power and influence in the modern capitalist society driven by economics. The concepts of Dharma, Karma and Vasudhaiva Kutumbham that are the essence of Indian

ethos can act as north star for a modern business in making ethical value-based decisions. Ethics is an important and intrinsic part of Indian philosophy based on the principle of oneness in creation. (Sandeep Gupta, N.K. Bishnoi, Catherine Mathews, 2011). Values and morals as depicted in the Ramayana and Mahabharatha can guide a business manager to tide over ethical dilemmas and make holistic value-based decisions. Organisations are increasingly incorporating workplace spirituality in their workplaces, strategies and culture. Indian ethos-based workplace spirituality can help an organisation to realise its socio-economic social responsibility. (Sandeep Gupta, N.K. Bishnoi, Catherine Mathews, 2011). Principles and values from Indian ethos that focus on holistic development of organisation and society are being adopted in business and management practices in current era. (Giriraj Kiradoo, 2017).

The current paper attempts to study some of the timeless truths as espoused in the Indian ethos and philosophy and contrast and integrate it with modern management concepts that will help a business organisation to address its contemporary challenges and issues.

Rationale of the study:

A vast amount of scientific literature exists addressing the challenges faced by businesses and management through various theories developed in the West like Abraham Maslow's Need hierarchy theory of motivation, the concept of corporate social responsibility of a business, behavioural studies, Theory X and Theory Y of motivation, the concept of Triple Bottom Line, the stakeholder theory of organisational management and so on. However, research on application of Indian ethos in management is an emerging field that draws from the wisdom of Indian ethos to resolve contemporary issues and challenges of businesses. Assimilating the insights and eternal truths and values of Indian ethos with the rational and scientific theories in management will help an organisation to find holistic answers to the ever challenging questions of management and corporate world.

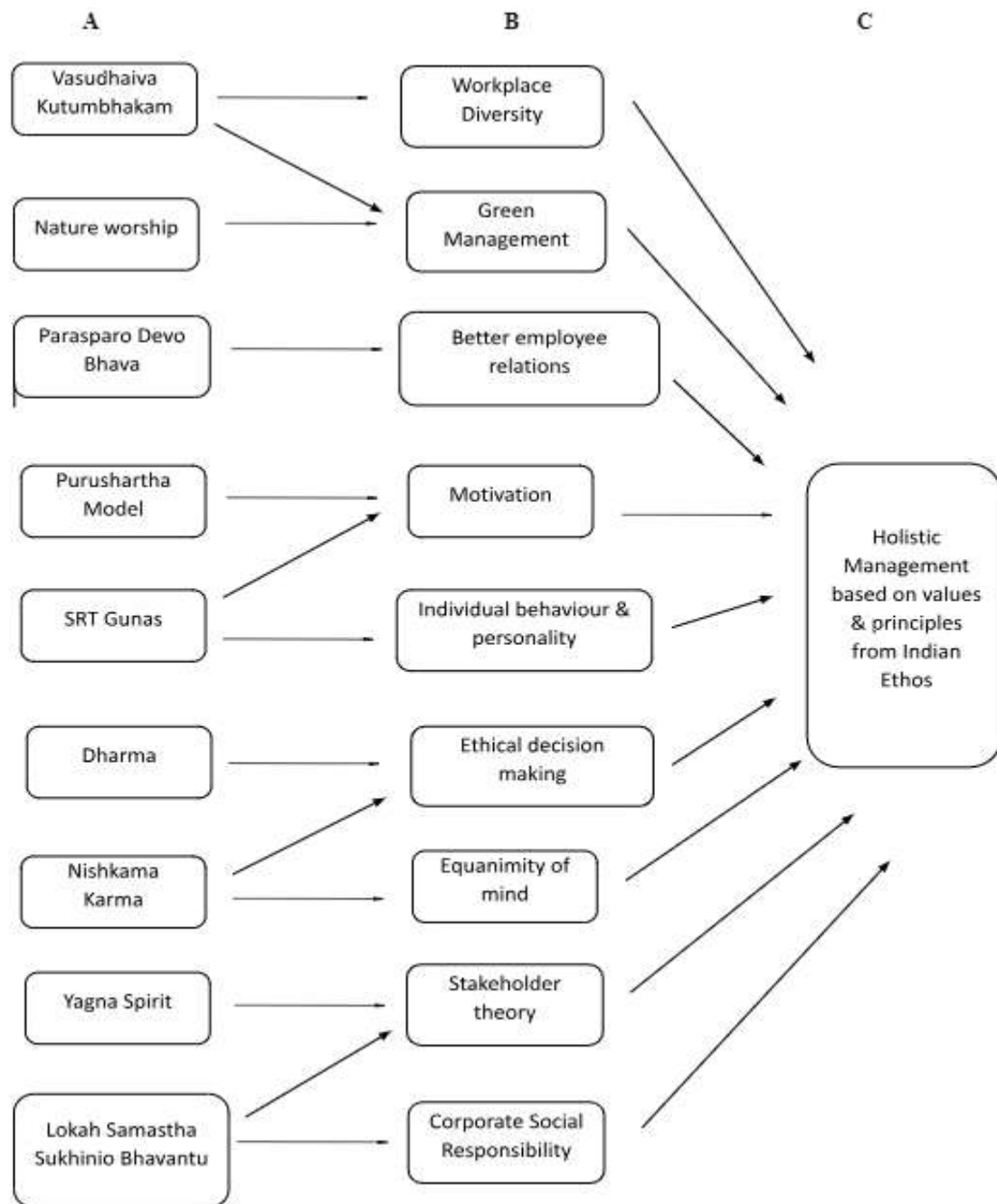
Research methodology

The current chapter attempts to study the principles and values from Indian ethos that can be assimilated with the management theories and ideas resulting in holistic value-based management. The study is based on secondary data in the form of research papers, journal articles and chapters. Literature on Indian ethos and philosophy related to the topic have also been studied for the purpose of research.

Discussion

This part of the chapter highlights the important principles that are the essence of Indian Ethos and their application in different management issues. The paper attempts to synthesize the principles drawn from Indian ethos into the modern theories and ideas of management to address the contemporary business concerns. In the Figure 1 shown below, Part A comprises of values and principles derived from Indian ethos and Part B depicts the management concepts. Assimilation of Indian principles with the modern management concepts will lead to Part C – Holistic Management based on Indian Ethos.

Figure 01: Assimilation of values and principles derived from Indian ethos(A) in management concepts(B) leading to holistic value based management(C).



