ENVIRONMENT & SUSTAINABLE DEVELOPMENT

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Environment & Sustainable Development

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Foreword

Human gets all the resources from its surroundings known as environment. It is very essential to understand the environment where we live and get maximum benefit from it. But at the same time it is also essential to understand the ways the environment must be utilized so that it will not get deteriorated over time and remain available for future generation. Replenishing and restoring the depleted environment is important step for sustainable development. Realizing the significance of these facts, the current book is aimed at providing platforms to the authors that were keen to write and make aware readers about environment and sustainable development.

This book is divided in two parts: Environmental concerns (Part I) and Sustainable Development (Part II). The part I starts with chapters dedicated to major environmental concerns, environmental movements and governmental policies for protection of environment in India. One chapter describes the environmental management in Punjab. This part of the book also deals with agriculture and agricultural forestry. Two chapters describe the toxicological effect of metals on soil and aquatic ecosystem. One chapter specifically deals with effects of pollution on aquatic biodiversity. In one chapter, authors have shown the results of their work on biodiesel production from waste cooking oil. Diverse aspects of environment has been covered by incorporating chapters like noise pollution, climate change, emerging trends in geography and environmental dynamics and awareness of environment and its conservation. The part II of this book starts with description of sustainable agriculture in India followed by technological innovations in modern farming. Sustainable use of ethnomedicinal plants and biodiversity of coastal ecosystem were also dealt in this part. Diverse aspects of sustainable development have been covered by incorporating chapters like urban planning, food security & public distribution system, green marketing, purple and green economy etc. One chapter of this part deals with positive and negative aspects of alcohol in context of sustainable development. The last chapter of this part gave an overview of consumerism in India.

I highly appreciate the efforts of editors of the book Dr. Lalita K. Sharma and Dr. Vikas Chandra for compiling diverse topics and presenting this book to increase the awareness of environment and sustainable development. This book will not only be beneficial to researchers and academicians but also to general audience.

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Preface

As compared to other creatures, human beings are gifted with innovative mind and intellect. They are ruling the planet earth by making gradual progression in the field of science and technology. They are exploiting the natural resources for their own benefit. By doing so, they have created an imbalance in their ecosystem. Urbanization and industrialization have severely affected the flora as well as fauna of the earth. Moreover, the uncontrolled utilization of resources in the materialistic world has depleted these resources for our own future generations. If we continue exploit the resources in uncontrolled pace we will end up with havoc in the earth. Considering these concerns we must educate ourselves to our environment in which we live. We must also learn the strategies by which we can recycle and regenerate our resources so that they will remain available in a sustainable manner. In this context, in our current book we have covered several topics related to environment and sustainable developments.

The book has been divided into two parts. Part-I deals with environmental concerns. It contains seventeen chapters. It covers the major environmental concerns, environmental movements occurred in India and government policies for environment protection; environmental management; prospects and challenges of agroforestry in India; effect of plant growth hormones on growth and yield attributes of brinjal; isolation and characterization of *Aazotobacter* from the soil; response of pink pigmented facultative methylotrophs on growth and yield of African marigold; assessment of transfer factors of heavy metals from soil to vegetable crops grown around Mumbai (India); causes, significance and impact of toxicology and metal pollution in aquatic environment; effect of pollution on aquatic biodiversity; production of biodiesel from waste cooking oil; noise pollution; change of climate and its impact on human health and environment; emerging trends in geography and environmental dynamics; comparative study of students of professional and conventional courses regarding awareness of environment; and role of school teachers in environment awareness and conservation.

Part-II deals with sustainable development. It contains ten chapters. This part incorporates the topics viz. the sustainable agriculture; opportunities and problems of modern farming in India; sustainable use of native ethnomedicinal plants; conservation of Ssundarban's mangrove ecosystem and sustainable use of its biodiversity; urban planning; an overview of public distribution system in India; green marketing; purple and green economy;

a critical analysis of whether alcohol is an evil or a good substance for sustainable development and an overview of consumerism.

This book presents an overview and omits many details. The book should thus be viewed as a starting point rather than a comprehensive guide. Each chapter of this book, represents the views of the author in his/her individual capacity, and does not necessarily reflect the views of the authors' firms, or the authors of other chapters, or our views as the editors.

We wish to thank all the authors who contributed their time and expertise for preparation of various chapters to this book. We hope this book helps you to gain a better understanding of the wide scope of environment and sustainable development.

Dr. Lalita K. Sharma
Dr. Vikas Chandra

Acknowledgement

Every mature person in professional life is keenly aware of his/her sense of indebtedness to many people, who have motivated and influenced his/her intellectual development ordinarily. This feeling is formally expressed in gestures of acknowledgement. Our endeavor shall be incomplete without the acknowledgement of those who have helped us in carrying out this study. We would like to convey our feelings of gratitude to all those who have in any manner helped us in completing this edited book. Their valuable guidance and wise direction has enabled us to complete this work in a systematic and smooth manner, obeying the norms of scholastic research.

First of all, we bow our head in reverence to the ***God almighty****, for providing us with this opportunity to work with the intelligentsia and enabling us to reach far beyond our own, restricted ambit of thought and action and has been made this endeavour successful.*

We are thankful to all the persons and organizations working very hard to protect the environment and educating people for utilization of resources in a sustainable manner. We extend our heartiest gratitude and indebtedness towards all authors for their immense interest, judicious guidance and continuous encouragement throughout this work which help us in completing the work of book in a systematic manner.

Last and most importantly, we again thank The Almighty God for answering our prayers by providing the finance, the strength, wisdom and knowledge that enabled us to start and conclude this book.

Once again our sincere thanks to all.

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Contents

CHAPTER 1

MAJOR ENVIRONMENTAL CONCERNS

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ABSTRACT

All the sectors of the economy, namely, agriculture, industry and the community in general are contributing to the degradation of our environment. The over-exploitation of natural resources, the excessive use of fertilizers and pesticides, the excessive use of groundwater, rapid growth of vehicular traffic, large scale migration to cities and deforestation etc. are complicating our environmental problems. In spite of the existence of policy framework at national and state level, sufficient legislations for the enforcement of environmental norms/standards, our environment is getting more and more polluted day by day. Therefore, it seems that the problem of environmental degradation is basically a problem of poor environmental governance. Therefore, the right approach to make correction in the present set-up is to identify the concerns relating to environment.

Keywords: Environmental concerns, pollution, degradation

1.0 INTRODUCTION

Human well being is intricately linked with the well being of the environment. Hence, man's quest for improving the quality of environment through the interactive process with nature is an ongoing phenomenon. However, in his quest for economic development of the riches of nature, man has failed to recognize the limits imposed by ecological systems. The natural environment is being over exploited to fulfill human needs. During the last few decades the scale of our needs has grown so high that we have degraded the ecosystems upon which our health and livelihood depends. This has resulted in an ecological backlash (Jerath, 1995). Our Environment includes living and non-living things around us. The non-living

components of environment are land, water and air. The living components are germs, plants, animals and people. For better environment, all its components should be protected from pollution. Environmental pollution is caused due to over-use of natural resources, presence of a large number of people and livestock in congested areas, use of agro-chemicals, setting up of factories, running of automobiles, burning of fuel, etc. A change in the environment due to pollution affects the ecological balance and productivity of natural resources; such as land, water, forests and livestock.

The term environment means "the sum total of all the external conditions and influences that has direct and indirect affect on the development of an organism". It is a complex combination of physical, chemical, cultural and biological factors. It affects the form and survival of an organism. Accordingly, environment can be classified as physical environment (non-living components like climate, terrains, land forms, water bodies etc.) and biological environment (living components like man, fauna, flora and micro organisms). Environment, at a particular time is the sum of all the abiotic and biotic elements at a place. The basic components include habitat, biodiversity and energy. Environment at a given place is not same always. It changes in space and time. There is a functional relationship between its biotic and abiotic components. The flow of energy in the environment determines the working of environment and its components. Environment works to maintain an ecological balance.

The human beings, directly and indirectly are influenced by the factors of environment. Among these factors, climate has direct effects on the human's economic activities. It has a major influence on the process of decision-making regarding the use of resources. This influences the culture and life style of the different races of the people. Though with the help of advancement in science and technology, man is in the position of modifying the environment by creating artificial changes but that is to a very limited extent. Changes in the environment are a continuous process since the earth came into existence. The natural forces like volcanoes, tectonics, earthquakes, cyclones, wind, ice etc. are responsible for the changes in the earth's structure and environment. Among these forces, human beings are considered to be the most powerful agent for the changes in environment. He is regarded as the transformer and creator of his surroundings in the environment. With the increase in the number of people, this effect has become more significant. With the advancements in science and technology, man has become more capable in influencing the environment (favorable as well as unfavorable). It has given rise to number of environmental concerns.

2.0 MAJOR ENVIRONMENTAL CONCERNS

Major environmental concerns include global warming, ozone depletion, air pollution, destruction of earth's forests, loss of plants and diversity, and natural hazards like earthquakes, volcanoes, typhoons, landslides, droughts and floods. Some of the important environmental concerns are discussed below.

2.1 Greenhouse Effect and Global Warming

Greenhouse effect is a phenomenon that occurs when short-wave radiation from the sun travelling through the earth's atmosphere are absorbed at the planetary surface and are reradiated upward as long-wavelength thermal radiation. These long wave radiations are absorbed by various atmospheric constituents and again reradiated. Some of these radiations are directed downwards towards earth's surface resulting in surface warming. This extra warming is known as Greenhouse effect. The important Green House Gases (GHGs) are water vapours and carbon dioxide (CO_2). These green house gases are important for the human existence due to which earth has able to maintain an average temperature of approximately 15ºC. Without the presence of Green House Gases, the surface temperature of planet would be about -19 ºC and which could not support life.

Over the period of time, especially Industrial Revolution has resulted in the increase of CO_2 which has led to undesired rise in earth's temperature. This has now become a matter of concern as it has become a major threat to the existence of human life. So the phenomenon which has played a major role for the existence of human life now has become a major contributor for the extinction of human life on earth. Some of the recent research studies has noted that the increase in level of CO_2 and warmer global temperatures have a disastrous effect on the biosphere. Researchers have also shown that warmer average temperature since 1960s has resulted in earlier springs and later winters over the higher and temperate latitudes of the northern hemisphere of the earth. According to the research reports of the experts, there is 10 percent unit reduction in snow cover due to global warming. Higher temperatures decreases the soil moisture levels that result in lower growth and yield in agriculture. The experts in bio-geography have also suggested that rise in global temperature forces the animal and plant species to shift towards the colder regions of poles and higher elevations which results in high pollution of these areas.

2.2 Acidification

Acidification is rain or snowfall with a pH of less than 5.65. pH is concentration of hydrogen ions. A natural solution has pH of 7.0. Lower the pH, more acidic is the solution. This happens due to presence of sulphur compounds or nitrogen oxides into the atmosphere.

These chemicals are largely injected by local burning in thermal power plants, industrial furnaces and motor vehicles. These chemical compounds react with water in the atmosphere to form sulphuric acid and nitric acid. The droplets of these compounds move to long distances with the help of air and wind before their final precipitation on the surface of the earth in the form of Acid Rains. The main gases involved in the acid rain production are nitrogen oxides; nitrogen dioxide (NO_2); nitrous oxide (NO) and sulphur dioxide (SO_2). These gases are the resultant of fossil fuel burning and industrial processes. The major countries which witness acid rains are Norway, Sweden, Denmark, Finland, Poland, Germany, Britain, Belgium, Netherland and France in Europe. The industrial regions of Eastern China, Thailand, Malaysia, Indonesia, India, Nigeria, West Indies, Argentina and Uruguay have great risk of acid rains. The entire North East of North America (New Foundland to Gulf of Mexico) is witnessing high acid rains.

Acid rains largely affect the aquatic life. There are more than 1000 lakes all over the world that has become very acidic and does not support aquatic life. There is also widespread damage of forests due to acidic rains. This results in acidification of soil. Due to acidification there is leaching of potassium, calcium, magnesium and other chemical elements which results into the death of trees and forests. Acid rains also affect the building made up of marble and limestone. Taj Mahal in India is the example of structure that suffers by acidic precipitation. Many historical monuments in Athens are also damaged by acidic rains. It has harmful effect on the human health too. Asthma, pneumonia and respiratory problems are caused due to acidic rains.

2.3 Ozone Depletion

A single molecule of ozone is formed by the combination of three atoms of oxygen. It is not found in the lower atmosphere under natural and normal conditions. Ozone is found in the stratosphere in layer of 20 and 50 kilometers. It is continuously formed and then removed. Ozone is formed by the absorption of ultraviolet radiation in the range of 0.1 to 0.3 microns in length. It is important because it helps in filtering out harmful ultraviolet (UV) rays coming to the earth. It acts as a barrier to ultraviolet B (UV-B) radiations that cause skin cancer, cataracts and other diseases of eyes besides reducing the body's defense mechanism which results the human body to be more prone to infectious diseases. The decrease and absence of the ozone layer in the atmosphere result into the phenomenon known as Ozone Depletion. This problem was first identified in 1970s when the invention of supersonic aircraft was done. These supersonic aircraft fly in the lower atmosphere emitting nitrogen oxides. It was found that the ozone depletion was caused mainly due to CFC (ChloroFloro Carbons) gases.

These gases are also emitted by various house-hold appliances like refrigerators, retardants, solvents, aerosol propellants and foamed plastics due to their non-toxic, non flammable and chemically inert properties. The CFC gases do not degrade rapidly and eventually travels through the troposphere to the stratosphere. In stratosphere they come across UV radiations that are absorbed by ozone layer. These CFC gases produce chlorine that reacts with ozone. It results into the release of oxygen molecule that causes the destruction of ozone layer. Each chlorine atom destroys 10,000 ozone molecules. These chlorine atoms have an extended life period of approximately 100 years, and results into continuous destruction of ozone layer. In Antarctic continent 'ozone hole' is found. Every year, this ozone hole widens and deepens. Ultraviolet radiations reaching the earth's atmosphere due to ozone depletion damages eyes tissues, reduction in immunity, damages of crop and aquatic life forms.

2.4 Salinisation

It is the process of accumulation of soluble salts in upper soil horizons. Salinisation reduces and harms the crop growth. Salinisation has increased in dry-lands due to increase in attempts of crop production by irrigation which results into more accumulation of water and high evaporation that causes salinisation of soil.

2.5 Desertification or Desertisation

It is a term coined by French forester Abbeville in 1949 to describe land degradation. There are number of definitions of desertification but it was only Thomas and Middleton in 1994 that gave approved definition. The UN Convention to Combat Desertification (CCD) was signed in 1995. After that it was ratified by 150 countries. Desertification is the process of land degradation that occurs in arid, semi-arid and dry-sub-humid areas which results due to various factors like variations in climates and activities of humans. The land degradation occurs in the form of soil erosion, internal soil changes, depletion of ground water reserves and irreversible changes to vegetation communities. This convention includes multiple causes for desertification but the major causes for degradation were regarded as human actions. The tropical and sub-tropical lands are more prone to land degradations. The researches of United Nations have concluded that about 40 per cent of Africa's non-desert is likely of becoming desert. Similarly, 33 per cent of Asia's land and 20 per cent of Latin America's land are endangered. In the countries like Jordan, Lebanon, Somalia, Ethiopia, Southern Sudan, Chad, Mali, Mauritania and Western Sahara are more prone to desertification.

2.6 Soil Erosion

It is a natural process of removal of top soil mainly by water and wind. The humans have resulted in increase in rate of soil erosion. In the areas where there is high precipitation,

the rate of soil erosion is more. The rate of soil erosion is influenced by rainfall's efficiency to erode; volume of run off; wind strength; slope angle; slope shortening (terrace, ridges); length of wind fetch; and shelter belts. The pressure of population on arable land, cropping patterns, crop rotation, land management, tillage practices and chemical fertilizers significantly affect soil erosion. So deforestation, intensification of agriculture, urbanization, poverty, fire, war, mining and tourism are also the major contributors to soil erosion. The major areas affected by soil erosion are grain lands of USA, Central Mexico, Egypt, Algeria, Libya, Somalia, Ethiopia, Niger, Mali, Middle-East, Central-Asia, Mongolia, basins of China, Himalayan region, Thar Desert of India and Deserts of Australia. According to researchers, nearly 75,000 million tones of productive soil are eroded in the world annually. India witnesses about 6000 million tones of soil erosion annually by wind and water. It results into the adverse effect both in the area from where it is eroded and the area where they are deposited. The deposits in lakes and ponds destroys the aquatic ecosystems by adding more nitrogen and phosphorous. As soil erosion process is irreversible, so it is most important to adopt remedial measures to combat soil erosion for the protection of environment.

2.7 Deforestation

Industrialization, urbanization, rise in population and consumerism in developed countries results in large scale deforestation in tropical and sub-tropical areas in the world. Ever-increasing demand of food has resulted into increase in the demand of agriculture land, agro based industries, forest-based industries and commercial wood for fuel. This requires more of the forest to be cleared to fulfill these demands by bringing more area under the cultivation and grazing ground. Deforestation results into soil erosion, flooding, siltation, salinisation, global warming and climate change. It is considered to be the major contributor to environmental degradation. United Nations in their assessment report released by Food and Agriculture Organization (FAO) indicates that throughout the world, the total forest area is declining at a significant rate. According to the assessment, deforestation activities are more concentrated in developing countries. The governments of the countries play an important role in deforestation by changing the land uses for infrastructure development. Building roads, dams, railways, airways, irrigation, electricity, telecommunication services and other civic amenities also resulted in deforestation activities.