Vasudhaiva Kutumbhakam

This is perhaps one of the most well known adages of Indian ethos in contemporary times. ‘Vasudhaiva Kutumbhakam – One Earth, One Family, One Future’, is the theme of India’s G20 presidency. ‘*Vasudha*’ refers to Mother Earth and ‘*Kutumbha*’ means family. The phrase first appearing in the Maha Upanishad, one of the 108 Upanishads, means, ‘the entire world is one family.’ Vasudhaiva Kutumbhakam espouses the timeless idea enshrined in Indian Ethos that all creation is inter-connected. Today, in the age of globalisation when business organisations operate across several nations dealing with stakeholders of multiple ethnicities and cultures, the ideal of Vasudhaiva Kutumbhakam can act as guiding principle to the managerial decision makers in respecting cultural practices and traditions of different

countries and ethnicities. Vasudhaiva Kutumbhakam also essentially propagates the idea of inclusion by implying familial belonging across diversities. Diversity and inclusion practices have been linked to better performance, more creativity and innovation, and greater revenues and market share (Herring Cedric et.al. 2009, Scott, K.A., Heathcote J.M. and Gruman, J.A. 2011, Miller Toyah, Triana María Del Carmen, 2009). Several diversity strategies have been designed and implemented by multinational business organisations. Today, when businesses are busy solving the diversity question with corporate policies, diversity initiatives and DEI strategies, inculcating the idea of Vasudhaiva Kutumbhakam in the workplace culture can prove invaluable in attaining the diversity mission. Swami Vivekananda, the spiritual disciple of Sri Ramakrishan Paramahansa began his groundbreaking speech in the 1893 Parliament of Religions with the words, '*Sisters and Brothers of America,*' that was followed by a huge applause from the audience. This phrase used by Swami Vivekananda to address a foreign audience while representing a nation on the other side of the world, subjugated under colonialism but possessing of spiritual wisdom encapsulates the essence of Vasudhaiva Kutumbhakam. The much touted Stakeholder approach which appeals to the corporate conscience to think beyond the immediate needs of the owners or shareholders and consider the concerns of other stakeholders including but not limited to employees, workers, society, environment and government also is an expression of the 'Kutumbha' aspect that insists on considering the 'other' as one's own.

Environment

Environment is accepted today as one of the key stakeholders of a business and corporates are expected to fulfil their responsibility towards the environment. While the past two centuries of industrialisation were synonymous with exploitation of natural resources in the quest for economic growth, better sense has prevailed now among the policy makers and there is an increasing pressure on the corporates to adopt sustainable business practices. Sustainable development refers to development that takes care of environment, economics and society. United Nations World Commission on Environment and Development (1987) defined sustainable development as one 'meets the needs of the present without compromising the ability of future generations to meet their own needs.' (Y. Loknath, B. Abdul Azeem, 2017). A triple bottom line approach refers to the business organisation concerned with profits, people and planet and adopting sustainable practices in its operations. This approach requires firms to engage in profit making while positively contributing to the society and minimizing the negative impact of its operations on the environment. Green management addresses these concerns regarding impact of business on environment. Green management refers to environmentally conscious business that avoids pollution, waste and emissions and engages in environmentally sustainable business practices. (Elshaer Ibrahim A. Azazz Alaa M. S., others, 2023).

In Indian ethos, earth is endowed with the personality of motherhood. Earth or Bhu Devi is worshipped as mother, and mankind and other creatures are her children. Rituals and traditions in Indian ethos also accord earth and other aspects of nature with a divine status to be worshipped and revered rather than exploited as a resource. In Hinduism, Bhu Devi is worshipped as an incarnation of Goddess Lakshmi and the consort of Varaha, the incarnation of Narayana or Sri Vishnu, one of the three major divinities in the Hindu pantheon. There are several festivals and associated rites and rituals in the Hindu religious practices that centre on

worshipping the various aspects of nature such as *Pola*, a festival celebrated in Maharashtra and Chattisgarh where bulls and oxen are revered. In the festival of Narali Poornima, the fishing community in Maharashtra along Mumbai and Konkan Coast worship the seas as an aspect of Lord Varuna, the god of oceans and waters. Chhath Pooja, celebrated in North India and some parts of Nepal is a festival dedicated to the Sun God. Rivers such as Ganga, Narmada, Yamuna etc. are deified by the people and worshipped in several parts of the country. In the Indian mythos, the river Ganga is considered holiest of the rivers and associated with Lord Shiva. Nag Panchami, Gau pooja, Vat Poornima are some other festivals in various parts of India that entail worshipping of the snakes, cows and the banyan tree respectively. These traditional religious and folk practices inculcate a sense of harmony and inter-connectedness with the environment. A modern business organisation can inculcate these practices and rituals among its workforce that will create a filial and reverent attitude among its decision makers towards the environment. The earlier principle of Vasudhaiva Kutumbhakam if read along with the above-mentioned practices expands the idea of family to include nature and environment.

Paraspar Devo Bhava

One of the major challenges for management is to create and nurture good, harmonious employee-employer relations. The differences and disputes between labour and management are due to the different interests of both sides. These differing interests have led to conflicts, disputes, strikes and even violence in several instances. The ideal of ‘Paraspar Devo Bhava’ emphasises ‘to regard the other as divine being’. The ‘other’ whose interests, socio-economic class as well as priorities are different is to be treated with the same reverence one reserves for the divine or sacred. This ideal can help internalise a more humane attitude among the management and workers towards one another. Shri Rang Avadhoot Maharaj, a spiritual leader and independence activist credited with spreading the message of Datta-panth in Gujarat, popularised the ideal of Paraspar Devo Bhava through his writings and works.

SRT Gunas

‘Guna’ means quality or attribute. According to several Hindu schools of philosophy, the three Gunas – Sattva, Rajas and Tamas are prevalent in all creation and beings in the world. ‘Sattva’ refers to purity, calmness, knowledge, peace, truthfulness and virtuousness. ‘Rajas’ is the attribute of passion, action, desire, ego, ambition and attachment. ‘Tamas’ on the other hands means indolence, sleep, darkness, fear, inertia and ignorance. All the three gunas are present in an individual but at any one point of time one Guna will be predominant. Thus individuals and their actions are classified by Indian philosophy into Sattvic, Rajasic and Tamasic gunas. Guna theory helps us to understand the motivational needs and personality of an individual. A person with predominantly Sattvic gunas will be self-motivated and able to take decisions in a calm and peaceful manner. A Rajasic personality can be better motivated by extrinsic rewards that will appeal to their sense of ambition, personal achievement and egoistical needs. On the other hand, an individual with a tamasic personality may be motivated by fear of punitive consequences. Thus, SRT gunas offer a practical guide towards motivation based on the behaviour and innate nature of the individual. The knowledge of Guna theory can help one become a successful manager through a better understanding of human nature and mental modes. The three Gunas are

further explained by Lord Krishna to Arjuna in the Bhagwad Gita in chapter 14. Lord Krishna refers to Sattva as ‘pure, illuminating and full of well being’, Rajas as ‘arising from worldly desires and affections’ and Tamas as ‘born of ignorance...deluding living beings through negligence, ignorance and sleep.’ (Holy Bhagwad Gita Commentary by Swami Mukhtananda).

Purushartha Model

The word ‘Purusha’ refers to individual and ‘arthas’ means goals of life. According to the Purushartha concept, there are four goals or aims of a human birth. These are Dharma (righteousness or duty), Artha (Wealth, economic abundance), Kama (pleasure or enjoyment of desires) and Moksha (liberation of the soul). The Purusharthas are explained in the various Dharmashastras, Upanishads, the epics Ramayana and Mahabharatha and other Hindu texts. The Purusharthas act as guiding light to an individual in performing actions as a part of society. Of the four Purusharthas, Dharma is considered to be the greatest. The pursuit of Artha and Kama should be in accordance with the Dharmic principles. The ultimate aim of human existence, the purpose of human life is to attain Moksha or liberation from desires leading to freedom from the cycle of birth and death. Dharma, Artha, Kama and Moksha can be understood as the guiding principle of all human efforts. The Indian values can be utilized along with western ideas of motivation to achieve individual and organisational growth. (N. Suman, Ashok H.S., 2015) The Purushartha theory can be understood as an Indian approach towards motivation. If we contrast the Purushartha model with Maslow’s Need Hierarchy theory of motivation, the fundamental motives in the latter are physiological needs followed by safety and security needs while the highest-level needs are self- actualisation needs that is fulfilling one’s full potential. In the Purushartha model, the fundamental basis of all human actions is Dharma, that is, to live life in a righteous manner whereas the highest and ultimate goal is Moksha, attaining freedom from all desires or motivations. The Purushartha model can add to Maslow’s Need hierarchy theory to better understand human motivations and realise the objectives of life.

Dharma

‘Dharma’ is one of the basic tenets of Hinduism and other belief systems that originated in India like Buddhism, Jainism and Sikhism. The term ‘Dharma’ is ubiquitous in Indic traditions and has several connotations. It can refer to righteousness, duty, justice, moral duties, virtue, and law and customs or even ‘innate characteristics or nature of things.’ The opposite of Dharma is ‘Adharma’ that refers to unrighteousness or indulging in an action that is against the accepted laws and customs or against one duty. In the context of ethics, the idea of Dharma assumes great importance. In management and business ethics, ‘Dharma’ can be read as a manager or an employee performing actions in accordance to his ‘duty’ or ‘role’ while following the principles of righteousness (dharmic actions). The appropriate Dharma for a manager is to balance the interests of various stakeholders without privileging any single stakeholder. (Nilakant Venkataraman, 2016, Pg 77) Similarly, a business entity while taking decisions should consider its dharma as a responsible corporate citizen taking care of its stakeholders. Dharma can act as the guiding principle for an organisation in resolving its ethical dilemmas and challenges. The epics Ramayana and Mahabharatha show the protagonists as well as other characters facing *dharamsankat* or ethical dilemmas such as Lord Rama having to banish his wife Sita to the forest as per his

Raja-Dharma (duty of a king) or Sri Krishna reminding Arjuna of his Dharma as a warrior to fight against his own relatives, thus illuminating the various aspects of Dharma.

Nishkama Karma

Karma means action and along with Dharma forms the cornerstone of most of the Indic religions including Hinduism. The verse expounding Nishkama Karma appears in Chapter 2 of the Bhagwad Gita where Sri Krishna explains to a dejected and dismayed warrior Arjuna to ‘perform actions without caring for its fruits or rewards.’

Ch 2. Verse 47

*karmaṇy-evādhikāras te mā phaleṣhu kadāchana
mā karma-phala-hetur bhūr mā te saṅgo ’stvakarmaṇi*

Translation – You have a right to perform your prescribed duty, but you are not entitled to the fruits of action. Never consider yourself to be the cause of the results of your activities, and never be attached to not doing your duty.

(Source: <https://www.holy-bhagavad-gita.org/> commentary by Swami Mukundananda)

The philosophy of Nishkama Karma or ‘desireless action’ forms a prominent part of Bhagwad Gita. The doctrine of Nishkama Karma means performing actions without expectation of rewards. Thus, our action should be desireless arising from detachment. The actions have to be performed as an offering to the divine. This practice of detached action leads to equanimity of mind. The practice of Nishkama Karma emphasizes on detachment and equanimous attitude towards success and failure leading to happiness. (Singh B.D., 1999). This would result in the individual developing balanced state of mind while breaking free from the dichotomies of joy-sorrow, pleasure-pain, success-failure and gain-loss, thus reducing stress and negative emotions like greed and fear. Thus, a manager practicing the philosophy of Nishkama Karma will be able to make value based ethical decisions while free from stress, fear, and attachment.

Yagna spirit

The Yagna spirit as espoused in Indian philosophy meaning ‘that which connects individual and the universe for mutual benefit and prosperity’ provides a framework for social entrepreneurship. ‘Yagna is performed for the individual profit and for the social well-being.’ (J. Chandrashekhar, Avinash Shivdas, 2014). The word ‘Yagna’ has multiple meanings such as ritual, worship, sacrifice or an offering. Yagna spirit refers to first offer or give (to the Devas or the divinities), and then take (blessings/ fulfilment of desires). (J. Chandrashekhar, Avinash Shivdas, 2014). In the context of a business, the yagna spirit can symbolise an organisation fulfilling its responsibilities towards various stakeholders such as the community, environment, government, consumers and workers in order to attain its objectives.

Lokah Samastah Sukhino Bhavantu

Lokah Samastah Sukhino Bhavantu (LSSB) is a Hindu prayer that translates to ‘May the entire world be blessed with happiness.’ This prayer which is a part of various ceremonies and rituals presents the idea of interconnectedness of all beings. Today, the challenges such as climate change and global warming makes us realise the timeless truth in the ancient Indian dictum that one’s prosperity cannot be divorced from global realities. Today’s

problems such as climate change, rising sea levels, global warming, health crisis like the one presented by Covid 19, economic recession, global poverty and hunger etc. require various participants of the global economy including Governments, international institutions and business organisations to work together. While the stakeholder perspective envisions a business organisation dealing productively with all its stakeholders, LSSB compels one to think and care for even those who may not be your direct stakeholder, thus once again underscoring the Indic idea of inter-connectedness of all beings. The idea of Lokah Samastha Sukhino Bhavanthi can be assimilated with the practice of corporate social responsibility. A corporate firm can attain its environmental, philanthropic, ethical and economic responsibilities to create shared value that benefit communities and by extension fulfil its role in mitigating the global challenges.