2.8 Waste Disposal

The industrialized and urbanized countries of the world are continuously generating variety of toxic wastes. For a long time, people were using natural system for waste disposal like fresh water to remove solid and liquid wastes and atmosphere to dilute gaseous waste

products of combustion. But these natural systems have become saturated and have resulted into unhealthy environment. These waste products remain in earth's natural systems for a longer period and sometimes always. It has become a serious problem due to business practices of using and making non-destructible and non-recyclable products and by-products. Due to this, the volumes of wastes are always growing at an alarming rate. So the matter of waste disposal has become a serious concern. Every method of waste disposal results into different kinds of implications like if a waste is buried in the earth it results into deterioration of ground water quality. Similarly if it is burned in air it causes air pollution. If wastes are dumped into water bodies it pollutes the water bodies like; rivers, seas & oceans. So, all these methods results into 'waste dispersal' rather than waste disposal. These wastes can be classified as; solid waste, liquid waste, gaseous waste and radioactive wastes.

2.8.1 Solid Wastes

Solid Wastes are the wastes generated which are solid in nature. These are disposed by land-filling, incinerating, compositing, open dumping, animal feeding, fertilizing and dumping in oceans. These kinds of disposal activities has resulted into the various types of ecological and hydrological consequences like change in environment of areas where dumped. It becomes very serious when the water passes through a landfill and dissolves organic and inorganic compounds into underground water-table.

2.8.2 Liquid Waste

Liquid Waste includes wastes which are liquid in nature. Mostly these are discharged into water bodies like lakes, seas and oceans. The hot water created by cooling systems in power plants and factories is very dangerous for the aquatic life of the streams where it flows. This results into the rise in temperature of water bodies, thus destroying the aquatic life. The water bodies are also polluted by oil seepage in large quantities by marine transportation, exploration of crude oil, petroleum and petroleum products, off-shore drilling and refining. It result into the formation of sticky layers on the surface which prevents free diffusion of gases, clog adult organisms feeding structures, and decrease the sunlight available for photosynthesis.

2.8.3 Gaseous Wastes

Gaseous Wastes includes the pollutants which are gaseous in nature and minute liquid and solid particles that remain suspended in the atmosphere. It results from the emissions of industries, urbanization and consumerism. Gaseous wastes have resulted into the phenomenon of acidic rains, global warming and climate change.

2.8.4 Radioactive Wastes

Nuclear energy industries have resulted into a much dangerous type of radioactive wastes. The nuclear waste results into large amount of heat and are extremely hazardous. Some of these radioactive isotopes have longer life cycle. The source of radiations can be natural or man-made. Natural sources include cosmic rays, environmental and living organisms, radionuclide of radium, thorium, uranium and isotopes of potassium (^{40}K) and carbon (^{14}C) are found in soil, rocks, air and water. Human body has also small amount of these radiations. Man made sources include X-ray machines, radioactive fallouts (nuclear tests), nuclear reactor wastes, industrial, medical and research uses of radioactive materials. Television, tube-lights, radium watches are also the source of man-made radiations. The effects of radioactive radiation can be classified broadly into two categories somatic effects and genetic effects. Somatic Effects- human body is composed of tissues, bones, muscles etc. These parts have different level of sensitivity towards radiations. For example, skin tissues and bones are highly sensitive. These radiations cause skin cancer, bone cancer, cataract, cardiovascular disorders, premature ageing and sometimes death of a person. Genetic Effect- human's genetic framework is subjected to great risk due to radiations emitted from natural as well as anthropogenic sources. These radiations are capable of doing genetic defects by making changes in DNA of the human body. This leads to abnormalities in the person and sometimes causes death of the person (Husain, 2014).

3.0 CONCLUSION

From the above discussion, it is evident that environment is the important component of human life but this is being polluted by various sources. Substantial pollution is made by human activities.

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CHAPTER 2

MAJOR ENVIRONMENTAL MOVEMENTS OCCURRED IN INDIA: AN ELUCIDATION

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ABSTRACT

The environment is the aggregate of external conditions that influence the life of human beings and all other living organisms. The rapid destruction of forests, pollution, population explosion, expanding industrialization, unplanned urbanization, soil erosion, natural hazards like flood, drought, landslide, earthquake, etc. have created ecological imbalances in recent years. Through various day to day activities, human beings have been always exploiting the environment in a great extend. At the same time, human beings have taken different conservative measures for environmental sustainability. Remarkably, India has witnessed numerous movements by common people and groups against the destruction or exploitation of the environment. The present article highlighted some of the major environmental movements that occurred in India and their factors related.

Keywords: Awareness, environment, environmental education, environmental movement, pollution

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1.0 INTRODUCTION

In the present time, the problems of environmental degradation have attracted the attention of a wide section of people all over the globe. Because of the rapid destruction of forests, population explosion, expanding industrialization, unplanned urbanization, soil erosion, natural hazards like flood, drought, landslide, earthquake, etc. have created ecological imbalances in recent years. Creating environmental awareness and understanding among the masses is the one and only solution for the prevention of all types of environmental problems. Therefore, nowadays the environmental awareness

became an important area of study among educators and researchers across the world. Similarly, in the present time, environmental education as a subject of study became almost compulsory in all levels of the education system.

In a wider sense environment is taken to mean all those which are physical, chemical, organic, and non-organic components of the atmosphere, lithosphere, and oceans. The environment is the aggregate of external conditions that influence the life of an individual or the living organisms, especially the life of the human. The environment ultimately determines the quality of survival of life (Kumar, 2012). Environmental education is a way of creating knowledge, understanding values, attitudes, skills abilities, and awareness among individuals and social groups towards the environment and its protection. It is the process of education about the environment, education for the environment, and education through the environment. Because environmental education is a process in which individuals gain awareness of their environment and acquire knowledge, skills, values, experience, and also the determination, which will enable them to act individually and collectively to solve present and future environmental problems. It is a process to promote the awareness and understanding of the environment, its relationship with the man, and his activities. It is also aimed at developing responsible actions necessary for the preservation, conservation, and improvement of the environment and its components (Shrivastava, 2008).

2.0 POLLUTION AND BURNING ENVIRONMENTAL PROBLEMS OF THE PRESENT WORLD

The present world is facing increasing environmental problems due to rapid environmental pollution in every fragment that is soil, water, and air. The pollution is an evil of all development. Environmental pollution means lowering the quality of the environment at the local level caused by human activities for the exploitation of resources. Pollution is an undesirable change in the physical, chemical, and biological characteristics of air, water, and soil that may harmfully affect the life or create a potential health hazard of any living organism. Air pollution is the contamination of air as the result of the presence of various harmful particles and it causes various harmful diseases and conditions (Mary, 2018). Water pollution refers to the contamination of water bodies and is the leading worldwide cause of diseases and deaths (more than 14000 people daily). The contamination of soil with an excess of chemicals, fertilizers,

insecticides, herbicides is hampering the environment to a great extend. Deforestation is one of the dangerous obstruct to environmental sustainability and it is primarily man-made motion. It has a serious negative impact on the environment and loss of habitat for millions of species is the most remarkable impact. Moreover, it has decreased global vapor flows from the land by 4 percent. The deforestation of trees not only lessens the amount of carbon stored, but it also releases carbon dioxide into the air. This is because when trees die, they release the stored carbon. Last but not the least; the population explosion is a big problem in India. The population of India was around 361 million during the census of 1951. It reached over 1.21 billion during the census of 2011. The main effects of population explosion are; over-population, poverty, illiteracy, unemployment, pollution, poor health, global warming, extreme use of resources, etc. Directly or indirectly population explosion is the seed of all environmental problems in India.

As a result of increasing environmental degradation, different unfruitful consequences are occurring such as global warming, ozone depletion, acid rain, and so on. Global warming is the current increase in temperature of the Earth's surface (both land and water) as well as its atmosphere. It is being caused by the accumulation of greenhouse gases in the atmosphere produced by human activities. Ozone in the stratosphere protects Earth from damaging amounts of ultraviolet (UV) radiation. A depleted ozone layer would allow more of the Sun's rays to reach Earth's surface. Chlorofluorocarbons (CFCs) and other halogenated ozone-depleting substances (ODS) are mainly responsible for man-made chemical ozone depletion. Acid rain is acid polluted rain that has been released into the atmosphere from industrial processes (BYJU'S, 2020). Acid rain is very harmful to agriculture, plants, and animals.

3.0 MAJOR ENVIRONMENTAL MOVEMENTS OCCURRED IN INDIA

There is continuous exploitation of the environment occurring in the world. Government of all over the world passed different acts and commissions with the motive of environmental protection. There are many environmental movements that take place all over the world by different environmentalists. The environmental movement can be defined as a social or political movement, for the conservation of the environment or for the improvement of the state of the environment. The terms 'green movement' or 'conservation movement' are alternatively used to denote the same. The environmental movements favor the sustainable management of natural resources. It is a type of social movement by individuals or groups with the common interest in environmental protection and brings reforms in policies (Tong,

2005). The spatial scope of various environmental movements ranges from being local to the almost global. In the history of India, we witnessed a number of movements that occurred by the common people for the protection of the environment. Some important environmental movements of India those were able to acquire global attention are the following:

i. Bishnoi Movement (1700)

Bishnoism have been started in 1485 by Saint Guru Jambheshwar in the Thar Desert of Rajasthan, India. With the vision of uniting people on a common platform, Guru Jambheswar Ji advised 29 principles to become a Bishnoi. The word 'Bishnoi' stands for BISH (20) and NOI (9) derived from these 29 principles out of which 6 principles are dedicated to environmental protection and compassion for all living beings. The Bishnois may be considered as India's first environmentalists. Long before the world came to know about the environmental crises, Bishnois have been cognizant of man's relationship with nature and the importance to maintain its delicate balance (Humairah, 2017).

In 1700, the then king ordered his people to cut trees in Bishnois' village. Amrita Devi Bishnoi, a female villager could not bear to witness the destruction of both her faith and the village's sacred trees. She hugged the trees and encouraged others to do the same. Her head was severed and 363 Bishnoi villagers were killed in this movement. The Bishnoi tree martyrs were influenced by the teachings of Guru Maharaj Jambaji, who founded the Bishnoi faith in 1485 and set forth principles forbidding harm to trees and animals. The king who came to know about these events rushed to the village and apologized, ordering the soldiers to cease logging operations. Soon afterward, the maharajah designated the Bishnoi state as a protected area, forbidding harm to trees and animals. This legislation still exists today in the region. The famous Chipko Movement was inspired by the true story of *Amrita Devi Bishnoi.*

ii. Chipko Movement (1973)

The movement took place in 1973 mainly by the village women with the motive of opposing deforestation. Chipco movement was a non-violent movement aimed at the protection and conservation of trees and forests from being destroyed. The name of the Chipko movement originated from the word 'embrace' as the villagers used to hug the trees and protect them from wood cutters from cutting them. In the 45th anniversary of the movement, Google wrote "The Chipko Andolan also stands out as an eco-feminist movement. Women formed the nucleus of the movement, as the group most directly affected by the lack of firewood and drinking water caused by deforestation. The power of protest is an invaluable and powerful agent of social change" (Express Web Desk, 2018).

It was first started in Chamoli district and later at Tehri-Garhwal district of Uttarakhand. Namely Sundarlal Bahuguna, Gaura Devi, Sudesha Devi, Bachni Devi, Chandi Prasad Bhatt, Govind Singh Rawat, Dhoom Singh Negi, Shamsher Singh Bisht, and Ghanasyam Raturi were the main leaders of this movement. "Ecology is the permanent economy" was the slogan by the eco-activist Sundarlal Bahuguna. The Chipko movement gathered momentum in 1978 when the women faced police firings and other tortures. Further, environmentalist and Gandhian social activist Chandi Prasad Bhatt, founder of the cooperative organization Dasholi Gram Swarajya Sangh, led the Chipko movement near the village of Mandal in 1973. The then state Chief Minister, Hemwati Nandan Bahuguna set up a committee to look into the matter, which eventually ruled in favor of the villagers. Gandhian activist Sunderlal Bahuguna appealed to Indira Gandhi, the then Prime Minister of India, resulted in the ban of cutting trees. His appeal resulted in a 15-year ban on chopping of green trees in 1980. This became a turning point in the history of eco-development struggles in the region and around the world.

iii. Save Silent Valley Movement (1973-79)

Silent valley is an evergreen tropical forest in the Palakkad district of Kerala. Save Silent Valley was a social movement that occurred in the 1970s for protecting from destruction by the construction of a large dam. The movement was led by Kerala Sastra Sahitya Parishad (KSSP) an NGO, the poet-activist Sughathakumari, and the people of Palakkad district of Kerala. Saving the environment was the prime motto of the movement. The movement takes place when the Kerala State Electricity Board (KSEB) proposed a hydroelectric dam across the Kunthipuzha River that runs through Silent Valley. In February 1973, the Planning Commission approved the project at a cost of about Rs.25 crores. Many feared that the project would submerge 8.3 sq. km of untouched moist evergreen forest. Several NGOs strongly opposed the project and urged the government to abandon it (Mary, 2018).

The Kerala Forest Research Institute carried out an environmental impact study in 1977 and proposed that the Silent Valley area be declared a biosphere reserve. Later on, in 1978 Indira Gandhi, the Prime Minister of India, approved the project, with the condition that the state government enacts legislation ensuring the necessary safeguards. In 1979 the Government of Kerala passed legislation regarding the Silent Valley Protection Area (Protection of Ecological balance Act of 1979) and issued a notification declaring the exclusion of the hydroelectric project area from the proposed national park. In January 1981, bowing to unrelenting public pressure, Indira Gandhi declared that Silent Valley will be

protected. In June 1983 the Centre re-examined the issue through a commission chaired by Prof. M.G.K. Menon. In 1985, Prime Minister Rajiv Gandhi formally inaugurated the Silent Valley, National Park.

iv. Jungle Bachao Andolan (1978-80s)

The Jungle Bachao Andolan took place in the 1980s when the government projected to substitute the natural Sal forest of Singhbhum district (later comes under Jharkhand) of undivided Bihar, with highly-priced Teak plantations. This move was called by many as "Greed Game Political Populism". The movement of Singhbhum district for land, forest, and water was the struggle for right over and part of the socio-economic aspects of the Jharkhand movement. But, long before the Jungle Bachao Andolan of what is now Jharkhand, this region had seen rebellion, victory, and loss in the Adivasis' struggle to live and work in their own forests. The movement, which spread to nearby states, has highlighted the gap between the Forest Department's aims and the people's.

To stop the Jungle Bachao Andolan, the government tried all the ways and the police killed numbers of Adibasi people. Regardless of governmental pressures, the movement continued for a long time. As a result of long-run Jungle Bachao Andolan, the Scheduled Tribes and Other Traditional Forest Dweller (recognition and Forest Rights) Act, 2006 came into existence under the Manmohan Singh government. This act has given rights and ownership to the Adivasi and indigenous people. Finally, Jharkhand Jangle Bachao Andolan has developed a four-tier community forest governance strategy namely i) The traditional village council, ii) Forest protection committee, iii) Women's cooperatives, and iv) A youth forum (Sunil, 2018).

v. Appiko Movement (1983)

Appiko movement is the southern version of the Chipko movement. The Appiko Movement was locally known as "Appiko Chaluvali" ('hugging' in Kannada is 'appiko'). It was held in Uttara Kannada and Shimoga districts of Karnataka State and this movement was facilitated by Pandurang Hegde. The locals embraced the trees which were to be cut by contractors of the forest department. The Appiko movement used various techniques to raise awareness such as foot marches in the interior forest, slide shows, folk dances, street plays, etc.

The Appiko Movement tried to save the Western Ghats by spreading its roots all over southern India. The movement's objectives can be classified into three major areas. First, the Appiko Movement is struggling to save the remaining tropical forests in the Western Ghats. Second, it is making a modest attempt to restore the greenery to denuded areas. Third, it is

striving to propagate the idea of rational utilization in order to reduce the pressure on forest resources (Hegde, 1989). The movement became a success. The current status of the project is stopped (Sharma, 2008).

vi. Narmada Bachao Andholan (NBA), 1985

The river Narmada traverses three of Indian states namely Gujarat, Madhya Pradesh, and Maharashtra. In the year of 1985, the government of India with the assistance of the World Bank planned to build a dam that is Sardar Sarovar Dam across the Narmada River without paying the attention to environmental degradation. The project had become a threat to the environment and surrounding Adivasi peoples. With the motive of opposing the large dam construction, there was a great social movement occurred. The movement was headed by Medha Patkar, Baba Amte, Adivasis, farmers, environmentalists, and human rights activists.

The movement first started as a protest for not providing proper rehabilitation and resettlement for the people who have been displaced by the construction of Sardar Sarovar Dam. Later on, the movement turned its focus on the preservation of the environment and the eco-systems of the valley. Activists also demanded the height of the dam be reduced to 88 m. from the proposed height of 130m. The environmental issue was taken into court. In October 2000, the Supreme Court gave a judgment approving the construction of the Sardar Sarovar Dam with a condition that the height of the dam could be raised to 90 m. This height is much higher than the 88 m. which anti-dam activists demanded, but it is definitely lower than the proposed height of 130 m. The project is now largely financed by the state governments and market borrowings. The project is expected to be fully completed by 2025. Although not successful, as the dam could not be prevented, the NBA has created an anti-big dam opinion in India and outside. It questioned the paradigm of development. As a democratic movement, it fully followed the Gandhian way (Visvanathan, 2015).

vii. Tehri Dam Conflict (1980s -2004)

In 1978, the construction of India's highest dam on the Bhagirathi River in Tenhri, Uttarakhand started. There were many controversies in this project. In 1986, the Ministry even advised the government to abandon it because the dam was located in an earthquake-prone zone. Apart from that it would submerge Tehri town and displace 85,000 people. The residents had already filed a case in the Supreme Court challenging the project

The Tehri Dam has been the object of protests by environmental organizations and local people of the region. Virendra Dutt Saklani, lawyer and founder of the Anti-Tehri Dam Struggle Committee, was quick to point out the consequences associated with the large

project (Nachowitz, 1988). Environmental activist Sundarlal Bahuguna led the Anti-Tehri Dam movement from the 1980s till 2004. The protest was against the displacement of town inhabitants and the environmental consequence of the weak ecosystem. Tehri dam attracted national attention in the 1980s and the 1990s. The major objections include seismic sensitivity of the region, submergence of forest areas along with Tehri town, etc. Despite the support from other prominent leaders like Sunderlal Bahuguna, the movement has failed to gather enough popular support at national as well as international levels (Sunil, 2018).