Conclusion

The current study recommends assimilating the wisdom of Indian ethos in modern concepts and ideas of management to create a holistic management model based on Indian values as depicted in Figure 1. The values derived from Indian ethos through its ancient scriptures, the Upanishads, the Vedas, the Bhagwad Gita, the various schools of philosophy and belief systems and the epics Ramayana and Mahabharata are timeless, profound and exhaustive. These values and principles can provide solutions to the various issues and concerns of a modern business organisation. Emergence of management ideas such as corporate social responsibility, creating shared value, stakeholder theory, sustainable business practices, diversity and inclusion and green management indicate a paradigm shift in the role of the business organisation from a 'profit maximising' machine to a responsible corporate citizen with broader obligations. As businesses around the world grow into this new role, re-evaluating their priorities to include the concerns of various stakeholders, principles of Indian ethos can provide the much needed ethical grounding based on spiritual and holistic values. Thus, synthesizing values and principles derived from Indian ethos such as Vasudhaiva Kutumbhakam, Dharma, Nishkama Karma, SRT gunas and others discussed above into modern management ideas and concepts will lead to holistic value-based management.

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ISBN: 978-81-959050-4-1

**NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS
SUSTAINABLE DEVELOPMENT**



**Dr. Shantaram G. Baviskar
Dr. Manisha S. Pawar**

NATURAL SCIENCES AND ENVIRONMENTAL AWARENESS TOWARDS SUSTAINABLE DEVELOPMENT



Fern International Publication Pune
Govt. Regd. No. UDYAM-MH-32-0072613
Malshiras, Dist-Solapur (MS), India
and
Sr.No.-48/60/1/3, Swapnapurti Niwas Yervada Vasti, Vadgaon
Budruk, Pune, Pin-411041
Email- fppune2003@gmail.com



Price-750

Natural Sciences and Environmental Awareness towards Sustainable Development

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Natural Sciences and Environmental Awareness towards Sustainable Development

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Publishing Agency

Fern International Publication Pune

Web: <https://fppune.org>

E-mail: fppune2003@gmail.com

Publisher Address

Jyoti Kerappa Mane

Deshmukh Colony, Mhaswad Road, Malshiras, Malshiras, Malshiras, Malshiras,
Solapur, 413107

Mob- 888454089

and

Amitsons Digital Copier, Pune Swargate

106, Paras Chamber, 1st Floor, Above Bank Of

India, Near Laxminarayan Theatre, Swargate, Pune- 411009

Mob-7058486065

Printed By

Amitsons Digital Copier 106, Paras
Chamber, 1st Floor, Above Bank Of
India, Near Laxminarayan Theatre,
Swargate, Pune- 411009

Edition: 1st

ISBN: 978-81-959050-4-1

Copyright: Jyoti K. Mane

Publication Date: 20/10/2023

Price: 1000

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Green Energy for Emerging India: Potential, Policies and Challenges

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Abstract

Today, India is on the verge of transitioning from conventional energy resources to sustainable growth powered by green energy resources. Green energy will be the source of next phase of India's growth. The present paper attempts to understand the potential and challenges in the adaptation of green energy resources in the light of various policies framed by the Government of India in order to attain its NDC commitments. The study is based on secondary sources of data viz. publications and reports by international and national bodies. A few research papers were also referred to obtain the information. It is observed that India's attainment of Net Zero emissions depends on its successful harnessing of renewable energy resources; besides working towards improving fossil fuel efficiency, framing policies for utilisation of green energy, innovation in environment friendly technologies and bringing efficiency in the transportation of power supply. Towards this end, India has already formulated policies and undertaken a slew of measures such as the National Solar Mission, National Hydrogen Energy Mission, PM KUSUM etc. However, the challenges remain in terms of lack of research and development, land acquisition, inefficiencies in power distribution, the rapid growth of population, urbanization, industrialization, high dependence on fossil fuel based energy resources etc.

Keywords: Green Energy, India, Potentials, Policies, Challenges.

Introduction:

The challenge of global warming induced climate change has imposed a sense of urgency among the decision-makers across the world to adapt to a more sustainable model of growth and reduce dependence on fossil fuels. An important landmark demonstrating the collective intention to fight climate change and restrict the increase in

global average temperatures is the Paris Agreement adopted by 196 parties at the United Nations Climate Change Conference on 12th December 2015. Though India's energy use is less than world average on per capita basis, it is the world's third largest energy consuming country. (India Energy Outlook, 2021). In its Updated Nationally Determined Contribution (NDC) under Paris Agreement submitted in August 2022 to UNFCCC, India has stated its intention '*to adopt a climate friendly and cleaner path*' towards economic development. India has set ambitious and commendable targets such as, reducing emissions intensity of its GDP by 45% by 2030 from 2005 levels, achieving 50 percent cumulative electric power from non-fossil fuel based sources by 2030, restoring forest cover thereby creating an additional carbon sink of 2.5 to 3 billion tonnes by 2030, mobilising investments in development programmes towards sectors vulnerable to climate change, building capacities and technology transfer related to climate change. With this background, the present paper highlights the major policies and programs launched by the government to utilise the green energy resources at their optimum level.

Objectives:

The objective of the present paper is to study the potential and challenges in the adaptation of green energy sources in the light of various policies framed by the Government in its mission to attain the NDC commitments.

Data and Methodology:

The present study is based on the secondary information obtained from national and international reports including the reports published by the International Energy Agency and Ministry of New and Renewable Energy, India. Information available in research papers has also been taken into consideration. The paper is written in theoretical form.