4.0 CONCLUSION

The above-cited movements were not only protected the concerned area; but also created greater awareness among the people all around the world. As the results of the environmental movements, the government of India looked at the situation and came up with remedial actions. Most of the cases, the authority listened to the common people's voice. As the consequences of such movements, the government enacted various acts and the nation got greater awareness of environmental factors. On 15th December 2006, Forest Rights Bill was passed in Lok Sabha during the office of UPA, headed by Dr. Manmohan Singh. It was the result of Jungle Andolan in Singhbhum and other tribal movements across the tribal belts in India. The height of Sardar Sorobar Dam also decreased after the heavy protest. India has incorporated in its Constitution a commitment to environmental protection and improvement. In the Directive Principles of State Policy, Article 48 says "the state shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country"; Article 51-A states that "it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures." The country has enacted several laws, acts, as well as plans for the protection of the environment. They are -The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1988; The Air (Prevention and Control of Air) Act, 1974 as amended in 1981 and 1987; The Forest (Conservation) Act, 1980; The Motor Vehicle Act, 1980; The Environment (Protection) Act, 1986; The Factories Act, 1988; The Liability Insurance Act, 1991; The National Environment Appellate Act, 1997; National Wildlife Action Plan, 1980; National Wasteland Development Board (NWDB) set up mainly to increase tree and other green covers on wastelands; A Biosphere Reserves Programme and a National Forest Policy, 1988; A central water commission; A National Biodiversity Authority; The Wild Birds and Animals Protection Act passed in 1887 and repealed in 1912; and New Wild Life Protection Act passed in 1972. The Department of Environment was set

up in 1980 to serve as the focal point in the administrative structure of the government for planning, promotion, and coordination of environmental programs.

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CHAPTER 3

GOVERNMENT POLICIES FOR ENVIRONMENT PROTECTION IN INDIA

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1.0 INTRODUCTION

Environmental policy refers to the commitment of an organization to the laws, regulations, and other policy mechanisms concerning environmental issues. These issues generally include air and water pollution, waste management, ecosystem management, maintenance of biodiversity, the protection of natural resources, wildlife and endangered species. Policies concerning energy or regulation of toxic substances including pesticides and many types of industrial waste are part of the topic of environmental policy. This policy can be deliberately taken to direct and oversee human activities and thereby prevent harmful effects on the biophysical environment and natural resources, as well as to make sure that changes in the environment do not have harmful effects on humans.

It is useful to consider that environmental policy comprises two major terms: environment and policy. Environment refers to the physical ecosystems, but can also take into consideration the social dimension and an economic dimension. Policy can be defined as a "course of action or principle adopted or proposed by a government, party, business or individual". Thus, environmental policy focuses on problems arising from human impact on the environment, which retroacts onto human society by having a (negative) impact on human values such as good health or the 'clean and green' environment. Environmental policy instruments are tools used by governments to implement their environmental policies. Governments may use a number of different types of instruments.

The goals of the environmental policy may be formulated in several ways - to protect human health, ensure viability of wild life, preservation of historic monuments, stopping further degradation of the environment etc. The policy is the overall environmental intention and direction forming the backbone and skeletal framework, from which all other

environmental components are hung including environmental management systems, audits, assessments and reports.

Government policies must be carefully formulated so that the individual measures do not undermine one another, or create a rigid and cost-ineffective framework. Overlapping policies result in unnecessary administrative costs, increasing the cost of implementation. the European Union, the very first Environmental Action Programmed was adopted by national government representatives in July 1973 during the first meeting of the Council of Environmental Ministers. Since then an increasingly dense network of legislation has developed, which now extends to all areas of environmental protection including air pollution control, water protection and waste policy but also nature conservation and the control of chemicals, biotechnology and other industrial risks. Overall organizations are becoming more aware of their environmental risks and performance requirements.

2.0 SOME GOVERNMENT POLICIES TO PROTECT ENVIRONMENT IN INDIA

- National Conservation Strategy and Policy Statement on Environment and Development, 1992
- Policy Statement for the Abatement of Pollution, 1992
- National Environment Policy, 2006
- Vision Statement on Environment and Health
- The National Green Tribunal Act, 2010
- The Air (Prevention and Control of Pollution) Act, 1981
- The Water (Prevention and Control of Pollution) Act, 1974
- The Environment Protection Act, 1986
- Hazardous Wastes Management Regulations
- The Wildlife Protection Act, 1972
- The Forest Conservation Act, 1980
- Public Liability Insurance Act, 1991
- The Biological Diversity Act, 2002
- Coastal Regulation Zone Notification

2.1 National Conservation Strategy and Policy Statement on Environment and Development, 1992

The National Conservation Strategy and the Policy Statement on Environment and Development are in response to the need for laying down the guidelines that will help to

weave environmental considerations into the fabric of our national life and of our development process. It is an expression of India's commitment for reorienting policies and action in unison with the environmental perspective. It talks about the nature and dimensions of the environmental problems, actions taken in response to the problems and lists out priorities and strategies for action. It also views development policies from environmental perspectives and the support policies and systems required.

2.2 Policy Statement for the Abatement of Pollution, 1992

The objective of this document is to integrate environmental considerations into decision-making at all levels. To achieve this, the document lays down steps to be taken to prevent pollution at source, encourage, develop and apply the best available practicable technical solutions.The Policy Statement for Abatement of Pollution, adopted in 1992 lays emphasis on pollution prevention in place of the conventional end-of-the-pipe treatment also identified the adoption of best available and practicable technologies as the key element for pollution prevention. The focus of the various programmes and schemes of the Ministry and its associated organizations related to pollution prevention and control is, therefore, on such issues such as promotion of clean and low waste technologies, waste minimization, reuse or recycling, improvement of water quality, environment audit, natural resource accounting, development of mass based standards, institutional and human resource development etc. The whole issue of pollution prevention and control is dealt with by a combination of command and control methods as well as voluntary regulations, fiscal measures, promotion of awareness etc.

2.3 National Environment Policy, 2006

A diverse developing society such as India provides numerous challenges in the economic, social, political, cultural, and environmental arenas. All of these coalesce in the dominant imperative of alleviation of mass poverty, reckoned in the multiple dimensions of livelihood security, health care, education, empowerment of the disadvantaged, and elimination of gender disparities. The present national policies for environmental management are contained in the National Conservation Strategy and Policy Statement on Environment and Development 1992, Policy Statement on Abatement of Pollution 1992, National Agriculture Policy 2000, National Population Policy 2000 and National Water Policy, 2002 have also contributed towards environmental management. All of these policies have recognized the need for sustainable development in their specific contexts and formulated necessary strategies to give effect to such recognition. The National Environment Policy seeks to extend the coverage, and fill in gaps that still exist, in light of present

knowledge and accumulated experience. It does not displace, but builds on the earlier policies. Sustainable development concerns in the sense of enhancement of human well-being, broadly conceived, are a recurring theme in India's development philosophy. The present day consensus reflects three foundational aspirations. First, that human beings should be able to enjoy a decent quality of life; second, that humanity should become capable of respecting the finiteness of the biosphere; and third, that neither the aspiration for the good life, nor the recognition of biophysical limits should preclude the search for greater justice in the world. The National Environment Policy is also a response to India's commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21. It is recognized that maintaining a healthy environment is not the state's responsibility alone, but also that of every citizen. A spirit of partnership should thus be realized throughout the spectrum of environmental management in the country. While the state must galvanize its efforts, there should also be recognition by each individual – natural or institutional, of its responsibility towards maintaining and enhancing the quality of the environment.

2.4 Vision Statement on Environment and Health, 2002

The purpose of vision document was to evolve a strategy of health-risk reduction arising from environment pollution would help the implementing agencies to revise the environmental and industry specific actions. Ministry of Environment and Forests (MoEF) had constituted a Committee on Environment and Health in July, 1999 and the report was submitted in May, 2000. The Report of the "Committee on Environment and Health" brought out issues requiring attention of various stakeholders. The "Conference on Environmental Health" organized by Ministry of Environment and Forests in November, 2002 also brought out thrust areas and action points that need to be implemented for protection of public health.

The environment in which we live greatly influences our health. The household, workplace, outdoor and indoor environments may pose risks to health in a number of different ways. The poor quality of air which we may breathe, the contaminated water we may drink and the surroundings in which we live, determine our quality of life. While the genetic factors may also be responsible for causing diseases but the environmental factors play much more active role in contracting various diseases. The key purpose of this Vision Statement on Environment and Human Health is to evolve a strategy for health risk reduction. It also offers a comprehensive approach to the environmental health management plans, which would be a systematic approach to estimate the burden of disease and injury due to different environmental pollutants. Therefore, the activities and programmes required to be

taken up for the protection of the public health due to environmental pollution are also given in this statement in the form of a road map. Given the growing need for trained environmental practitioners, graduate schools throughout the world offer specialized professional degrees in environmental policy studies. While there is not a standard curriculum, students typically take classes in policy analysis, environmental science, environmental law and politics, ecology, energy, and natural resource management. Graduates of these programs are employed by governments, international organizations, private sector, think tanks, universities, and so on.

2.5 The National Green Tribunal Act, 2010

The National Green Tribunal Act, 2010 (No. 19 of 2010) (NGT Act) has been enacted with the objectives to provide for establishment of a National Green Tribunal (NGT) for the effective and expeditious disposal of cases relating to environment protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto.

The Act received the assent of the President of India on June 2, 2010, and was enforced by the Central Government vide Notification no. S.O. 2569 (E) dated October 18, 2010, with effect from October 18, 2010. The Act envisages establishment of NGT in order to deal with all environmental laws relating to air and water pollution, the Environment Protection Act, the Forest Conservation Act and the Biodiversity Act as have been set out in Schedule I of the NGT Act.

Consequent to enforcement of the National Green Tribunal Act, 2010, the National Environment Tribunal Act, 1995 and the National Environment Appellate Authority Act, 1997 stand repealed. The National Environment Appellate Authority established under s 3(1) of the National Environment Appellate Authority Act, 1997 stands dissolved, in view of the establishment of the National Green Tribunal under the National Green Tribunal Act, 2010 *vide* Notification no. S.O. 2570 (E) dated October 18, 2010.

2.6 The Air (Prevention and Control of Pollution) Act, 1981

The Air (Prevention and Control of Pollution) Act, 1981 (the "Air Act") is an act to provide for the prevention, control and abatement of air pollution and for the establishment of Boards at the Central and State levels with a view to carrying out the aforesaid purposes.

To counter the problems associated with air pollution, ambient air quality standards were established under the Air Act. The Air Act seeks to combat air pollution by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that give rise to

air pollution. The Air Act empowers the State Government, after consultation with the State Pollution Control Boards (SPCBs), to declare any area or areas within the Sate as air pollution control area or areas. Under the Act, establishing or operating any industrial plant in the pollution control area requires consent from SPCBs. SPCBs are also expected to test the air in air pollution control areas, inspect pollution control equipment, and manufacturing processes.

2.7 The Water (Prevention and Control of Pollution) Act, 1974

The Water Prevention and Control of Pollution Act, 1974 (the "Water Act") has been enacted to provide for the prevention and control of water pollution and to maintain or restore wholesomeness of water in the country. It further provides for the establishment of Boards for the prevention and control of water pollution with a view to carry out the aforesaid purposes. The Water Act prohibits the discharge of pollutants into water bodies beyond a given standard, and lays down penalties for non-compliance. At the Centre, the Water Act has set up the Central Pollution Control Board (CPCB) which lays down standards for the prevention and control of water pollution. At the State level, SPCBs function under the direction of the CPCB and the State Government.

Further, the Water (Prevention and Control of Pollution) Cess Act was enacted in 1977 to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003.

2.8 The Environment Protection Act, 1986

The Environment Protection Act, 1986 (the "Environment Act") provides for the protection and improvement of environment. The Environment Protection Act establishes the framework for studying, planning and implementing long-term requirements of environmental safety and laying down a system of speedy and adequate response to situations threatening the environment. It is an umbrella legislation designed to provide a framework for the coordination of central and state authorities established under the Water Act, 1974 and the Air Act. The term "environment" is understood in a very wide term under s 2(a) of the Environment Act. It includes water, air and land as well as the interrelationship which exists between water, air and land, and human beings, other living creatures, plants, micro-organisms and property.

Under the Environment Act, the Central Government is empowered to take measures necessary to protect and improve the quality of environment by setting standards for emissions and discharges of pollution in the atmosphere by any person carrying on an industry or activity; regulating the location of industries; management of hazardous wastes, and protection of public health and welfare. From time to time, the Central Government issues notifications under the Environment Act for the protection of ecologically-sensitive areas or issues guidelines for matters under the Environment Act.

In case of any non-compliance or contravention of the Environment Act, or of the rules or directions under the said Act, the violator will be punishable with imprisonment up to five years or with fine up to Rs 1,00,000, or with both. In case of continuation of such violation, an additional fine of up to Rs 5,000 for every day during which such failure or contravention continues after the conviction for the first such failure or contravention will be levied. Further, if the violation continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years.

2.9 Hazardous Wastes Management Regulations

Hazardous waste means any waste which, by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics, causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances.

There are several legislations that directly or indirectly deal with hazardous waste management. The relevant legislations are the Factories Act, 1948, the Public Liability Insurance Act, 1991, the National Environment Tribunal Act, 1995 and rules and notifications under the Environmental Act. Some of the rules dealing with hazardous waste management are discussed below:

- **Hazardous Wastes (Management, Handling and Transboundary) Rules, 2008**, brought out a guide for manufacture, storage and import of hazardous chemicals and for management of hazardous wastes.
- **Biomedical Waste (Management and Handling) Rules, 1998**, were formulated along parallel lines, for proper disposal, segregation, transport, etc, of infectious wastes.
- **Municipal Solid Wastes (Management and Handling) Rules, 2000**, aim at enabling municipalities to dispose municipal solid waste in a scientific manner.

In view of the short-comings and overlapping of some categories causing inconvenience in implementation of the Biomedical Waste (Management and Handling) Rules, 1998 as well as the Municipal Solid Wastes (Management and Handling) Rules, 2000, the Ministry of Environment, Forest and Climate Change has formulated the draft Bio-Medical Waste (Management & Handling) Rules, 2015 (Draft BMW Rules) and the draft Solid Waste Management Rules, 2015 (Draft SWM Rules) and sought comments on the draft Rules.

The Draft BMW Rules are to replace the Biomedical Waste (Management and Handling) Rules, 1998, and the Draft SWM Rules are to replace the Municipal Solid Waste (Management and Handling) Rules, 2000. The objective of the Draft BMW Rules is to enable the prescribed authorities to implement the rules more effectively, thereby, reducing the bio-medical waste generation and also for its proper treatment and disposal and to ensure environmentally sound management of these wastes, and the Draft SWM Rules aim at dealing with the management of solid waste including it segregation at source, transportation of waste, treatment and final disposal.

- **E - Waste (Management and Handling) Rules, 2011** have been notified on May 1, 2011 and came into effect from May 1, 2012, with primary objective to reduce the use of hazardous substances in electrical and electronic equipment by specifying threshold for use of hazardous material and to channelize the e-waste generated in the country for environmentally sound recycling. The Rules apply to every producer, consumer or bulk consumer, collection centre, dismantler and recycler of e-waste involved in the manufacture, sale, purchase and processing of electrical and electronic equipment or components as detailed in the Rules.
- **Batteries (Management & Handling) Rules, 2001** deal with the proper and effective management and handling of lead acid batteries waste. The Act requires all manufacturers, assemblers, re-conditioners, importers, dealers, auctioneers, bulk consumers, consumers, involved in manufacture, processing, sale, purchase and use of batteries or components thereof, to comply with the provisions of Batteries (Management & Handling) Rules, 2001.

2.10 The Wildlife Protection Act, 1972

The Wild Life (Protection) Act, 1972 was enacted with the objective of effectively protecting the wild life of this country and to control poaching, smuggling and illegal trade in wildlife and its derivatives. The Act was amended in January 2003 and punishment and penalty for offences under the Act have been made more stringent. The Ministry has

proposed further amendments in the law by introducing more rigid measures to strengthen the Act. The objective is to provide protection to the listed endangered flora and fauna and ecologically important protected areas.

2.11 The Forest Conservation Act, 1980

The Forest Conservation Act, 1980 was enacted to help conserve the country's forests. It strictly restricts and regulates the de-reservation of forests or use of forest land for non-forest purposes without the prior approval of Central Government. To this end the Act lays down the pre-requisites for the diversion of forest land for non-forest purposes.

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, recognizes the rights of forest-dwelling Scheduled Tribes and other traditional forest dwellers over the forest areas inhabited by them and provides a framework for the same.

The Indian Forest Act, 1927 consolidates the law relating to forests, the transit of forest-produce and the duty enviable on timber and other forest-produce.

2.12 Public Liability Insurance Act, 1991

The Public Liability Insurance Act, 1991 was enacted with the objectives to provide for damages to victims of an accident which occurs as a result of handling any hazardous substance. The Act applies to all owners associated with the production or handling of any hazardous chemicals.)