Result and Discussion:

India's attainment of Net Zero emissions by 2070 depends on its successfully harnessing non-renewable energy sources including Wind energy, Solar power, Biomass, Hydropower, and Nuclear Power; besides adopting climate-friendly technologies, framing environment-friendly standards and regulations, working towards improving coal efficiency, and bringing efficiency in power supply. Towards this end, India has already formulated policies and undertaken a slew of measures such as the National Solar Mission, National Hydrogen Energy Mission, PM-KUSUM Scheme, National Bioenergy Programme, etc. However, the challenges remain in terms of investment financing, research and development, land acquisition, demands of a huge burgeoning population, urbanization, high dependence on coal, etc.

a. Solar energy: Solar power comprises 50.24% of the total potential for energy from renewable sources which is estimated at 14,90,727 MW as of 31st March 2022 (GoI, 2023). India being located in the tropical region is endowed with an abundance of solar energy. According to the Ministry of New and Renewable Energy, India's land area receives about 5000 trillion kWh of energy from the Sun per year. This comes to around 7,48,990 MW. The National Institute of Solar Energy (NISE) has estimated that 748 GW of energy can be produced from Solar PV modules by utilizing 3% of wasteland (Murthy

G. S., 2022). Solar energy can help in meeting the growing energy demand without harming the environment and is a clean, easy to maintain and sustainable method of generating power. (Sharma, et. al. 2012). The Development of Solar Parks and Ultra Mega Solar Parks Scheme that was started in December 2014 has been extended till 2026. Under this Scheme, the Central Government shares the financial burden of setting up solar parks with the states. A total of 50 solar parks across 12 states in the country have been sanctioned till now, with a total capacity of 37,990 MW. Out of these, 11 solar parks with an aggregate capacity of 8,521 MW have been completed, and 7 solar parks with an aggregate capacity of 3,985 MW have been partially completed. Financial Assistance through the VGF (Viability Gap Funding) Scheme up to specified limits is provided for Solar PV Power Projects. In order to promote rooftop solar usage, the Solar Rooftop Subsidy Scheme has been launched where a 30% subsidy for installation is provided to states in general categories, and a subsidy up to 70 % is provided by the Central government in case of states in special categories. In order to develop high-efficiency solar PV manufacturing through cutting-edge technology, a Production Linked Incentive (PLI) Scheme for the National Programme on High-Efficiency Solar PV Modules has been formulated with an outlay of Rs. 24000 crores. Under Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyaan (PM-KUSUM), small farmers, co-operatives, panchayats, etc. are assisted in setting up solar energy-based power plants up to 2MW and standalone solar agricultural pumps. As of 30 Sept 2023, a total of 137.95 MW installed solar capacity has been achieved under this program, and 262,873 standalone solar pumps have been installed. The International Solar Alliance is an inter-governmental grouping of countries that lie between the Tropic of Cancer and the Tropic of Capricorn. The initiative first proposed by the Indian Prime Minister, in November 2015 aims at harnessing solar energy for growth, replacing carbon-intensive fossil fuels, and ensuring energy security. As of June 30, 2023, India has commissioned solar projects with a total capacity of 70.10 GW which includes 57.22 GW from ground-mounted solar projects, 10.37 GW from rooftop solar projects, and 2.51 GW from off-grid solar projects. (Ministry of New and Renewable Energy, 2023). Some of the challenges faced in the successful harnessing of solar power are land procurement, the decline in wastelands in recent decades, regulatory bottlenecks, and multiple approvals required, (India Energy Outlook, 2021)

b. Wind energy: Along with solar, wind power is an important source of green and renewable energy in India. Of the total renewable power generation potential as of 31 March 2022, the wind power potential is 46.66% at 6,95,509 MW (120m hub height). (Energy Statistics India, 2023). The National Institute of Wind Energy (NIWE) has identified the eight windy states that can realise most of this potential- Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, and Telangana. In terms of the cumulative installed capacity of wind energy, India ranks fourth in the world. Several policies offering fiscal and financial incentives have been formulated by the Government to encourage wind power projects such as Accelerated Depreciation benefits; concessional custom duty exemption on certain components of

wind electric generators, Generation Based Incentive (GBI) Scheme, etc. The National Institute of Wind Energy, Chennai provides support in the form of wind resource assessment and identification of potential sites. Offshore wind turbines are a comparatively new development in this sector with the first offshore turbine built in Denmark in 1991. India has a vast coastline of 7600km which offers tremendous potential to harness the wind power through offshore turbines. The National Offshore Wind Energy Policy has been notified by the Government to ensure offshore wind energy development in the country.

c. Hydropower: Hydropower is clean, renewable, and a low-carbon source of energy. In the year 2022-23, energy from India's hydroelectric power plants accounted for 12.5% of the total power generated in the country. (Powell Lydia et. al. 2023). According to the STEPS scenario projection by IEA outlined in India Energy outlook in 2021, 'modern bioenergy, solar, wind and hydropower could meet a quarter of India's total energy demands in 2040' with hydropower witnessing capacity doubling to about 100GW in 2040. (India Energy Outlook, 2021). According to the Small Hydro Database of July 2016 compiled by the Hydro and Renewable Energy Department (HRED), there is an estimated potential for power generation of 21133 MW across 7133 sites in the country from small and mini hydel projects. The major challenges in large hydropower projects are related to land acquisition, resettlement, and rehabilitation (India Energy Outlook, 2021). Environmental and social costs, deforestation, and loss of biodiversity are some of the other challenges associated with large-scale hydropower projects. (Powell Lydia et. al. 2023). However, small hydropower projects are more environmentally friendly and do not cause deforestation and displacement. Hydropower can contribute significantly to power system flexibility as compared to other energy sources.

d. Bioenergy: Traditional bio-mass mostly used in rural areas in the form of fuel wood, straw, dung, charcoal, etc, is inefficient, unhealthy, and harmful to the environment. Modern bioenergy technologies can help to convert surplus biomass, bagasse, organic waste, agricultural residues, forest industries residues, and other waste into energy with a minimum negative impact on the environment while avoiding emissions. It is estimated that 130 Mtoe of energy can be generated from sustainable organic waste streams. (India Energy Outlook, 2021). A National Bioenergy Programme has been formulated by the Ministry of New and Renewable Energy for the period April 2021 to March 2025 with an outlay of Rs. 858 Crores to realise the energy potential of biofuels and biomass. Under this scheme, support and financial assistance for setting up biogas, Bio CNG plants, and other Waste to Energy projects is provided. The National Biofuels Policy, of 2018 targets 'bioethanol blending in gasoline of up to 10% in 2022 and 20% in 2030' (India Energy Outlook, 2021). The policy also envisages setting up 12 new biorefineries across the country with an investment of around Rs. 10000 Crore by Oil Marketing Companies. Some of the challenges in the adoption of bioenergy are supply chain uncertainties, high upfront costs and financing required, and use of bio-mass for non-energy purposes like fodder for animals, as manure, fuel for households in rural areas, etc.