2.13 The Biological Diversity Act, 2002

The Biological Diversity Act 2002 was born out of India's attempt to realise the objectives enshrined in the United Nations Convention on Biological Diversity (CBD), 1992 which recognises the sovereign rights of states to use their own Biological Resources. The Act aims at the conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner. The National Biodiversity Authority in Chennai has been established for the purposes of implementing the objects of the Act.

2.14 Coastal Regulation Zone Notification

The Ministry of Environment and Forests had issued the Coastal Regulation Zone Notification *vide* Notification no. S O. 19(E), dated January 06, 2011 with an objective to ensure livelihood security to the fishing communities and other local communities living in the coastal areas, to conserve and protect coastal stretches and to promote development in a sustainable manner based on scientific principles, taking into account the dangers of natural hazards in the coastal areas and sea level rise due to global warming.

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CHAPTER 4

ENVIRONMENTAL MANAGEMENT IN PUNJAB

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Birds, Animals, Greenery and Rivers are the pride of Environment, Do not play with them.

1.0 INTRODUCTION

Punjab is an agrarian state and is the largest producer of food grains in the country. The major industries in Punjab are manufacturing of agricultural equipments, electrical goods, machine tools, textiles, sewing machines, sports goods, starch, tourism, fertilizers, bicycles garments, and the processing of pine oil and sugar. The state also consists of number of Steel Rolling Mills plants in Mandi Gobindgarh, District Fatehgarh Sahib. The Government of Punjab monitors the air quality of various places of state under NAAQM (National Ambient Air Quality Monitoring) scheme.

This scheme is financed by Central Pollution Control Board (CPCB) and Ambient Air Quality Monitoring (AAQM) scheme financed by State Government. PPCB (Punjab Pollution Central Board) monitors ambient air quality at 20 locations in the state. Out of these nine locations are residential-cum-commercial areas and eleven are industrial locations. As per data of PPCB for period 1995 to 2005, the 24 hourly and annual average of SPM/RSPM (Suspended Particulate Matter/ Respirable Suspended Particulate Matter) at residential-cum-commercial monitoring locations generally exceed the permissible limits for residential areas (24 hourly permissible limits for SPM and RSPM are 200 $\mu g/m^3$ and 100 $\mu g/m^3$ respectively and for annual average permissible limits are 140 $\mu g/m^3$ and 60$\mu g/m^3$) throughout the year and maximum values have been observed in

parts of Ludhiana, followed by Jalandhar and Amritsar with respect to their permissible limits. However, the annual averages of SO_2 and NO_2 concentrations at all locations remain within permissible limits. In the industrial areas, SPM/RSPM levels have been reported to be above permissible limits in Mandi Gobindgarh and in parts of Ludhiana with respect to annual averages. A comparison of SPM/RSPM data with their respective permissible limits indicates that the concentrations of SPM/RSPM are beyond the permissible limits at all the monitoring stations. The concentration of SO_2 and NO_2 at various industrial locations of the state indicates that the values are within the permissible limits (Tiwana, et al., 2007).

Although the Punjab state has rich sources of surface and ground water but due to increase in population and overuse of ground water for agriculture purpose the sources of water are shrinking. The rainfall is not sufficient and even not coherent in all regions of the state. About 80 per cent of the annual rainfall is received in only three monsoon months and the rest of months remain almost dry. The total water resources available are 31 lacs Hectare meter, surface canals provide 14.5 lacs Hectare meter and ground water recharge (rains and canal seepage) provides 16.8 lacs Hectare meter of water. The demand of water for agriculture purposes is 43.7 lacs Hectare meter and the excess demand of 12.4 lacs Hectare meter is met through over-exploitation of ground water resources.

The paddy-wheat cycle followed after Green Revolution has further deteriorated the condition of underground water resources. It is going down by 30 cm per year. More than 100 blocks have turned dark. PPCB monitors water quality at different locations under National Water Monitoring Program (NWMP) scheme of PPCB, in which samples are collected every quarter (March, June, September, December) and analyzed for physio-chemical parameters. The main causes of water pollution in Punjab are increase in population; urbanization; industrialization; and agricultural practices. Intensive agriculture and injudicious use of farm chemicals like fertilizers and pesticides that seeps into ground water (leaching) causes water pollution. Due to HYV (High-Yield Variety) seeds, the consumption of fertilizers has increased eight times in past 36 years from 213 nutrient thousand tons in 1970-71 to 1692 nutrient thousand tons in 2006-07.

Around 60 per cent of the state's area is already under population pressure at present, and this effects the future plans of Punjab to develop. Industrial development in

the state is also very low. Due to this, the region does not have favorable conditions especially, the underground water table which is depleting at an alarming rate because of intensive agriculture and high density of population (Tiwana, et al., 2007).

2.0 LAW OF THE STATE FOR THE PROTECTION OF ENVIRONMENT

2.1 The Punjab Land Preservation (Chos) Act, 1900

The Act was made in 1900 and extends to whole of the state. This act empowers the governments to provide conservation of subsoil water or the prevention of erosion in any area subject to erosion or likely to become liable to erosion.

2.2 Punjab Preservation of Sub Soil Water Act 2009

For improving ground water level, Punjab Government has enacted 'The Punjab Preservation of Sub Soil Water Act, 2009'. According to this Act, no farmer will be allowed to sow nursery of Paddy before 10th May of the agricultural year. Furthermore, no farmer can transplant paddy before the date fixed by State Government by notification. The authorized officer is empowered to destroy the nursery of paddy or transplanted paddy at the expense of such farmer if the dates are being violated (Sharma, 2011).

All the other rules made by the Government of India are applicable on the state of Punjab also.

2.3 Administrative set up for Environment in Punjab

In Punjab the Department of Science, Technology and Environment & Non conventional Energy has been entrusted the responsibility for looking after the matters relating to environment and coordinating with state and central authorities. The Department performs its activities through six authorities at state level namely; Punjab State Council for Science & Technology (PSCST); Punjab Pollution Control Board (PPCB); Punjab Energy Development Agency (PEDA); Punjab Biotechnology Incubator (PBI); Pushpa Gujral Science City; and Punjab Biodiversity Board.

The department coordinates and monitors the activities of these institutions. It takes care of the financial and human resource requirements of these institutions by liasoning with the state departments of planning finance and other associated departments and agencies; and the Central Ministries of Environment and Forest, Science & Technology, Non-Conventional and Renewable Energy and Ministry of Culture and other related ministries.

2.4 Punjab State Council for Science & Technology (PSCST)

The PSCST was established by Department of Science, Technology and Environment, Punjab on July 21, 1983. PSCST has the responsibility for the promotion of sustainable development through conservation of natural resources, rural environment improvement and application of Science & Technology. It encourages small- scale industries for controlling industrial pollution by providing them technology and knowledge. The council is responsible for developing Science & Technology infrastructure in the state. The council promotes mega projects in the state like Pushpa Gujral Science City, National Agri Food Biotechnology Institute, Punjab Biotechnology Incubator, and Biotechnology Park etc. The council has the responsibility for conducting Science & Technology outreach and Capacity Building activities which includes IPR issues. The council promotes and conducts Research & Development and survey projects. The council liaises with international, national and state level Science & Technology bodies.

The council has also prepared draft of the 'State Policy for environment and developmental guidelines' for 14 departments according to the draft of Environmental Policy prepared by Ministry of Environment & Forest (MOEF), Government of India. The council identifies the issues relating to environment that requires special attention of the state and are important for the conservation of environment and sustainable development. The draft policy is based on 'Polluter Pays Principle'. The council has established an 'ENVIRONMENT DIVISION' which assists the State Department of Environment, Government of Punjab. The assistance is provided by the division in technical matters related to environment, identifying major areas of ecological concerns, planning coordinating and monitoring various schemes related to environment. The division also assists the council in creating environmental awareness and promoting environmental education, training & research. The division implements the projects and programmes related to environment for international bodies like UNESCO, UNDP etc and MOEF at national level.

The PSCST established ENVIS (Environment Information System) Node in December, 2002 with the assistance of World Bank Project of MOEF, GOI for the identification and highlighting issues related to environment of the state. The node was upgraded to ENVIS centre in January, 2005. ENVIS in PSCST is a decentralized system

with focal point at the MOEF, GOI having network of 78 centers throughout the country. The centre has website "www.punenvis.nic.in" that provides information and time series database on the matters related to environmental issues of Punjab.

2.5 Punjab Pollution Control Board (PPCB)

PPCB is responsible for performing all the functions and responsibilities of CPCB in the state. It coordinates and communicates on all the environmental related issues with CPCB. PPCB is the body that is responsible for monitoring and implementing various schemes and programs of CPCB related to environment. PPCB is responsible for the implementation of all the rules and laws made by central and state government for the prevention, control and abatement of pollution in Punjab.

2.6 Punjab Energy Development Agency (PEDA)

PEDA has the responsibility of identification promoting and implementation of projects that are related to renewal energy. The renewal energy includes solar, micro-hydel, bio-gas, bio-mass and wind energy. PEDA is also responsible for the promotion of energy conservation. It is the nodal agency in the state for CDM projects and promotion of Energy Auditing in collaboration with BEE.

2.7 Punjab Biotechnology Incubator (PBTI)

PBTI is responsible for providing quality testing and certification services in agriculture, food and environmental sectors. It also includes training and dissemination of information on food quality and safety aspects to producers, processors, consumers and industry. The R & D related to this domain is conducted by PBTI.

2.8 Pushpa Gujral Science City (PGSC)

PGSC has the responsibility of educating the people especially laymen in understanding science & technology through informal means and fun activities. It designs and develops exhibits in frontier areas of Science & Technology for sensitizing students and general public on scientific issues and demystifying complex scientific principles for easy understanding.

2.9 Punjab Biodiversity Board (PBB)

PBB has the responsibility for the promotion of conservation of wild and domesticated flora and fauna of the state. PBB also formed Biodiversity Management Committees for identification of Biodiversity Heritage sites and implementing the Biological Diversity Act (Sharma, 2011; Tiwana, et al., 2007).

3.0 CONCLUSION

All the sectors of the economy, namely, agriculture, industry and the community in general are contributing to the degradation of our environment. The over-exploitation of natural resources, the excessive use of fertilizers and pesticides, the excessive use of groundwater, rapid growth of vehicular traffic, large scale migration to cities and deforestation etc. are complicating our environmental problems. Inspite of the existence of policy framework at national and state level, sufficient legislations for the enforcement of environmental norms/standards, our environment is getting more and more polluted day by day. Therefore, it seems that the problem of environmental degradation is basically a problem of environmental governance. Therefore, the right approach to make correction in the present set-up is to identify the issues relating to all the stakeholders which influence the environmental governance.

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CHAPTER 5

AGROFORESTRY IN INDIA: PROSPECTS AND CHALLENGES

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ABSTRACT

The blend of executing different agricultural activities on the same agricultural land is mainly known as agroforestry. This is performed mainly with the integration and management of livestock, crops and trees within the same plot of land. The benefit of agroforestry is that it can be performed both on small and large land holdings. Agroforestry is also termed as a combination of the three most important aspects of geography which are ecology, agriculture and forestry. Though derived from ecology, agriculture and forestry the main difference lies in the process of integration of the livestock, crops and trees.

Agroforestry aims to be an aid to problems of land degradation, climate change, reduction in green houses gases. With the following benefits from agroforestry, there lies several challenges as well like extensive involvement of middlemen, installation and implementation of updated technologies which often turn out to be expensive. To exploit the benefits and cater to the problems, Government of India (GoI) launched the National Agroforestry Policy (NAP) in 2014. The article orients us in looking into the opportunities and challenges of agroforestry in India and also to how agroforestry can be considered as an instrument of economic development.

Keywords: Agriculture, employment, farmers, growth, sustainable

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1.0 INTRODUCTION

The blend of executing different agricultural activities on the same agricultural land is mainly known as agroforestry. This is performed mainly with the integration and management of livestock, crops and trees within the same plot of land. The benefit of

agroforestry is that it can be performed both on small and large land holdings. Agroforestry is also termed as a combination of the three most important aspects of geography which are ecology, agriculture and forestry. Though derived from ecology, agriculture and forestry the main difference lies in the process of integration of the livestock and crops and trees. Agroforestry can be practiced in both tropical and temperate regions. According to FSI (2013), in ancient times it was practiced for different purposes like fruits, fodder, food, firewood, bio-fertiliser etc. In today's time agroforestry can however be treated as prospect and tool for economic development by combining modern technology in agriculture with old agricultural practices. This is because a part of economic development is heavily dependent on use of technology along with employment and agroforestry caters to both these areas, as it employs more people in using technology in enhancing the agricultural produce and also the land quality. Steiner (2012), states that agroforestry is a shinning approach which can help in development of a country and is a concept of thinking small scale to achieve potentially big and transformative outcomes.

Indian agriculture today faces varied problems because of it's diverse demography, increasing demand for food items, and also climate change. Therefore, according to Dobriyal (2014), an integrated management system needs to be identified that will help in both producing more agricultural items and also increasing the quality of the produce. Thus, agroforestry has been identified as a solution to cater to this problem as it has both the capability to extensively help Indian agriculture ecologically and economically. This is because on one hand it will help stabilising ecosystems in one hand and provide ecologically viable explications to farmers in producing different products. Thus, as an aid in 2014 National Agroforestry Policy was adopted by India.

The article further discusses the The National Agroforestry Policy (NAP) 2014 in section (3), extent of agroforestry in India in section (4), challenges and future of Agroforestry in India under section (5) and lastly, the concluding remarks in section (6).

2.0 OBJECTIVES

i. To understand the extent of agroforestry policy after the adoption of the National Agroforestry Policy in 2014.

ii. To understand the challenges and future of agroforestry as to how it can be used as a tool for economic development.

3.0 THE NATIONAL AGROFORESTRY POLICY 2014

The World Congress on Agroforestry was organised in 2014 in New Delhi with the theme 'Trees for Life' to understand any limitation that might be faced while implementation

of the system of agroforestry. There were more than 80 countries who participated in the conference and the then President of India unleashed the National Agroforestry Policy (NAP) 2014, which is regarded as the first of its kind. According to the Ministry of Agriculture, it was a tribute to all the people who had made agroforestry an integrated science and also some of the communities who practiced agroforestry traditionally. Apart from this, it was also referred to as a one-stop solution in implementing agroforestry as a major tool for Indian Agriculture that would help in transforming lives of farmers and rural people dependent on agriculture. The important highlights of the policy werer setting up of institutions at national level for promotion of agroforestry; simplify laws relating to felling of trees, harvesting, transportation and also creating and maintaining of proper land records through management information systems (MIS). It also promised insurance to practitioners of agroforestry. Apart from increasing the extension of research and land building capacity it also promised increasing number of industries to deal with the agricultural produce. 20 trees namely *Gliricidia sepium*, River tamarind, Gum arabic tree etc. were identified that would yield multi purpose benefits in agriculture and were spared from all restrictions related to felling of trees, transportation and harvesting.

The primary objective of the NAP 2014 was to integrate the different agricultural and rural sector programmes that would help in the development of agroforestry under one roof. Different institutions like National Agroforestry Mission/Board, Ministry of Agriculture, GoI and upgrading of NRCAF, Jhansi (now CAFRI, Jhansi) have been established to fulfil this mission. This would also benefit the agricultural supply chain, development of enhanced technology to deal with climate change and also enhance the concept of region-based marketing linkages in agroforestry. With the help of this policy it is estimated that there will be massive Research & Development in the field of agroforestry. Comprehensively it can be said that this policy deals with all the problems relating to energy equipment, food security, employment generation, soil conservation, land degradation, climate-change adaptation. It also promises an industrial linkage to farmers. The following section discusses about the extent of agroforestry in India after the implementation of NAP 2014.

4.0 EXTENT OF AGROFORESTRY IN INDIA

Kumar (2017), states that though agroforestry is being practised in large parts of the country in one or another and has been adopted by the farmers in different agro-climatic zones, periodic estimation and monitoring of the area under it is still a challenging task due to lack of uniform methodology adopted by the different agencies. Currently about 25.32 m ha, or approximately 8.2% of the total geographical area is under agroforestry in India.

According to CAFRI Jhansi around 13.7m ha is under agroforestry in India. On the contrary, however, the Forest Survey of India states that 11.54 m ha or 3.2% of the geographical area is under agroforestry with Maharashtra, Rajasthan and Gujarat being the highest contributors in state-wise ranking. However, the estimation of FSI doesn't include several areas where block plantation is practiced thus showing lower values than that of CAFRI. This problem can be easily solved by implementation of a uniform GIS system. Additionally adjustments of areas for implementation of other agroforestry practices like forest gardening, agri-silvi-hoticulture, silvi-pasture and several others which are particular tree based is yet to be carried out. Though a challenging task but this can be catered to with the help of digital signatures for important trees that are essential for agroforestry. Agroforestry as discussed earlier also stimulates the process of employment. A particular chain is aimed to be followed in this regard. Primarily the farmers and prospective rural people interested in agroforestry are briefed through the established institutes about the process and agroforestry model, thereby introducing them to the technologies used and their implementation and benefits. As per Atlas this process has a potential to sequester 952 million tons approximately with regards to above the ground carbon which will in turn increase the cultivated land in rain fed areas by 20%. But to yield the benefits there are a lot of challenges that are yet to overcome. In context to challenges, let us further discuss about the challenges and future of agroforestry in India in the following section.

5.0 CHALLENGES & FUTURE OF AGROFORESTRY IN INDIA

5.1 Challenges of Agroforestry in India

According to CAFRI (2015), agroforestry system is one of the best known traditional practices and has an important role in reducing vulnerability, increasing resilience of farming systems and buffering households against climate related risks.

Despite the exemptions granted in the NAP 2014, there still lies the several restrictions in transportation, harvesting and marketing of agroforestry which restricts farmers and rural people in opting for agroforestry. More so no proper training is given to people engaged in agroforestry hence they are not updated about the latest technologies. The lack of seed variability and planting material add on to the crisis. According to Verma (2017), only 10% of the material is of standard quality. India has a varied agro-climatic region for versatile species also facilitating domestication of several species resulting into hype of some specific species like Eucalyptus. According to Nair and Puri (2014), another disturbing aspect is that in India, agroforestry research has mostly been conducted on research stations in relatively

small plots or/and laboratories. Little or no research has been done on an ecosystem or landscape level and most of studies are of relative short-term nature.

There is no marketing for agroforestry which limits the market to be a buyer's market, the middlemen making the most of the profit. Institutional finance is not at par with agroforestry like in the case of agriculture which is considered due to lack of awareness. Tax laws are very stringent in terms of agroforestry. Multiple agencies impose tax on the produce at different stages as a result of 'cascading effect' they loose grounds to the imported produce. Though GST was implemented in 2017 in India throughout different sectors it could not cater to the problems of agroforestry, the reason being the less of direct interaction between farmers and industry personnel. The middlemen mainly decide the final price of the produce and also charge a different price to the farmers. Thus the problem of multi layered pricing remains.

According to Kumar (2017), extension services are important for smooth dissemination of research results on the different aspect of agroforestry but research results on agroforestry, available in the public and private domain do not regularly reach the farmers due to lack of a proper or dedicated extension system. Also, farmers with major land holdings will get more benefit by the agroforestry related schemes than the small and marginal farmers. So there is need to introduce special programs on agroforestry models for marginal and small farmers because 2/3rd of the Indian farmers are small and marginal farmers.

Every system has it's own set of drawbacks and prospects. Thus, further we discuss about the future prospects of Agroforestry in India and where India stands at present.

5.2 Future of Agroforestry in India

According to CAFRI (2015), agroforestry is bound to play a major role in future, not only for its importance in food and livelihood security, but also for its role in combating the environmental challenges because country's land area cannot be stretched. Also in 2050, requirement of fodder increases by 1.5 times; food grain and fuel wood by two times; and timber by three times. Agroforestry has the potential to meet the demand for food, fodder, firewood and timber, against the continuously shrinkage of land and water resources and the threat of changing climate in future. To cater to this, the focus should be discovering new technologies that will help in agroforestry in all areas including arid, semi-arid and fragile zones. Along with these promotional plans should be made to ensure profitability to farmers. The state governments must also improvise on the state agroforestry plans in accordance with the NAP 2014. The advancement of sustainable agroforestry techniques on a wider range in future is viable only through integration of proactive farmer policies of government,

involvement of the industries, support services from NGOs and willingness of farmers. In this context, it can also be said that the public private partnership (PPP) model is also enhanced by agroforestry. Agroforestry has expanded in a big way wherever it has been supported by the private sector due to assured market for the growers. The private sector has established many successful agroforestry models like pulp and paper mills in Tamil Nadu (Tamil Nadu Newsprint Ltd), Andhra Pradesh (ITC Paper Board), Gujarat and Odisha (JK Paper Mills), Uttar Pradesh (West Coast Paper Mill); plywood industries in Haryana and Punjab (Yamunanagar) and Uttarakhand (Rudrapur); other wood-based industries (WIMCO Ltd) in the Indo-Gangetic region; gums and resins in Chhattisgarh, Jharkhand; tendu in Madhya Pradesh; cardamom in North East India and homegardens in Kerala are regional-specific models that have identified marketing linkages with farmers through contract farming. There is a need to build integrated linkages between different institutions and customers involved with the PPP model and ensure a complete value chain of agroforestry produce. According to CAFRI (2015), a major role for agroforestry in the near future will be to give environmental service such as climate change mitigation (carbon sequestration), phytoremediation, watershed protection and biodiversity conservation. However, this will need the development of mechanism to reward the rural poor for the environmental services that they provide to society.

6.0 CONCLUSION

Agroforestry is the new way forward to prosperity for farmers and rural people, from generation of employment and revenue to food security and nutrition; catering to other basic human needs on the sustainable basis and cushioning farmers from the harshness of climate change. Agroforestry creates more integrated, diverse, productive, profitable, healthy, sustainable land use systems and only option to increase the country's forest and tree cover to the 33%. The opportunities and benefit offered by agroforestry can only be getting with the help of substantial investments and coordinated efforts in research, education, extension services and appropriate national policies. National Agroforestry Policy (2014) has written a new chapter in the development of agroforestry in India. Not only has it increased the geographical area but also addressed most of the challenges faced by farmers and rural people but the major challenge left is to move forward the National agroforestry policy from paper to the ground level.

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CHAPTER 6

EFFECT OF GA3 AND NAA ON GROWTH AND YIELD ATTRIBUTES OF BRINJAL (Var. Mullukathiri)

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ABSTRACT

The experiment undertaken was carried out in Kalavai village at Vellore district, as the district is famous for its native variety of brinjal called "Mullukathiri". The district was more prone to severe drought and stress condition. Hence, to increase the yield of mullukathiri, the growth regulators at different concentrations GA3 (25, 50, 75, 100 ppm) and NAA (25, 50, 75, 100 ppm) are used. Foliar spray was given at 45th and 60th day after planting. Different characters like plant height, number of branches, days to first flowering, numbers of flowers per plant, number of fruits per plant, fruit weight and yield attributes were studied. Among all other treatments, GA3 50 ppm (T2) was significantly increased the vegetative growth, i.e. plant height (65.40 cm) and number of branches (8 nos); and GA3 50 ppm (T2) also recorded early flowering (32 days), higher number of flowers (37 nos), fruits/plant (19 nos), fruit weight (78.60 g) over control. With regard to yield, GA3 50 ppm recorded higher yield of 11 t/ha when compared to control (8.5 t/ha). Hence, to maximise the yield of mullukathiri brinjal, the usage of GA3 could be recommended.

Keywords: Mullukathiri, growth regulators, morphology, yield attributes

1.0 INTRODUCTION

India is the second largest producer of vegetables followed by china. All vegetables are enriched with vitamins, minerals, lots of fibre and have low calories and low fat content. The brinjal plant (*Solanum melongena*) also known as egg plant/aubergine, belongs to the family solanaceae with the chromosome number 2n = 24, is one of the important and principal vegetable grown throughout the country and the speciality is, it was well adapted to different agro climatic conditions and can be grown in various types of soil. It yields high in warm humid tropics and was susceptible to frost. The egg plants are rich in antioxidants and aids in weight loss, reduce heart diseases, keep the blood sugar level in control and also have anti- cancerous properties. West Bengal is the largest producer of brinjal followed by maharastra and Bihar. India lies in second position in production after china with the share of 23.3%. Recently many varieties have been released throughout the India. Mullukathiri (thorny brinjal) is the native variety of Vellore which brings pride to that district. It is mainly used to make "Ennai kathiri" which is the main and suitable side dish for briyani. The main advantage of mullukathiri variety is presence of spines in the leaves, stem and calyx of the fruit. The major problem which deters the brinjal crop was fruit and shoot borer. As the mullukathiri has spiny nature it was naturally resistant to fruit and shoot borer. It is mostly suitable for north eastern zones.

With this background, mainly to increase the yield of "Mullukathiri" with use of growth regulators like gibberellin (GA3) and 1-Naphthaleneacetic acid (NAA) of different concentrations this experimental study was undertaken.

2.0 MATERIALS AND METHODS

The experiment was conducted at the Kalavai village in Vellore district. The district lies on 225 m above mean sea level with much lesser rainfall and the average annual temperature was recorded as 27.9°C. The seeds of local variety of "Mullukathiri" was collected and utilized for this study. This experiment was conducted in a Randomized Block Design (RBD) consisting of 9 treatments with 3 replications. The treatment consists of T1- 25 ppm GA3, T2- 50 ppm GA3, T3- 75 ppm GA3, T4- 100 ppm GA3, T5- 25 ppm NAA, T6- 50 ppm NAA, T7- 75 ppm NAA, T8- 100 ppm NAA, T9- control (water spray). Each treatment has a plot size of 3X3m. The ridges and furrows are formed and the seeds were sown at the spacing of 60 x 60 cm at 2- 3 cm depth. The growth regulators are given in the form of foliar spray at 45^{th} and 60^{th} day after planting. Cultural practices are followed as per the package of practices. The observations like plant height (cm), number of branches (nos), days to first

flowering (days), number of flowers/plant (nos), number of fruits/plant (nos), average fruit weight (g) are recorded.

Table 1: Effect of Growth Regulators on Growth Attributes of Brinjal Plant

Treatments	Growth regulators	Plant height (cm)	Number of branches (nos)
T1	GA3- 25 ppm	53.20	5.00
T2	GA3- 50 ppm	65.40	8.00
T3	GA3- 75 ppm	44.30	4.00
T4	GA3- 100 ppm	50.10	5.00
T5	NAA 25 ppm	44.30	6.00
T6	NAA 50 ppm	55.20	7.00
T7	NAA 75 ppm	49.30	5.00
T8	NAA 100 ppm	45.10	5.00
T9	Control (Water spray)	36.40	4.00
Mean		49.25	5.44
S.Ed		8.25	1.33

Source: Primary data

3.0 RESULTS AND DISCUSSION

3.1 Vegetative Growth

The effect of growth regulators on the morphological characters of brinjal plant, plant height and number of branches was furnished in the table 1.

3.1.1 Plant height

Among the various treatments, GA3 50ppm recorded higher plant height (T2- 65.40cm) followed by NAA 50ppm (T6- 55.2cm) when compared with control (T9- 36.40). Thus GA3 at 50ppm has significantly influenced the height of the plants over other treatments.

3.1.2 Number of branches

The higher number of branches was recorded in the T2 (GA3 50ppm- 8 nos) followed by NAA 50ppm (7 nos) when compared with control T9 (4 nos). Hence, GA3 50ppm was significantly influenced the number of branches, over all other treatments.

Noor *et al*., 2017 has revealed that GA3 at 30 to 90 ppm has significantly increased the plant height in French beans over the control plants. And also it has shown to increase the number of branches, number of leaves, leaf dry matter at the different growth stages of French beans. Netam and Sharma (2014) have stated that, GA3 at 50ppm has increased the total plant height and number of leaves in brinjal plant at 30th day after transplanting.

Table 2: Effect of Growth Regulators on Flowering of Brinjal Plant

Treatments	Growth regulators	Days to 1st flowering	Number of flowers/ plant (nos)
T1	GA3- 25ppm	34.00	34.00
T2	GA3- 50ppm	32.00	37.00
T3	GA3- 75ppm	34.00	35.00
T4	GA3- 100ppm	37.00	34.00
T5	NAA 25ppm	38.00	35.00
T6	NAA 50ppm	33.00	36.00
T7	NAA 75ppm	37.00	33.00
T8	NAA 100ppm	36.00	35.00
T9	Control (Water spray)	39.00	28.00
Mean		35.55	34.11
S.Ed		2.40	2.57

Source: Primary data

3.2 Flowering Attributes

The data pertaining to the effect of various treatments of growth regulators on days to first flowering and number of flowers per plant was furnished in the table 2.

3.2.1 Days to first flowering

All the treatments were found to be superior over control in advancing the days to

first flowering. It ranges from 32 (T2) to 38 (T5) days. GA3 50ppm (T2) induced early flowering 32 days followed by NAA 50ppm (T5) in 33 days over control. Flowering was delayed in T9 which took 39 days for flowering.

3.2.2 Number of flowers per plant

Among the treatments, GA3 50ppm has shown to record the higher number of flowers/plant (37 nos) followed by NAA 50 ppm (36 nos). And the treatment T9 (water spray) recorded less number of flowers/plant (28 nos).

The results obtained above are corroborated with the findings of Kropi (2018). He stated that GA3 at 50ppm have shown to increase the total number of flower/plant, total number of fruits/plant and also increased fruit yield in brinjal. And also he stated that GA3 has increased the plant growth characters like plant height and number of branches. And the findings of Kropi and Phonglosa (2020) has revealed that GA3 at 50ppm has significantly increased the total number of flowers, fruits and fruit yield in brinjal plant among all other treatments.

3.3 Yield Attributes

The data pertaining the yield attributes like number of fruits/ plant and average fruit weight are furnished in the table 3.

3.3.1 Number of fruits/ plant

The highest number of fruits per plant was recorded at GA3 50ppm (T2) i.e. 19 fruits/plant, followed by NAA 50 ppm (18 fruits/plant) over control (T9). The T9 recorded least number of fruits/plant (13 nos).

3.3.2 Average fruit weight

All the treatments were superior over control (T9). Among them T2 (GA3 50ppm) recorded highest fruit weight 78.6g followed by T6 (NAA 50ppm) with the fruit weight of 77.20g. On the other hand the lowest fruit weight was recorded in T9 (water spray) was about 60.40g.

Moniruzzaman *et al*., (2014) has stated that the yield of brinjal was increased from 16- 23% with the application of GA3 and NAA at the rate of 30 and 40 ppm respectively over control. But the findings of Bisaria and Bhatnagar in 1978 are in agreement with the present study. He stated that GA3 50ppm has obtained maximum fruit number and yield of brinjal plant.

Table 3: Effect of Growth Regulators on Yield Attributes of Brinjal Plant

Treatments	Growth regulators	Number of fruits/ plant (nos)	Average fruit weight (g)
T1	GA3- 25 ppm	17.00	71.00
T2	GA3- 50 ppm	19.00	78.60
T3	GA3- 75 ppm	16.00	69.60
T4	GA3- 100 ppm	15.00	68.50
T5	NAA 25 ppm	17.00	69.50
T6	NAA 50 ppm	18.00	77.20
T7	NAA 75 ppm	17.00	62.30
T8	NAA 100 ppm	16.00	65.30
T9	Control (Water spray)	13.00	60.40
Mean		16.44	69.15
S.Ed		1.74	6.08

Source: Primary data

4.0 CONCLUSION

The growth regulators were found to exert significant influence of growth attributes, flowering behaviour and yield attributes of the plant. GA3 was involved in cell divison and elongation and NAA promotes cell elongation, flower bud initiation, apical formation and maximum fruit retention. On the basis of the experiment it was concluded that, among the growth regulators and their concentrations, the foliar spray of GA3 and NAA at 50 ppm were found to favourably influence the crop growth and yield attributes at different stages.

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CHAPTER 7

ISOLATION AND CHARACTERIZATION OF AZOTOBACTER FROM THE SOIL

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ABSTRACT

The importance of Nitrogen in overall plant nutrition is well known to all. Plant performance was crucially dependent on adequate supply of all elements, including the elements that requires in small quantities. There is a plenty of nitrogen present in the soil which supports the crop growth, but the crop exhibits reduced vegetative growth, because the nitrogen in the soil cannot be fixed by the plants easily. Exogenous application of nitrogen in the form of fertilizers is also necessary, but it leads to reduced fertility of the soil. Thus identification of an elite strain capable of fixing the nitrogen present in the soil as well as atmosphere will be an alternative tool to provide nitrogen to the plant. The above experimental study reveals that Azotobacter species is a Non –symbiotic nitrogen fixing heterotropic bacterium in Indian soils. The primary objective of the study was to isolate and identify the non-symbiotic nitrogen fixing Azotobacter sp with local ecology i.e. in our college field, which can be used for the preparation of biofertilizer. This particular study gains momentum for nitrogen fixation using microbes. Therefore, it can be concluded that

microbial inoculation facilitate efficient nutrient's uptake which ultimately produce plants of superior quality. The increased use of various biological processes in soil, will decisively contribute to make agriculture more productive and less harm to environment. Therefore, the study concluded that the beneficial microorganisms / biofertilizers applied in combination were a better choice for farmers to reduce the use of chemical fertilizers for sustainable crop production.

Keyword: Azotobacter, isolation, character, importance

1.0 INTRODUCTION

Azotobacter is a motile, oval or spherical bacterium that can develop massive amounts of capsular slime and form thick-walled cysts (Becking, 1981). The amino acid glycine, which is found in the nutrient medium peptone, affects the shape of the cell. Pigments are formed by *Azotobacter*. For example, the dark-brown water-soluble pigment melanin is formed by *Azotobacter chroococcum*. This mechanism occurs during the fixation of nitrogen at high levels of metabolism, and is thought to shield the nitrogenase system from oxygen. Other species of *Azotobacter* produce yellow-green to purple pigments, including a green pigment that fluoresces with yellow-green light and a blue-white fluorescence pigment.

They are aerobic, free-living soil microbes that play an important role in the nitrogen cycle in nature, binding inaccessible atmospheric nitrogen to plants and releasing it into the soil (nitrogen fixation) in the form of ammonium ions (Boddey and Dobereiner, 1995). It is used by humans for the processing of bio fertilisers, food additives, and certain biopolymers, in addition to being a model organism for the study of diazotrophs. *Azotobacter chroococcum*, the first representative of the genus, has been found and described, in 1901 by the Dutch microbiologist and botanist Martinus Beijerinck. Gram-negative bacteria present in acidic and alkaline soils, in water, and in contact with certain plants. *Azotobacter* species are widely used in farming, particularly in nitrogen biofertilizers such as *azotobacterin*, because of their ability to fix molecular nitrogen and thus increase soil fertility and stimulate plant development.

2.0 DISTRIBUTION

In neutral and weakly basic soils, but not in acidic soils, *Azotobacter* species are widespread. Despite the cold climate, short growing season, and relatively low pH values of these soils, they are often present in the Arctic and Antarctic soils. In dry soils, *Azotobacter* can live for up to 24 years in the form of cysts. In aquatic environments, including freshwater

and brackish marshes, members of the genus *Azotobacter* are also found. Many participants are concerned with plants and are situated in the rhizosphere, having certain relationships with the plant. Some strains are also found in the cocoons of the earthworm *Eisenia fetida*.