e. Hydrocarbon: Green hydrogen produced using renewable energy can help India

reduce its carbon emissions and attain its NDC commitments. It has the potential to replace fossil fuels in transportation, shipping, steel manufacturing, fertilizer production, petroleum refining, etc., and provide energy security. The National Green Hydrogen Mission has been implemented by the Government of India to enable the production, usage, and export of Green Hydrogen. It aims to replace fossil fuels with renewable fuels and feedstocks to produce hydrogen. Currently, most of the hydrogen consumed is generated from fossil fuel-based sources and is referred to as Grey Hydrogen. The National Green Hydrogen Mission aims to create capabilities to generate at least 5 MMT of Green Hydrogen per annum by 2030 with the potential to reach production to 10MMT with the growth of export markets. The various initiatives under this mission include facilitating the building of infrastructure and supply chains for storage and delivery of green hydrogen, reducing input and capital costs to increase cost-competitiveness, achieving scale and low costs, providing financial incentive mechanisms, creating a robust standard and regulations framework, R & D, etc.

f. Nuclear Power: Nuclear energy is a low-carbon, releases less carbon emission, and economically viable source of energy. Currently, there are 23 operational nuclear power reactors in India with an installed capacity of 7480MWe. This capacity is proposed to be increased to 22,480 MWe by 2031, with nuclear power accounting for nearly 9% of India's electricity by 2047. (World Nuclear Association, June 2023). Nuclear Power will form a significant part of India's energy basket as it aims to achieve its NDC goals and move away from fossil fuels.

g. Other Policies: Other technologies and policies towards encouraging green energy and realizing the NDC commitments include the Green Energy Corridors Initiative that was launched in 2015-16 to synchronize and facilitate the integration of energy produced from renewable sources with India's national grid system, better energy efficiency and fuel quality standards for passenger cars through Bharat Stage VI, Faster Adoption and Manufacturing of Electric Vehicles (FAME) II in 2019 to encourage EV adoption, constructing supercritical coal plants with higher efficiencies, promoting Clean Coal technologies, stricter pollution emissions norms for thermal plants introduced in 2015, distribution of LED bulbs through Ujala Scheme etc.

Conclusion:

Being the most populous and developing country, India needs a huge supply of energy to develop economically and to improve the standard of living of its population. Though the country is blessed with a variety of green energy resources, it has not yet utilized its green resources up to their full potential. The government of India and the state governments are making an effort to increase the use of green energy resources by adopting suitable policies, providing financial support and encouraging environment friendly technologies. However, there is a wide scope for improvement in the development and utilization of green energy sources in India by overcoming inherent challenges and adopting appropriate measures.

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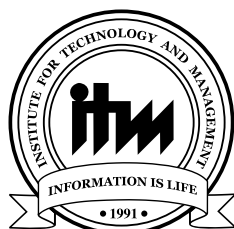
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NAVI MUMBAI



Published by **ITM Business School**

25 & 26 Institutional Area, Sector - 4, Kharghar (E), Navi Mumbai 410 210

ISBN : 978-93-5967-434-6

Message from the Convenor

The concept of sustainability has pervaded the world, and society at large. Numerous authors have written on the topic, each expressing unique ideas of where sustainability might lead society and how it can help entities. Among the various dimensions of sustainability (Human, social, economic and environmental) social sustainability has not been discussed much (Eizenberg and Jabareen 2017). The social dimension is key to the concept of sustainability as it emphasizes on the well-being of humans (Janker 2020). On the other hand environmental sustainability has become the pressing need of the hour.

Keeping in view the importance of Social and environmental sustainability in today's world, ITM Business School, Kharghar organized three days International Research Conference "SOCEN-2023" on 4-6th October, 2023. This conference seeks to bring ideas and thoughts on social and environmental sustainability from a management perspective to create a better tomorrow.

The conference was a great success, witnessing 110 papers from India and overseas. Renowned researchers from across the globe shared their insights as key note speakers. These included :

Dr Paurav Shukla : University of Southampton, UK

Dr Sunil Sahadev : University of Brighton, UK

Dr Stephen Wilkinson : UNOWD, Dubai

Dr Festus Victor Bekun: Istanbul University, Turkey

Dr Narasingha Das : Lebanese American University, Lebanon

Dr Avik Sinha : MDI Gurgaon

Prof P.J Mathew : Chief Mentor

The conference proceedings consist of abstracts and papers of all three dates. My best wishes to the participants and happy reading.

Dr Sangeeta Trott

Convenor

Message from the Director

SOCEN is an expression of the fact that the earth is common to all, and we need to plan and act on preserving it for our future generations! This theme of our conferences propelled researchers to probe deeper into social and environmental sustainability and create awareness and a sense of care for nature which has always been generous to mankind.

I extend my heartfelt congratulations to Dr Sangeeta Trott and the team on the successful publication of the conference proceedings for SOCEN 23. This marks a significant milestone for our institute and showcases the culmination of the hard work and dedication put forth by all involved in the Research Department team and is a testament to the institute's commitment to excellence. The conference witnessed 110 papers that were presented in the three days by students, academicians and corporates. The proceedings encapsulate cutting-edge research, innovative ideas, and diverse perspectives presented during the conference. Thanks to all the guests from academia and corporate who made remarkable references on how we can save the planet from further plunder.

I encourage everyone to spread the word about the publication and to explore the contents of the proceedings. Thank you, Researchers, for your outstanding contributions, and we look forward to celebrating many more successes together in the future.

Wishing all the best and happy reading.

Regards

Dr Lakshmi Mohan

Pro Vice Chancellor- ITM Skills University

Director- ITM Business School

Message from the Dean

It is my pleasure to congratulate all participants of the conference hosted by ITM Business School, ITM Skills University, Kharghar. The conference brought together scholars, researchers, and industry practitioners from diverse fields to engage in interdisciplinary dialogue and exchange of ideas. The theme of the conference was Social and Environmental Sustainability - A Management Perspective which reflects our commitment to addressing pressing challenges and advancing knowledge in the field of sustainability and green economy. Through a series of keynote presentations, panel discussions, and paper presentations, we had the opportunity to explore innovative approaches, share best practices, and collaborate on solutions to some of the most pressing issues of society. I am particularly excited about the breadth and depth of topics that are covered in the conference proceedings. From cutting-edge research in sustainability to transformative initiatives in social empowerment, the diversity of perspectives represented in this forum underscores the richness and dynamism of our academic community. I would like to congratulate the conference organizers, committee members, and all those who have contributed to the planning and execution of this event. Special compliment to the team for bringing out this conference proceeding. The organizing committee's hard work and dedication have been instrumental in ensuring the success of this conference and the publishing of this conference proceedings and I appreciate your efforts. It is through such scholarly interactions of all of you that we could collectively advance our understanding of complex issues and drive positive change in our respective fields. I wish you all had a stimulating and productive conference experience. May this proceeding here be marked by fruitful insights and meaningful future research that will continue to inspire you and the intellectual community at large.

Best wishes!!!