3.0 MATERIALS AND METHODS

3.1 Sample Collection

The soil samples were collected from the Ragi, Guava and Mango field at Anbil Dharmalingam Agricultural College & Research Institute (ADAC&RI), Trichy. The samples were collected from the depth of 6 cm, after discarding the top 5 cm layer. The collected samples were kept in the polythene bags or packets and brought to the laboratory for analysis.

3.2 Preparation of media

All the media were prepared in distilled water and autoclaved at 121^0C (15psi) for 20 min. Different media (Brown, 1962) used in the study are as follows:

Table1: *Azatobactor* Media Composition

1. Jensen's medium (g / l)	**2. *Azotobacter* agar (mannitol) medium (g / l)**	**3. Waksmann Medium (g / l)**
Sucrose - 20.000	Dipotassium phosphate-1.000	Mannitol-10.0
Dipotassium phosphate -1.000	Magnesium sulphate- 0.200	Calcium Carbonate-0.3
Magnesium sulphate-0.500	Sodium chloride -0.200	KH_2PO_4-0.5
Sodium chloride-0.500	Ferrous sulphate-TRACE	Magnesium Sulphate-0.2
Ferrous sulphate-0.100	Soil extract- 5.000	NaCl-0.2
Sodium molybdate-0.005	Mannitol-20.000	Agar- 20.0
Calcium carbonate-2.000	Agar-15.000	
Agar-15.000	Final pH (at 25°C)-8.3±0.2	

4.0 RESULT AND DISCUSSION

4.1 Isolation of *Azotobacter*

Azotobacter was isolated from rhizosphere soils of different crops (Guava, mango and Ragi) grown at ADAC&RI farm. Serial dilutions of the collected samples were made in 9.0 ml sterilized water blanks and 0.1 ml of appropriate dilution was plated on Jensen's medium. The plates were incubated at room temperature for 4-5 days. Bacterial colonies showing azotobacter growth were purified on waksmann medium and Mannitol agar medium and transferred to Jensen's medium slants for further use.

4.2 Screening of Azotobacter

4.2.1 Production of Brown pigmentation

Screening of bacterial isolates for *Azotobacter sp.* was done on Jensens medium agar plates. Growth of *Azotobacter sp.* for each isolate was determined by Brown colour Pigmentation.

4.2.2 Gram Staining

Gram staining is a common technique used to differentiate two large groups of bacteria based on their different cell wall constituents. The Gram stain procedure distinguishes between Gram positive and Gram negative groups by coloring these cells red or violet. Gram positive bacteria stain was violet due to the presence of a thick layer of peptidoglycan in their cell walls, which retains the crystal violet as these cells are stained. Alternatively, Gram negative bacteria stain red, which is attributed to a thinner peptidoglycan wall, which does not retain the crystal violet during the decoloring process. The above technique was followed and we observed the pink colour in the cells under the microscope, which indicates the isolated micro organism is gram-negative.

4.2.3 Catalase test

The bacterial cells are known to produce catalase and are exposed to a solution of 3% hydrogen peroxide, the oxygen released following decomposition of H_2O_2, which appears as effervescence or bubbles. The catalase test can be done on slide, tube or agar plate. We observed the air bubbles in the test tube.

4.2.4 Citrate utilization test

The bacterial isolates were streaked in slanting position, containing Simmons citrate agar and incubated for about 2 days at room temperature. The colour change from green to blue in the media indicates the isolates are positive and has utilized the citrate in media. We observed the colour change from green to blue, hence the given isolate is positive for citrase utilization.

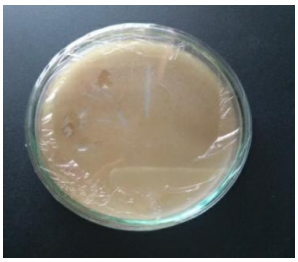

Figure 1 (a)

Figure 1 (b)

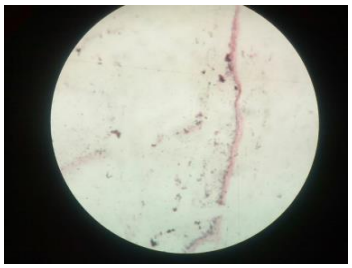

Figure 1 (c)

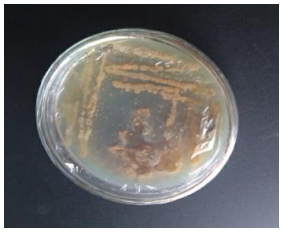		
Figure 1 (d)	**Figure 1 (e)**	**Figure 1 (f)**

Figure 1(a): Isolation of Azotobacter sp from finger millet rhizosphere, Figure 1(b): Purification of Azotobacter sp. obtained from finger millet rhizosphere, Figure 1(c): Microscopic image of Gram Staining of Azotobacter sp. obtained from finger millet rhizosphere. Figure 1(d): Pigment production by Azotobacter sp isolated from rhizosphere, Figure 1(e): Citrate test of Azotobacter sp. showing blue colour, Figure 1(f): Growth of Azotobacter.

5.0 CONCLUSION

Azotobacter sp very easy available, cheap and efficient biofertilizer and it can help to improve crops yield. This study, revealed Azotobacter sp can isolate very easily from soil and culture used for preparation of biofertilizer.

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CHAPTER 8

RESPONSE OF PINK PIGMENTED FACULTATIVE METHYLOTROPHS ON GROWTH AND YIELD OF AFRICAN MARIGOLD

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ABSTRACT

A field experiment was carried out to examine the response of PPFM on growth and yield of African marigold. There were six treatment combinations and the experiment was laid out in a Randomized Block Design with three replications. African marigold (Tagetes erecta var. Asoka Yellow F_1) seedlings were used for field experiment. The treatment details are T1 - PPFM at 1% Volume, T2 - PPFM at 2% Volume, T3 - PPFM at 3% Volume, T4 - PPFM at 4% Volume, T5 - PPFM at 5% Volume, T6 – Control. The quantitative parameters such as root length, shoot length, days taken for 50% flower initiation, flower diameter, flower yield per plant were evaluated. The experiment result indicated that the root length was observed high in (T3-19.70 cm) followed by (T2-18.50 cm), shoot length was high in (T3-70 cm) followed by (T2-65cm) and flower diameter was high in (T3-2.90 cm) followed by (T2-2.80 cm) and lowest growth parameters found to be at 5% PPFM and were significant among the above parameters. Days taken for 50% flower initiation, flower yield per plant was found to

be non significant. Therefore the foliar application of 3% PPFM can influence the growth and yield of African marigold.

Keywords: African marigold, Pink Pigmented Facultative Methylotrophs (PPFM), vegetative growth, flower yield, root growth

1.0 INTRODUCTION

African marigold (*Tagetes erecta L.*) belongs to the Asteraceae, an annual flower crop cultivated for its loose flowers. It is native of Mexico and South America. China is the leading producer followed by India and Peru in producing and exporting of flowers. Major importing countries are USA and Europe. India has about 1.10 lakh hectares under this crop with an annual production of 608.968 tonnes. Major growing states are Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh and West Bengal. In India marigold is one of the most commonly grown flowers and used extensively on religious and social functions in different forms and also making flower bed in herbaceous border for landscaping. The flower is used in poultry feed and manufacturing of food colours and neutraceuticals. Lutein, purified from marigold extract, is the most economically important component derived from the flowers and it is utilized in the pharmaceutical industry. Pink Pigmented Facultative Methylotrophs (PPFM) belongs to the genus *Methylobacterium* and it is an aerobic, Gram negative bacteria are distributed ubiquitously on plants. These bacteria are different from others in metabolizing methanol and other simpler carbon compounds by living in phyllosphere, the aerial surface of the plants. These bacteria able to grow on methanol, methylamine as well as on a variety of C_2, C_3 and C_4 compounds. These bacteria stimulate plant growth by providing plant growth hormones, vitamins and enzymes that influence germination and root growth under water stressed conditions.

2.0 MATERIALS AND METHODS

A field experiment was carried out to examine the response of PPFM on growth and yield of African marigold. There were six treatment combinations and the experiment was laid out in a Randomized Block Design with three replications. African marigold (*Tageteserecta* var. Asoka Yellow F_1) seedlings are procured from farmers. The seedlings are transplanted on mainfield when they are 28 days old with spacing of 60 X 30 cm in the first week of February. For observation, five plants per replication were randomly selected and observed. The treatment details are T1 - PPFM *at* 1% Volume, T2 - PPFM *at* 2% Volume, T3 - PPFM *at* 3% Volume, T4 - PPFM *at* 4% Volume, T5 - PPFM *at* 5% Volume, T6 – Control.

From the 15 days after transplanting the treatments are imposed to the plants in the mode of foliar application.

2.1 Growth and Yield Parameters

i. Root length

The length of root was measured at ninety days after transplanting of African marigold on five randomly selected plants from the base of collar to the tip of primary root and the mean was expressed in centimeter (cm).

ii. Shoot length

Ninety days old seedlings of African marigold plants were carefully lifted at random and length of the shoot was measured for five plants per replication from the base of the shoot to its tip. The mean was calculated and expressed in centimeter (cm).

iii. Days taken for 50 % flower initiation

Fifty per cent flower initiation was observed on five randomly selected plants per replication after transplanting in the main field. Mean was expressed in days from transplanting.

iv. Flower diameter

Flower diameter was observed on flowers harvested from five randomly selected plants per replication. Mean was calculated and expressed in centimeter (cm).

v. Flower yield per plant

The flower yield of five randomly selected individual plants per replication were collected and weighed. Mean were expressed in gram (g).

vi. Statistical analysis

The statistical analysis was done by adopting the standard procedures of Panse and Sukhatme (1985). The critical difference was worked out at five per cent (0.05) probability. The percentage values were transformed to angular (arc-sine) values for analysis. Analysis was carried out with AGRES software package and MS Excel® spreadsheet.

3.0 RESULTS AND DISCUSSION

i. Effect of root length on PPFM

There was a significant increase in root length of marigold from 16.0 cm untreated plants to 19.70 cm 3% PPFM applied marigold plant. Application of 2% and 1% PPFM also improves root growth to 18.50 cm and 18.20 cm respectively. There was negative impact on root growth of 15.10 cm was observed for 5% PPFM application. Basile *et al*., (1969) was the first person in demonstrating the growth enhancing effects of PPFMs on plants. The result of

root growth is mainly concerned with effective auxin and cytokinin production of PPFM. Influence of root length was increased by the combination of PPFM and PSB at different stages of growth in rice (Raghavendra and Santhosh, 2019). Dhale *et al*., (2011) reported that the combined bioinoculants of Surat *Azospirillum*, PSB and PPFM shows highest root and shoot length in cotton. The highest root length was found in the combination of ML55 and SB120 in soybean (Radha *et al*., 2009).

ii. Effect of shoot length on PPFM

Elongation of shoot length of marigold provides information about their vegetative growth. Treatment 3 with 3% application of PPFM increases the marigold shoot length to 70.0 cm from the 55 cm untreated control plants. There was also increase in shoot length of 65.0 cm and 60.0 cm for 2% and 4% PPFM application respectively. Improvement in shoot length is attributed by the production of cytokinins by PPFM. Importance of cytokinins on crop growth was confirmed according to the finding of Holland, 1997 on soyabean crop. Impact of shoot and root length increase by PPFM inoculation on paddy plants (Nysanth *et al*., 2018). Subhaswaraj *et al*., (2017) stated that the root and shoot length was gradually increased by the foliar application of *M. extorquens* MM2 (PPFM) in tomato. Radha *et al*., (2009) observed the shoot length was significantly increased by the combination of reference strain and SB120 on soybean.

iii. Effect of Days taken for 50 % flower initiation on PPFM

Days taken for 50 % flower initiation of African marigold was given in table 1. The significant differences among the treatments were not observed in Flower yield per plant of the crop.

iv. Effect of flower diameter on PPFM

The commercial value of marigold is correlated with the shape and size of the flower. Application of PPFM improves the flower size to greater extent. The largest flower size of 2.90 cm was recorded with 3% PPFM *Methylobacterium* sp. application. It is followed by the application of 2%, 1%, 4% and 5% PPFM application provides flower size of 2.80 cm, 2.70 cm, 2.65 cm and 2.60 cm respectively. Overall observation proves that PPFM applied marigold provides big size flowers when compared to control marigold.

v. Effect of flower yield per plant on PPFM

The result on flower yield per plant of African marigold was given in table 1. The significant differences among the treatments were not observed in flower yield per plant of the crop.

Table.1: Effect of PPFM on growth and yield of African marigold

Treatments	Root length (cm)	Shoot length (cm)	Days taken for 50 % flower initiation	Flower diameter (cm)	Flower yield per plant (g)
T1	18.20	57.00	44.33	2.70	37.722
T2	18.50	65.00	45.00	2.80	40.333
T3	19.70	70.00	43.33	2.90	39.167
T4	15.80	60.00	43.00	2.65	35.389
T5	15.10	48.00	43.33	2.60	34.833
T6	16.80	55.00	43.67	2.60	37.056
Mean	**17.3500**	**59.17**	**43.7778**	**2.7506**	**37.4167**
SE.d	**0.2992**	**1.0278**	**0.9149**	**0.0714**	**3.4165**
CD (0.05)	**0.6668****	**2.2900****	**2.0385 NS**	**0.1591****	**7.6125 NS**

Source: Primary Data

4.0 CONCLUSION

The present experiment investigated the effect on growth and yield of African marigold by the application of *Methylobacterium* sp. (PPFM) revealed that there is an positive effect on growth and yield of African marigold by improving its shoot, root and flowering potential. The maximum growth was observed at the application of PPFM at 3 % volume.

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CHAPTER 9

ASSESSMENT OF TRANSFER FACTORS OF HEAVY METALS FROM SOIL TO VEGETABLE CROPS GROWN AROUND MUMBAI, INDIA

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ABSTRACT

Dietary exposure of heavy metals through consumption of vegetables has been recognized as a risk to human health. The current study investigates concentration of heavy metals (Pb, Cu, Fe, Mn, Zn) in nutritionally important parts of vegetables (Spinach (Spinacia oleracea), Red Amaranth (Amaranthus gangeticus) and Okra (Abelmoschus esculentus)) and corresponding soil samples collected from outskirts of Mumbai. The sampling areas were the agriculture fields placed in the interstices of industrial units. The concentrations of all the toxic metals in vegetation and soil samples reported here were found to be within the prescribed limits. Leafy vegetables were observed to absorb more quantities of metals. None of the plants studied here were found to be hyperaccumulator species. . The transfer factors were within the range of 0.02 to 1.46 indicating that the plants accumulate heavy metals in varied concentrations in their nutritionally important parts. This study shows that vegetables grown in soil containing higher amount of heavy metals may get transferred into edible plant parts. Hence such areas should be monitored periodically to ensure human health.

Keywords: Transfer factor, vegetable, plant, soil, heavy metal, Mumbai

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1.0 INTRODUCTION

Metals play a significant role in biological systems such as structural components of proteins, regulators of metabolic activities, etc. (Sharma & Shailajan, 2009) However, presence of heavy metals to human proximity is of big concern due to their omnipresence, persistence, similarity in behaviour to vital elements, absorption and retention in living

tissues and toxicity. Presence of heavy metals in agricultural soils is currently an alarming situation. These harmful metals may come from bedrock itself. (Jolly et al., 2013) But the sources of much concern are commercial agriculture, chemical fertilizers and pesticides, mining, smelting, atmospheric pollutions, energy and fuel production, sludge dumping, etc. (Mirecki et al., 2015)

Plants can uptake metals through various mechanisms like absorption, adsorption, dissolution, redox reactions, ion exchange and precipitation. These reactions are in turn governed by edaphic conditions like soil minerals (carbonates, hyrdoxides, etc.), soil pH, organic matter (humic acid, polysaccharides, etc.), nutrient balance, trace metals concentration in soil, soil moisture, physico-chemical properties of soil, weather changes, temperature, etc. (Tarradellas et al., 1996) Some plants are said to have lower tolerance level to toxic metals since they accumulate high concentration of these metals and retain them in their tissues. (Freitas & Prasad, 2004) This also depends on factors like plant genomics, age of plant, plant vasculature, plant organs and tissues. (Trajkovic & Ilic, 2012)

The most common source of exposure of heavy metals to humans is through food. Among foods, vegetables are the most exposed to environmental pollution due to aerial sources, polluted soil and water, etc. Leafy vegetables are known to uptake heavy metals in highest concentrations. (Mapanda et al., 2005) These metals are retained in edible parts of the plant. Excessive concentration of heavy metals in foods beyond maximum permissible limits may cause health disorders. (WHO, 1992)

Soil to plant transfer of heavy metals is a major pathway of human exposure to heavy metals. This rhizosphere soil to plant transmission is studied using an index referred as Transfer Factor (TF). TFs are calculated as:

$$TF = \frac{Metal\ concentration\ per\ unit\ mass\ of\ dry\ vegetation\ (\frac{mg}{Kg})}{Metal\ concentration\ per\ unit\ mass\ of\ dry\ soil\ (\frac{mg}{Kg})}$$

(Mellem et al., 2012)

The transfer factor applies to long term chronic exposure of organisms to contaminant. The TFs are used in pathological risk assessment to calculate how many micrograms per kilogram of soil pollutants are transferred to the same volume of edible dry plant product. (IAEA, 2006) Transfer factor values in excess of one imply active bioaccumulation of the pollutant. It suggests that plant has the tendency to absorb more amount of pollutant from the soil. Values less than one imply either strong binding of the

pollutant to the soil or that the plant is not accumulating that material. Hence TF values indicate the binding strength of pollutant to soil or plant cells. (Harrison & Chirgawi, 1989)

The aim of current study was investigation of soil concentration of five heavy metals (namely, Pb, Cu, Fe, Mn and Zn). The corresponding uptake of these metals in nutritionally important Indian vegetable crops (Spinach (*Spinacia oleracea*), Red Amaranth (*Amaranthus gangeticus*) and Okra (*Abelmoschus esculentus*)) cultivated in agriculture fields placed in the interstices of industrial units was assessed. The elemental determination using differential pulse anodic stripping voltammetry (DP-ASV) and atomic absorption spectroscopy (AAS) was performed. The subsequent soils to plant transfer factors were then calculated. The Transfer Factors depend upon physico-chemical properties of soil. Hence, the parameters such as soil texture, pH, moisture content, organic matter and cation exchange capacity were analysed.