Dr. Sarit Prava Das

Dean Academics

INTERNATIONAL RESEARCH CONFERENCE SOCEN 2023

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Status of E-Waste Management in India

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Abstract

E-Waste is electronic products that are unwanted, not working and nearing or at the end of their useful life. Computers, laptops, smartphones, televisions, stereos, copiers and scanners are everyday electronic products. Use of electrical and electronic equipment on a large scale in India has resulted in the accumulation of large amounts of e-waste. E-waste management in India faces many challenges such as the large size of e-waste, lack of awareness about handling and disposal of e-waste, insufficient space for segregation, storage and recycling of e-waste, lack of research in e-waste management etc. Thus, toxic materials from uncontrolled e-waste enter the environment and it leads to many adverse effects on human health, soil and water quality. On the other hand, as e-waste consists of many valuable materials, it is wasted due to the dumping of e-waste. With this background, this secondary data-based paper attempts to understand the current scenario of e-waste management and issues related to e-waste in India by adopting an explanatory approach.

Key Words: E-Waste, Management, Pollution, Status, India.

Introduction

Electronic waste or e-waste is used to describe all electrical appliances and electronic devices that are discarded for reuse, recycling, or dumped in the bin. E-waste can be classified into [three categories](#): large household appliances, also called white goods, such as refrigerators, washing machines and air conditioners; goods built on information technology and telecommunications, also known as grey goods, such as computers, laptops, mobile phones, printers; and consumer goods, also known as brown goods, like televisions, cameras and recorders (Pendharkar, V. 2018). The electronics industry is the world's largest and fastest-growing manufacturing industry (Radha, 2002; DIT, 2003) with the annual global estimated production of e-waste to surpass 50 million tons in 2020 (Baldé, C. P. et. al. 2017). The last decade has seen tremendous growth in the manufacturing and consumption of electronic and electrical equipment all over the world. As a consequence of this, combined with rapid product obsolescence, and lower costs, discarded electronic and electrical equipment or 'E-waste' is now the most rapidly growing waste problem in the world. Most companies today design their products for planned or perceived obsolescence. This is reinforced through marketing and retailing practices, and affordability and convenience have taken over from product durability as primary drivers (Jennifer, 2005). The e-waste problem has reached great proportions with an estimated 50 million tons of e-waste produced worldwide each year. The Indian market is flooded with huge quantities of electrical and electronic products and gadgets, with huge internal demand (Vibhute, N. et al. 2021). The disposal of e-waste is an emerging global environmental and public health issue, as this waste has become the most rapidly growing segment of the formal municipal waste stream in the world. (Dahl R. 2002). India is not an exception to this. In India, the quantity of 'e-waste' or electronic waste has now become a major environmental problem. With this background, the present study attempts to address the current scenario of e-waste management and issues related to e-waste.

Objectives

- To understand the current scenario of e-waste management in India.
- To study the issues related to E-waste in India.
- To suggest measures for coping with the problem of e-waste management in India.

Materials and Methods

The present paper utilizes the data and information obtained from secondary sources viz. government reports, NGO publications, research, and news articles. It adopts the exploratory method to arrive at the conclusion. Some of the information obtained from empirical evidence is also considered. The paper focuses on e-waste management and also suggests some measures to cope with the issues related to E-waste in India.

E-Waste Life Cycle

Electronic devices all over the world are always designed to resist decomposition. Materials found in e-waste like glass may take millions of years for its decomposition. Thus, it is always better to recycle them using certified facilities. As electronic and electrical materials are not easily decomposed, they need to be sorted, disassembled and separated according to their type. Metal, glass, plastics and other materials found in the e-waste can be recycled to produce new products to save valuable natural resources from further exploitation. Manufacturers, shopkeepers, buyers, dealers, exporters, disassemblers, scrap dealers, smelters and recyclers are major stakeholders in the e-waste supply chain. As e-waste contains both toxic materials including Mercury, lead, cadmium, polybrominated flame retardants, barium, lithium and valuable materials such as iron, aluminum, platinum, silver and gold in it, management of e-waste is one of the emerging problems, however, it offers the business opportunity. Consequently, E-waste recycling is a vital matter of waste treatment. It is also important as the valuable materials can be recovered from it. Nevertheless, the process of collection and recycling of e-waste is complex in its nature that involves various products, people, particularly producers, dealers, retailers, buyers, recyclers, enterprises, area, machinery, financial support etc.

E-Waste Management in India

Electronic waste in recent years has become a vital environmental and health concern. India being a major consumer of electronic products faces a substantial challenge in managing e-waste effectively. The rising use of electronic devices and the rapid pace of technological developments contribute to the growing e-waste problem in India. Inappropriate disposal of e-waste results in many risks to the environment and the health of human beings. Several electronic devices contain hazardous materials like lead, mercury, cadmium and brominated flame retardants which can contaminate soil, water and air if not disposed properly. In view of addressing this issue, the government of India has formulated policies and regulations to manage e-waste properly. The E-Waste (Management and Handling) Rules 2011 were made functional to ensure proper collection, recycling and disposal of e-waste in an eco-friendly manner. These rules impose responsibilities on manufacturers, producers and bulk consumers of electronic goods to manage their e-waste effectively. According to these regulations, manufacturers should compulsorily set up e-waste collection centers and implement recycling and disposal mechanisms. They also need to get Extended Producer Responsibility (EPR) authorization and become accountable for the complete lifecycle of their products with proper e-waste management.

The rules also necessitate producers to incorporate labeling on their products indicating the eco-friendly disposal options available.

The government has established e-waste management facilities across the country to encourage proper disposal and recycling of electronic waste. These facilities help in the safe handling and dismantling of e-waste where hazardous substances are segregated and disposed of acceptably. Public awareness campaigns and educational initiatives have also been taken to promote responsible e-waste management practices. People are encouraged to take their e-waste to authorized collection centers rather than disposing of them with regular household waste. Moreover, some initiatives have been undertaken to promote the reuse and restoration of electronic devices to extend their lifespan and minimize e-waste generation. One of the primary challenges is the lack of awareness and knowledge among consumers about proper disposal and recycling methods. Many people still dispose of their electronic waste through informal networks which can lead to environmental and health hazards. The informal sector involved in recycling e-waste also faces challenges like insufficient infrastructure, lack of training and exposure to hazardous substances. To cope with these challenges, large investment is needed to build robust e-waste management systems, improve infrastructure and enhance the capacity of stakeholders involved in the recycling process. In short E-waste management is a persistent issue in India due to the increasing usage of electronic devices. The government has taken steps to regulate e-waste management through policies and regulations and public awareness campaigns have been launched to promote responsible practices. Yet, additional efforts are needed to address the challenges and build a sustainable e-waste management framework in the country.

Intricacy in E-Waste flows

E-waste in India generates from various sources and is characterized by its complex nature. It consists of both toxic as well as valuable substances. Thus, segregation of it has become a tedious process. As e-waste goes through many steps, from its generation to recycling, a number of interlinked stakeholders are involved in the value chain of e-waste. Consequently, e-waste follows different paths viz. formal recycling sector, informal recycling sector and semi-formal recycling sector. Interaction between these sectors is not established well. Most of the E-waste ends up with scrap traders and dealers who, for economic reasons, commonly transfer it into the informal sector.

Issues Related to E-Waste

There are several issues of e-waste in India.

E-Waste as a complex cocktail

E-waste involves a complex mix of unsafe and toxic materials. It consists of precious metals like silver (Ag), gold (Au), palladium (Pd) and platinum (Pt). One can find more than 50 elements from the periodic table in electronic equipment. Electronic devices are an alternative source of base metals such as copper (Cu) and tin (Sn) as well as special metals such as cobalt (Co), Indium (In) and antimony (Sb). It also consists of some toxic substances such as lead (Pb), mercury (Hg), cadmium (Cd), arsenic (As) and flame retardants.

1. Lack of awareness

India is lacking in public awareness, public legal education and also in legal e-waste literacy. People

are not fully aware of the ways to reduce and control e-waste. This has resulted in a very low recycling rate of e-waste. Customers of electronic devices and materials do not know the hazardous effects of e-waste. They have less legal knowledge about the penalties for inappropriate disposal of e-waste and are unaware of efforts being made by Non-Government Organizations (NGO's), local government bodies, state and central governments for effective e-waste management.

1. Imports of E-Waste

Cross-border flow of waste equipment into India- 80 percent of E-waste in developed countries meant for recycling is sent to developing countries such as India, China, Ghana and Nigeria. (Lundgren, 2012).

2. Lack of financial incentives

Most of the cities in India are lacking in a number of e-waste collection and recycling centers where households, establishments and industries can willingly drop e-waste. The majority of the urban population is accustomed to selling e-waste. They get a discount in exchange for the old product while purchasing any new electrical/electronic products from the retail market. Lack of financial incentives for the best e-waste management and proper e-waste disposal practices results in inappropriate disposal of e-waste.

3. Size of E-Waste generated

India is the fifth biggest producer of e-waste in the world; discarding 1.7 million tonnes (Mt) of electronic and electrical equipment in 2014 (Economic Times, 2015). It produces nearly 12.5 lakh MTs of e-waste every year, (ASSOCHAM, 2014).

4. Dearth of legal knowledge

Lack of legal knowledge on e-waste handling and disposal is one of the root causes of inappropriate management of e-waste. No clear guidelines on e-waste handling and disposal are available. The legal information on the handling and disposal of e-waste is not available on common platforms.

5. Dearth of Infrastructure

Infrastructure developed for the collection, handling, segregation, storage, transportation, disposal and recycling of e-waste in many Indian cities is not copious. Cities are not having sufficient space for conducting these activities. The high cost of e-waste recycling technology and machinery, high prices of land to be purchased for conducting e-waste management and related activities, inefficient collection and transportation facilities are the major hurdles in e-waste management in India.

6. Health-related risks

Since e-waste consists of several hazardous and toxic substances, it poses health-related risks. Improper disposal of e-waste pollutes soil and groundwater. Exposure to such pollution and unscientific handling of e-waste leads to the occurrence of various health issues like vomiting, eye irritation, headache, sickness etc. Persons involved in the process of recycling e-waste may suffer from damage to vital organs like liver and kidneys. Exposure to toxic e-waste for longer periods may lead to the occurrence of cancer, miscarriage and neurological illnesses.

7. Issue of child labor

In India, about 4.5 lakh child laborers in the age group of 10-14 are found to be engaged in various E-waste activities and that too without adequate protection and safeguards in various yards and recycling workshops. So, there is an urgent need to bring out effective legislation to prevent the entry of child laborers into E-waste market- its collection, segregation and distribution. (ASSOCHAM, 2014)

8. Unwillingness of authorities

Improper coordination among authorities accountable for the disposal and management of e-waste is one of the reasons behind the inappropriate management of e-waste in India. The concerned authorities are not always willing to conduct their duties and responsibilities. It is found that, several times the local government bodies in many cities do not take initiatives for appropriate e-waste management.

9. Improper security

Although India barred the import of e-waste under the E-Waste management rules, 2016, a substantial quantity of e-waste still ends up in the country's informal market from abroad.

10. Research paucity

India has long been known for its talent in the fields of science and technology. However, despite having a pool of talented researchers and engineers, the country is lagging behind in research and development. The situation is even more concerning when compared to other emerging economies like China, Brazil and Russia. According to the World Bank, India spends only 0.7% of GDP on research and development, compared to the global average of 2.2% (Godse, S. 2023).

11. High cost of e-waste recycling

In India, the cost of e-waste recycling is high. As there is a lot of uncertainty in the supply of e-waste, no investors are willing to invest in this field. Thus, about 90 to 95% of e-waste recycling is done in the non-formal sector, PCBs are treated in primitive methods to remove components and valuable metals. Burning cable and unwanted electrical/electronic materials to recover copper takes place in the open air leading to the leaching of chemicals and heavy metals into landfills and the recovery yield is also poor.

Suggestions

1. People should be made aware of e-waste collection, handling, storage, transportation, recycling and its overall management.
2. Efforts should be taken to integrate the organized and unorganized sectors working in the field of e-waste management.
3. Incentives should be provided in the form of financial support and boost morale as well as attract and retain talent.
4. Punitive actions should be taken for violating guidelines, rules and regulations regarding e-waste management.
5. Faster Clearance should be given to the projects related to e-waste management.

Limitations of the Study

This is a primary-level study in a descriptive form that involves qualitative scrutiny of the available

literature. It does not involve on-ground or on-site assessment, quantitative analysis and survey components of knowledge, attitude and practices in the environment.

Conclusion

The study reveals that the generation of e-waste in India is huge. Lack of awareness of e-waste management and legal knowledge, high cost of e-waste recycling techniques and machinery, lack of research, high risk in e-waste handling, complexity and toxic nature of e-waste are some of the major issues. Public awareness, integration of organized and unorganized sectors, provision of incentives, implementation of the e-waste-related legislature and faster clearance of e-waste recycling projects are some of the measures that should be undertaken for efficient e-waste management in India.

Acknowledgment

The authors are thankful to the skilled and unskilled workers, authorities, researchers and government employees involved in e-waste management for sharing their views and opinions.

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