2.0 MATERIALS AND METHODS

2.1 Study Area

The sampling area is located on western coast of Palghar district of Maharashtra. This area has been an industrial belt of Boisar - Tarapur - Dahanu. The zone contains industrial units, processing plants, power plants in the interstices of which the vegetable farms are located. The produce from these farmlands is consumed locally as well as sold in neighbouring markets of Mumbai and Thane region.

The sampling locations are shown in the map. The sampling locations were ascertained depending on the factors such as sample availability throughout the year, human population around the target areas, wind direction and wind speed, etc. The location from which vegetation sample was collected soil sample was also collected from the same location. Ready to harvest, mature plant samples were collected from the field directly. Entire plant from root tip to shoot tip was collected. In case of Okra, only the fruit part having nutritional value was collected. The vegetation samples were temporarily stored in clean plastic bags to bring them to laboratory. The samples were cleaned for probable dirt material, washed using distilled water and edible plant part was separated with a clean stainless steel knife. The samples were then coded and initial weight was recorded. The samples were then kept for drying in oven at 100 °C until a constant dry weight was obtained. This dry matter was stored in self-sealing and coded polythene bags. 2 g of dried sample was then kept in muffle furnace (450 °C) for ashing. This ash was then used for acid digestion.

Figure 1: Sampling Locations

Corresponding rhizosphere soil samples were also collected from the site where vegetation sample was taken. The sample was temporarily stored in coded and clean polythene bags to bring it in laboratory. Fine textured soil samples were then weighed and dried in oven at 100 ºC until a constant weight was obtained. Soil samples were then sieved using a magnetic sieve to obtain soil size below 2mm. Such soil was then stored in self-sealing and coded polythene bags for further acid digestion.

2.2 Plant Sample Preparation and Analysis

2 g of ashed vegetation sample was digested using an acid mixture (5 ml conc. HNO_3 (65%) + 1 ml of (70%) $HClO_4$) in an acid cleaned beaker. The mixture was heated on a hot plate with constant heating to near dryness and then cooled. The above steps were repeated a couple of times for maximum leaching of target metals. 5 ml of 0.25% HNO_3 was then added to mixture, warmed and cooled. The content was filtered through Whatman Filter Paper number 62 in a standard flask. Final volume was made to 25 ml with 0.25% HNO_3.

2.3 Soil Sample Preparation and Analysis

1 g of oven dried soil was taken in Teflon - PFA container. 6 ml conc. HNO_3 (65%) and 2 ml HF (30%) were added. The sample was digested in a microwave digestion system with a three stage programme. The containers were cooled and the content was transfered in Teflon beakers. The content was evaporated to complete dryness on a uniform heating using hot plate. 5 ml of 0.25% HNO_3 was then added to mixture, warmed and cooled. The content was filtered through Whatman Filter Paper number 62 in a standard flask. Final volume was made to 25 ml with 0.25% HNO_3. The analysis of target metals was done using DP-ASV and AAS.

3.0 RESULTS AND DISCUSSIONS

Concentration of different metals in plants depends upon the relative level of exposure to the contaminated soil.

3.1 Physico-Chemical Parameters of Soil

Knowledge of the association of heavy metals with soil properties and their affinity to each soil constituent is the key to better understand their behaviour in soils. Hence while studying the uptake of metals in biological systems; it is necessary to report the results in support with the corresponding physico-chemical properties of soil. (Gałuszka, 2007) Table 1 gives the various physico - chemical properties of soil:

Table 1: Physico – Chemical Properties of Soil

Sr. No.	Sampling Location	Soil pH	Soil Texture	Moisture Content (%)	Organic Matter (g %)	CEC C mol /Kg
1.	Vangaon	7.67	Loamy	10.38	2.7	31.9
2.	Chinchani	7.31	Sandy Loam	16.08	1.6	40.4
3.	Paam	7.56	Sandy Loam	13.03	2.5	41.1
4.	Wadhwan	7.16	Loamy	12.67	2.4	38.3
5.	Varor	7.46	Loamy	12.30	2.1	34.9
6.	Tembhi	7.63	Sandy Loam	12.01	2.4	41.6
7.	Dahanu	7.87	Loamy	12.36	2.3	38.8
8.	Tarapur	7.26	Sandy Loam	15.97	1.9	40.2
9.	Boisar	7.71	Sandy Loam	12.56	2.4	41.3

The pH of soil was predominantly found to be slightly alkaline indicating favourable conditions for microbial survival in soil. This is also evident from the organic matter content of soil as it ranges between 1.6 – 2.7 g %. The soil texture has been found to be loam to sandy loam. Thus the soil has good water holding capacity with simultaneous drainage of excess water. It is also evident from moisture content of soil recorded as in the range 10.38 – 16.08%. The CEC values in the study area have been found to be higher (31.9 – 41.6 C mol / Kg with an average value of 38.72) indicating that root uptake of nutrients was not affected due to CEC.

Heavy metals are often referred to as trace or toxic elements because of the manifestation of their toxic effects in plants, animals and humans (Doelsch & Van de Kerchove, 2006) and herbal remedies (Obi et al., 2006) Heavy metals coming from anthropogenic sources are more dangerous because of their instability and solubility leading to high bio-availability.

Table 2: Concentration of Heavy Metals in Soil Samples

Toxic metal	Concentration of heavy metals		
	Minimum	**Maximum**	**Mean**
Pb (mg/Kg)	0.27 ±0.01	0.9 ± 0.06	0.51 ± 0.03
Cu (mg/Kg)	53.52 ± 3.13	112.49 ± 6.58	80.83 ± 4.55
Fe (mg/ml)	9.38 ± 0.41	36.50 ± 0.93	15.99 ± 0.76
Mn (mg/Kg)	0.09 ± 0.01	1.46 ± 0.1	0.53 ± 0.04
Zn (mg/Kg)	0.12 ± 0.03	0.76 ± 0.06	0.33 ± 0.03

The soil concentration of Pb ranged from 0.27 to 0.9; Cu from 53.52 to 112.49, Fe from 9.38 to 36.5; Mn from 0.09 to 1.46 and Zn from 0.12 to 0.76 mg/Kg in the collected soil samples. The mean heavy metal content in soil samples decreased in the order Cu>Fe>Mn>Pb>Zn. The concentration of heavy metals in soil samples was found to be higher than the corresponding plant samples. This is observed to be a general trend as it is also reported by Demi˙rezen & Aksoy (2006).

Lead (Pb) is a toxic metal and most people and animals receive the largest portion of their daily Pb intake via food. The mean concentration of lead in Spinach, Red Amaranth and Okra was found to be 0.68 ± 0.01 mg/Kg, 0.64 ± 0.01 mg/Kg and 0.23 ± 0.01 mg/Kg respectively. Thus according to this study, Spinach showed higher tendency

to accumulate lead than Red Amaranth, while the least shown by Okra. Prevention of Food Adulteration Act, 1954 of India and its successive amendments describe the safe intake levels of Pb from vegetables as 2.5 mg/Kg. (Lokeshwari & Chandrappa, 2006) The same standard for food materials as per FAO - WHO Codex series has been 5 mg/Kg. (Kabata & Pendias, 2011) None of the samples in this study exceeded the said limiting concentration. This shows that the edible parts of all the three vegetables were safe for consumption.

The current study revealed that the concentration of copper (Cu) in Spinach, Red Amaranth and Okra is 12.68 ± 0.32 mg/Kg, 10.71 ± 0.2 mg/Kg and 15.93 ± 0.23 mg/Kg respectively. Thus, considering the edible portion of the vegetables; Okra has the ability to absorb and store higher concentration of copper within its fruit part followed by Spinach and the least values shown by Red Amaranth within their leaves. FAO - WHO Codex describe permissible limit of Cu for food materials to be 40 mg/Kg. While the PFA, 1954 describes the permissible level to be 30 mg/Kg. None of the value reported in the current study showed a value more than the maximum permissible level. Although the maximum values were within the PFA standard but still approaching to it. Thus it is important to determine the background metal concentration of agricultural soils before fertilization. Excess of Cu in soil plays a cytotoxic role, induces stress and causes injury to plants. This leads to plant growth retardation and leaf chlorosis. (Lewis et al., 2001) No such cases of chlorosis were visible in current study.

Iron (Fe) is considered as an essential transition metal that participates in control of various metabolic and signalling pathways. However, its rich coordination chemistry and redox properties are such that it is capable of escaping out of the control mechanisms. Fe may interact with nuclear proteins and DNA causing oxidative deterioration of biological macromolecules. (Valko et al., 2005) Fe concentration in Spinach, Red Amaranth and Okra was calculated to be 510 mg / Kg, 590 mg / Kg and 240 mg / Kg. Hence, not Spinach, but Red Amaranth is considerably higher bio-accumulator of iron; Okra fruits being the least. The results were comparable with those determined by Lokeshwari & Chandrappa (2006). As per WHO guidelines, permissible standard for Fe is given as 5.0 mg/Kg for food crops. None of the plants analysed in current study gave Fe concentration beyond limiting value.

Table 3: Concentration of heavy metals in selected vegetables

Metal	Spinach (*Spinacia oleracea*)			Red Amaranth (*Amaranthus gangeticus*)			Okra (*Abelmoschus esculentus*)			Permissible Limits
	Min.	**Max.**	**Mean**	**Min.**	**Max.**	**Mean**	**Min.**	**Max.**	**Mean**	
Pb (mg/Kg)	0.16 ± 0.01	1.30 ± 0.02	0.68 ± 0.01	0.14 ± 0.01	1.03 ± 0.04	0.64 ± 0.01	0.05 ± 0.01	0.78 ± 0.03	0.23 ± 0.01	5mg/Kg[(a)]
Cu (mg/Kg)	7.20 ± 0.17	22.20 ±0.96	12.68 ±0.32	5.83 ± 0.06	21.39 ± 0.5	10.71 ± 0.2	10.21 ± 0.09	29.33 ± 0.44	15.93 ± 0.23	40 mg/Kg[(a)]
Fe (mg/ml)	0.06 ± 0.01	1.10 ± 0.02	0.51 ± 0.01	0.02 ± 0.01	1.27 ± 0.02	0.59 ± 0.01	0.06 ± 0.01	0.69 ± 0.02	0.24 ± 0.01	5.0 mg/Kg[(a)]
Mn (mg/Kg)	0.05 ± 0.01	0.34 ± 0.05	0.21 ± 0.01	0.05 ± 0.01	0.27 ± 0.07	0.13 ± 0.021	0.04 ± 0.01	0.22 ± 0.10	0.10 ± 0.03	500[(b)]
Zn (mg/Kg)	0.09 ± 0.01	0.89 ± 0.06	0.31 ± 0.02	0.12 ± 0.02	0.92 ± 1.65	0.29 ± 0.026	0.14 ± 0.04	0.52 ± 0.2	0.34 ± 0.09	99.4[(a)]

(a)= FAO - WHO Codex standards stated by Alina Kabata – Pendias, Trace elements in soils and plants, Fourth edition, CRC Press, US, 2011; (b)= Pendias, A.K. and Pendias, H. 1992. Trace Elements in Soils and Plants. Boca Roton, CRC Press, pp. 271-276

Manganese (Mn) is a member of the iron family and both elements are closely associated in geochemical processes. The Mn concentration in vegetables was 0.21 ± 0.014 mg/Kg for Spinach, 0.13 ± 0.021 mg/Kg for Red Amaranth and 0.1 ± 0.039 mg/Kg for Okra. Hence the values are quiet significant, falling within the world wide vegetable concentration range of Mn. The results do indicate that Spinach has the highest tendency to accumulate Mn as compared with Red Amaranth and Okra. For a plant to be healthy, the Fe: Mn ratio should range from 1.5 to 2.5. This ratio for both Spinach and Okra was determined to be 2.4. But the ratio for Red Amaranth was calculated to be 4.53. The value is thus found to be twice than the maximum limiting value. This indicates the effects of Mn induced Fe toxicity in Red Amaranth.

Zinc (Zn) is reported to be concentrated in chloroplasts especially in the plants such as spinach. It is also likely to be accumulated in vacuole fluids and in cell membranes. (Tiffin et al, 1972) The Zn concentration in vegetables was 0.31 ± 0.02 mg/Kg for Spinach, 0.29 ± 0.026 mg/Kg for Red Amaranth and 0.34 ± 0.09 mg/Kg for Okra. The permissible limits prescribed by WHO-FAO Codex and PFA India are 99.4 mg/Kg and 50 mg/Kg respectively. None of the plants under current study showed a value more than the permissible limits stated above. The soil was in fact found to be deficient in Zn, thereby requiring an amendment.

The transfer factor values for Pb were calculated to be 1.06, 1.20 and 0.7 respectively for the plant species Spinach, Red Amaranth and Okra. This shows that Red Amaranth shows higher tendency to accumulate lead in its tissues than Spinach while the least given by Okra. The values were found to exceed 1 for Red Amaranth as well as Spinach. It indicates a preference given by the two vegetables towards active absorption of Pb. The plants grown in heavily lead contaminated areas may tend to absorb Pb thereby entering on to human body and hence should not be consumed.

The transfer factor values for Cu were calculated to be 0.17, 0.13 and 0.18 respectively for the plant species Spinach, Red Amaranth and Okra. All the values were within the range of 0 to 1; approaching zero. It shows that, the plants are selective in absorption of certain metals and their retention in tissues. Although the metals are present in considerably high quantities in ambient soils, the plants will absorb them only in quantities required for their sustenance. However, this should not be considered as a thumb rule, as it will vary depending on factors discussed previously.

Table 4: Transfer Factors of selected heavy metals in three plant species

Heavy Metal	Plant Sample	Avg. Concentration in plant tissue (mg/Kg)	Average Concentration in soil (mg/Kg)	Transfer Factor (TF)
Lead (Pb)	Spinach	0.68 ± 0.01	0.64 ± 0.03	1.06
	Red Amaranth	0.64 ± 0.01	0.53 ± 0.05	1.20
	Okra	0.23 ± 0.01	0.47 ± 0.02	0.48
Copper (Cu)	Spinach	12.68 ± 0.32	72.78 ± 0.13	0.17
	Red Amaranth	10.71 ± 0.2	77.88 ± 0.19	0.13
	Okra	15.93 ± 0.23	86.15 ± 0.18	0.18
Iron (Fe)	Spinach	0.51 ± 0.03	21.2 ± 0.06	0.024
	Red Amaranth	0.59 ± 0.03	25.49 ± 0.07	0.023
	Okra	0.24 ± 0.04	20.38 ± 0.05	0.011
Manganese (Mn)	Spinach	0.21 ± 0.01	0.75 ± 0.06	0.28
	Red Amaranth	0.13 ± 0.02	0.97 ± 0.11	0.136
	Okra	0.10 ± 0.03	0.78 ± 0.05	0.128
Zinc (Zn)	Spinach	0.31 ± 0.02	0.27 ± 0.05	1.14
	Red Amaranth	0.29 ± 0.02	0.21 ± 0.06	1.38
	Okra	0.34 ± 0.03	0.21 ± 0.06	1.61

The transfer factor values for Fe were calculated to be 0.024, 0.023 and 0.011 for Spinach, Red Amaranth and Okra respectively. Fe concentration of soil is exceedingly higher than the corresponding plant species. This made the transfer factor values extremely lower. The TF values for Fe in all the three species studied here were found to be relatively similar. Hence it can be said that the absorption and accumulation capacities of the three plant varieties are approximately similar under given set of conditions.

The TF values of Mn were determined to be 0.28 for Spinach, 0.136 for Red Amaranth and 0.128 for Okra. These values for Red Amaranth and Okra are quiet significant but it is higher for Spinach. This shows that Spinach is accumulating and storing Mn higher than the rest of the two vegetables. Similar results were reported by (Uwah et al., 2011). The TF values of Zn were calculated to be 1.14, 1.38 and 1.61 for Spinach, Red Amaranth and Okra respectively. The TFs of all the plants were found to be more than 1. This indicates that all three plant species are actively absorbing Zn from soil and storing it within its edible parts.

4.0 CONCLUSION

The concentration of five metals Pb, Cu, Fe, Mn and Zn was investigated in soil and edible parts of vegetables collected from outskirts of Mumbai. The mean heavy metal content in soil samples decreased in the order Cu>Fe>Mn>Pb>Zn. The relative abundance of metals in spinach and Red Amaranth decreased in the order Cu>Pb>Fe>Zn>Mn. The relative abundance of metals in Okra decreased in the order Cu>Fe>Pb>Zn>Mn. The metal concentrations of the edible parts of vegetables varied in different samples and hence variations in metal concentrations among different varieties reflect the difference in uptake capabilities and their further distribution. The concentrations of all the toxic metals in vegetation and soil samples reported here were found to be within the prescribed limits.

The transfer factors of metals from soil to plant depend upon physico-chemical parameters of soil. The soils to plant transfer factors were evaluated for all the three vegetation species through multiple number of samples from different areas. The transfer factors were within the range of 0.02 to 1.46. Out of these, more than 81% of the samples showed TF values below 1 (in the average range of 0.019 to 0.48). This indicates that target plants are accumulating the toxic metals from soil and storing in its tissues but there is no specific affinity shown by higher rate of absorption. The remaining 19% of the samples were reported to be exhibiting the TF values more than 1 (found in the average range 1.06 to 1.61). The values more than 1 have been exhibited by the two metals, Pb and Zn. This shows that the plants are actively absorbing these toxic metals from soil and storing them within their

tissues. The reason may be linked with higher content of these metals in soil adding to their background concentration along with their foliar absorption. Leafy vegetables were observed to absorb more quantities of metals. Hence it is therefore suggested to consume those vegetables at lower amount in the diet to reduce any toxic effect. Thorough washing with clean water is prescribed to minimize the aerial burden of metals. None of the plants studied here were found to be hyperaccumulator species.

Expanding population and high demand for land has left very few options for agriculture in and around urban areas. Hence the cases of farming around industrial zones are seen increasingly these days. Efforts should be thus made to segregate the industrial and agricultural land types. Farming on or near industrial units should thus be avoided for human health benefits.

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CHAPTER 10

SIGNIFICANCE OF TOXICOLOGY AND METAL POLLUTION IN AQUATIC ENVIRONMENT: CAUSE AND IMPACT

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ABSTRACT

During recent years the metal toxicology and metal metabolism in aquatic environment are gaining ever increasing importance, as fast industrialization and urbanization in developing countries, various anthropogenic influences, and the acidic soil forms have raised the concentration of metal pollutants in fresh water bodies and reservoirs. That is the reason why considerable attention has been focused on the fates of metals and their derivatives in the aquatic environment. The contamination of heavy metals in aquatic environment in higher concentration poses a serious threat to aquatic organisms owing to bioaccumulation and biomagnifications in the food chain. In aquatic ecosystems, the levels of toxic metals have increased either directly, as a result of atmospheric deposition and waste water discharge and runoff or indirectly through mobilization from sediments owing to acidification. Metal toxicity to fresh water organisms has been reviewed by various researchers time to time, revealing the possible causes and their impacts.

Heavy metals are well known toxicants to animals, of which inorganic and organic compounds of heavy metals are very common in the environment and often accumulate in food chains. The ionic forms of metals are more toxic than complex inorganic or organic compounds, producing toxic effect at high concentrations. Heavy metals, like Mercury, Lead, Cadmium, Copper, and Zinc are the most important pollutants which effect fish and aquatic environment. The fish, which is the largest group of living vertebrates, is known for their ability to concentrate metals in their organs. When their concentration increases, they pose toxic impacts like denaturation of proteins, alterations in membrane permeability and active transport, clogging of gills, respiratory distress etc. Hence, it is a great threat to the health of fish and to consumers including mankind. The objective of the present article is to briefly describe the generalized mechanism of action of heavy metals in metal toxicology and their possible impacts.

Keywords: Metal, toxicology, toxicity, acute toxicity, fish

1.0 INTRODUCTION

Toxicology is a multidisciplinary subject dealing with the qualitative and quantitative study of the adverse or toxic effect of chemicals and other anthropogenic materials or xenobiotics on organisms. The term toxicology is derived from two Greek words; “toxicon”, which means poison and “logos”, meant for study. In order to distinguish between modern toxicology and classical toxicology, the term ecotoxicology was described in 1974 by Truhaunt. Ecotoxicology refers to the study of the effect of new toxic substances on the environment and evaluation of their impact on the relative number and biomass of elements of the ecosystem. In this regard, toxicity is the inherent potential or capacity of a material to cause adverse effect in a living organism, while a toxicant is an agent or material that can produce an adverse effect in a biological system, causing alteration in its structure or function or producing death.

In recent years the problem of metal pollution in aquatic environment has drawn the considerable attention of many researchers. Rapid industrialization and urbanization especially in developing countries, various human welfare activities and increased use of metal containing fertilizers in agriculture lead to a constant rise of the concentration of metal pollutants in fresh water reservoirs as a result of water run-off. These cause greatest hazard to an array of aquatic organisms particularly the fish population which has been the major food item of human. Moreover, the process of bioaccumulation and biomagnification can lead to the availability of toxic levels of metals from fish to human, even when the exposure is low.

The impact of metal pollutants on aquatic biota can be studied by toxicity tests which are used to detect and evaluate the potential toxicological effects of metals on aquatic organisms. The presence of potential human health hazards from persistent bioaccumulative chemicals may be more readily detected by analysis of aquatic organisms than by analysis of water samples. The acute toxicity test, which is an indispensable part of water pollution studies, has manifold utility. It offers an opportunity to evaluate the intrinsic toxicity of the chemical used, predict probable hazards to target or non-target species, determine to most susceptible species, identify target organs and provide information for the risk assessment of acute exposure to the chemicals. It helps to predict, diagnose and prescribe possible treatment for acute exposure to the chemical. The data from acute toxicity studies help institutions, government and research institutions to formulate safety measures for their researchers and for those engaged in development, production and use of the chemicals.

2.0 SIGNIFICANCE OF TOXICOLOGY

Ecotoxicology includes the study of the transport, distribution, biotransformation and the ultimate fate of chemical in the environment. Since ancient time people were aware of venoms of snake, poisonous plants and toxic minerals like arsenic, lead and antimony. Greek philosopher Hippocrates (400 BC) is known as one of the earliest person to express some knowledge of toxicology. Orfilla, a Spanish physician (1787-1853) recognized what is called today as forensic toxicology (developing means of detecting poison and determining the reason of death). Although the study of toxicology is very old and acute toxicity tests are used to estimate safe concentrations of toxicants in the environment, they provide little information on the mode of toxic action or environmental situations where accessory factors affect toxicity. By combining physiological, biochemical and histological studies with more traditional acute or chronic toxicity tests one can gain insight into the mode and site of toxic action as well as determine environmentally safe concentration of toxicants.

2.1 Subdisciplines of Toxicology

There are various subdisciplines of toxicology namely, analytical toxicology meant for identification and analysis; clinical toxicology for diagnosis, antidote and other ameliorative measures; forensic toxicology for legal implications; occupational toxicology, that means exposure to toxicants during work in industry; environmental toxicology including contamination, toxicity through food, air, water, detection sources and bioaccumulation; regulatory toxicology for setting laws, regulation and standards.

2.2 Types of toxic chemicals

Toxicants are of various types like industrial chemicals, agricultural pollutants, drugs, food additives, natural toxins, household poisons etc., but the most toxic chemicals of today's concern are metals, pesticides, chloride, cyanides, ammonia, detergents, and others. Of them, toxic effect of metals is a widespread concern in the modern industrial context. Virtually all metals can produce toxicity when ingested in sufficient quantities, but there are several which are especially important because either they are so pervasive, or produce toxicity at such low concentrations.

3.0 TOXICITY TESTING – ACUTE AND CHRONIC

Acute toxicity tests are generally used to determine the levels of toxic agent that produces an adverse effect on a specified percentage of the test organisms in a short period of time. Mortality is one of the most common adverse effects that are measured in acute toxicity test. The concentration that cause mortality following a short term exposure is called a lethal concentration while concentrations which are not lethal, but can cause adverse effects over

long term exposure are called sub-lethal concentrations. A meticulously designed acute toxicity study often provides important clues to the mechanism of toxicity of a particular class of chemical. In a well designed acute toxicity study the dose-response relationship of both lethal and non-lethal concentrations of the chemicals are considered. Very often, biochemical parameters in acute toxicity test help in elucidating the mechanisms of toxic actions.

Acute toxicity test, also known as "short time toxicity test," is designed to evaluate the relative toxicity of the test chemical usually at lethal concentrations to select the test organisms. The test is carried out over a short period, usually 96 hours, during which the selected test organisms are exposed to a series of test chemical concentration. Fishes, a major part of aquatic biota and occupying a position at the top of the aquatic ecosystem, are considered to be an important indicator species.

3.1 Methods of accessing 'Acute toxicity'

i. ***Static Bioassay method*:** Bioassays are generally made in few chambers without any change of test medium.

ii. ***Static Renewal Bioassay*:** This is similar to static bioassay method, except test organisms are periodically exposed to test solution of the same composition.

iii. ***Recirculation method*:** Test solution is continuously circulated.

iv. ***Flow through Bioassays*:** Test solutions flow in and out of the test chamber.

3.2 LC_{50} and EC_{50}

The concentration of a harmful chemical, generally in aqueous solution, which causes death of 50% of specified population of organisms in a defined set off experimental conditions within a specified period of time, is called 'median lethal concentration (LC_{50})'. The concentration of a chemical in a medium that is effective to 50% of test organisms producing some sublethal response is the median effective concentration (EC_{50}). By acquiring the knowledge of LC_{50} value of a pollutant, the discharge of the chemical into nearby water bodies can be regulated to protect the hydrobionts. Moreover, to select the sublethal doses for toxicity tests, determination of LC_{50} value is absolutely necessary.

Mortality of the test animal (fish) is the criteria for acute toxicity. The results of acute toxicity tests are usually expressed as LC_{50} or median tolerance limit. The period of exposure may be 24, 48, 72 or 96 hours. The average size and weight of test animals selected during the experiment of LC_{50} value determination are maintained for rest of the experiments of sublethal toxicity studies. Several statistical methods have been used to estimate the LC_{50} values based on probit and logit method. These methods have, however, some limitations.

The most widely used method is the calculation of LC_{50} value for 96 hours using regression analysis as well as by interpolation of straight line (Doudoroff *et al*., 1951).

4.0 METAL TOXICOLOGY AND HEAVY METALS WITH SPECIAL REFERANCE TO HUMAN

There are 35 metals that concern human because of occupational or residential exposure; off them the most concerning metals are Cu, Zn, Sn (methylated form), Cd and Hg (both methylated and non-methylated), Ni, Cr, Pb, As and Al. Among them, 23 are heavy elements or "heavy metals" like antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, manganese, mercury, nickel, platinum, silver, tellurium, thallium, tin, uranium, vanadium, and zinc. Heavy metals are those that are five times or more dense than water, i.e. with a specific gravity of at least 5 times the specific gravity of water.

The heavy metals are categorized into two groups on the basis of their role in biological systems. The first group is 'beneficial heavy metals', which are nutritionally essential for life activities of biological systems. Some of these are referred to as the trace elements, e.g., Cu, Fe, Zn, Mn, Co etc. They have significant biological role in metalloenzymes and may be required as trace elements by the cell. Their toxicity occurs either at metabolic deficiencies or at high concentrations. The second group includes 'toxic heavy metals', e.g., As, Pb, Hg, Cd, Sn etc., which do not play any essential role. Some metals are required by our body in small amounts, but can be toxic in larger quantities.

The toxicity of any metal, as of any substance, solid, fluid or gaseous, depends upon a great many factors like, the nature of its compounds, its way of entry into or contact with body or skin surface, its mode of action, its concentration in the atmosphere, presence of other modifying chemicals and the susceptibility of the individual exposed to its effect. In other words, potential toxicity of metals and their compounds depends on its bioavailability, i.e. the degree to which substances becomes available at the physiological site of activity after administration. Bioavailability depends on biological parameters and on the physiochemical properties of metals, their ions and their compounds.

Metals may enter the body through various sources and once in the body, they compete with and displace essential minerals such as calcium, magnesium, zinc, copper, etc., and interfere with organ system function. The most important pathways of human exposure to heavy metals are food, beverages and drinking water, heavy metals in suspended matter, dust fall out, soil and house dust, tobacco smoking, amalgam fillings, etc.

5.0 SOURCES OF HEAVY METALS IN ENVIRONMENT

Heavy metals are introduced into the environment from a variety of natural and anthropogenic sources. Heavy metal pollution resulting from natural sources include atmospheric deposition, geologic weathering, volcanic eruptions, forest fires, biogenic sources etc. Some anthropogenic sources which significantly contribute to the heavy metal contamination in the environment include coal combustion, automobile exhaust, and discharge of agricultural, municipal and industrial waste products. Industrialization and urbanization are the main causes of increased levels of heavy metal water contamination, which are transported by runoff from industries, municipalities and urban areas, and finally accumulated in the soil and sediments of water bodies. Heavy metals can be present in the form of hydroxides, oxides, sulphates, phosphates, sulphides, silicates and organic compounds.

6.0 HEAVY METAL TOXICITY IN AQUATIC ENVIRONMENT

There are many individual metals causing varying degrees of toxicity, based on acute and chronic exposures. Exposure to toxic heavy metals is generally classified as acute, 14 days or less; intermediate, 15-354 days; and chronic, more than 365 days (ATSDR). Acute toxicity is usually from a sudden or unexpected exposure to a high level of the heavy metal. Chronic toxicity results from repeated or continuous exposure, leading to an accumulation of the toxic substance in the body. The effect of heavy metals on aquatic life may be acute resulting in mass mortality of fishes or chronic involving changes in behaviour, reduction in survival, growth and reproduction.

In aquatic system, the fish are the largest group of living vertebrates. Major routes by which toxicants gain access to the body are through gastrointestinal tract (ingestion), gills (respiration) and integument (topical) in fish. Aquatic organisms either quickly metabolize and eliminate these xenobiotics from their body or live with pathological lesions and neoplasm induced by the toxicants. Fish are very sensitive test organisms widely used in acute and chronic toxicity tests. Investigations on toxicity make possible to evaluate effects of sublethal concentrations on growth, behaviour, physiology and biology of organisms. In this connection, fishes are known for their ability to concentrate heavy metal in their muscles and various organs. That is the main reason why metal toxicology is gaining the importance worldwide.

6.1 Uptake pattern of metals

In aquatic environment, uptake of metals occurs mostly through gills, i.e. simple diffusion, influenced by pH, temperature, water hardness and mucus. The principle that lies

behind it is that negative charge on gills attracts positively charged metals. Higher the pH, lower the uptake because increased pH ionize the molecules, which have little ability to cross epithelial membranes. The water chemistry of the system controls the rate of adsorption and desorption of metals to and from sediment. Adsorption removes the metal from the water column and stores the metal in the substrate. Desorption returns the metal to the water column, where recirculation and bioassimilation may take place. Metals may be desorbed from the sediment if the water experiences increase in salinity, decrease in redox potential, or decrease in pH.

- ***Salinity increase:*** Elevated salt concentrations create increased competition between cations and metals for binding sites. Often, metals will be driven off into the overlying water. (Estuaries are prone to this phenomenon because of fluctuating river flow inputs.)
- ***Redox Potential decrease:*** A decreased redox potential, as is often seen under oxygen deficient conditions, will change the composition of metal complexes and release the metal ions into the overlying water.
- ***pH decrease:*** A lower pH increases the competition between metal and hydrogen ions for binding sites. A decrease in pH may also dissolve metal-carbonate complexes, releasing free metal ions into the water column.

7.0 MODE OF ACTION OF TOXIC METALS

Metal toxicity or poisoning arises when they are not metabolized by the body and there is toxic accumulation in the soft tissues. Fishes are known to accumulate heavy metals in their tissues like liver, which influences the vital functions and reproduction of fish. Uptake of heavy metals by fish mainly takes place by ingestion of contaminated food and water or through the gills and skin, from where they are carried to other tissues and liver, either for its transformation or storage. Metals exert toxicity effect by the following ways-

i. By affecting permeability of plasma membrane

Metals like Cu and Hg interact with plasma membrane and exert conformational changes in the membrane. This results in activation of membrane bound enzyme or an ion channel leading to cell damage.

ii. By stabilizing tissue component

Some metals have capability to bind with tissue components and stabilizing them exerting toxicity. Metals like Cu and Hg bind with collagen protein, while Cu, Zn, Co, Ni forms covalent linking with protein.

iii. By forming complexes or ligands and inactivating enzymes

In general, heavy metals produce their toxicity by forming complexes or "ligands" with organic compounds. These modified biological molecules lose their ability to function properly and result in malfunction or death of the affected cells. The most common groups involved in ligand formation are oxygen, sulphur and nitrogen. When metals bind to these groups they may inactive important enzyme systems or affect protein structure. Metal ions bind with functional groups or ligands and form coordinate covalent complexes with nitrogen or other groups, such as -OH, $-NH_2$, -SH, -COOH. For example, Lead binds with $-NH_2$ inside haemoglobin causing lysis of porphyin, Arsenic binds with -SH group of haemoglobin and causes hemolysis. Also, heavy metal ions like Hg^{2+}, Cd^{2+}, Pb^{2+} act as effective enzyme inhibitors.

Generally, toxic metals attack the active sites of enzymes, inhibiting essential enzyme action. About one third of all enzymes are metalloenzymes, which are enzyme proteins containing metal ions (metal cofactors) bound directly to the protein or to enzyme-bound nonprotein part (prosthetic groups). Their action is inhibited when one metal ion of a metalloenzyme is replaced by heavy metal ion of similar size and charge. For example, Zn^{2+} in some metalloenzymes is substituted by Cd^{2+} leading to Cadmium toxicity.

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CHAPTER 11

EFFECTS OF POLLUTION ON AQUATIC BIODIVERSITY

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ABSTRACT

Water is indispensable for living beings. Industrialization, urbanization and other human activities have severely affected the quality of water. Polluted water cannot be used for drinking, agriculture and other purposes. Moreover, water pollution is responsible for disbalancing the aquatic ecosystem. In this chapter authors have discussed the impact of water pollution on aquatic biodiversity. Authors have also mentioned the effect of consumption of polluted water on human health.

Keywords: Aquatic ecosystem, biodiversity, water pollution, river, lake, ocean

1.0 INTRODUCTION: AQUATIC BIODIVERSITY

Water, covering 71% of the earth, is essential for all the life forms in this planet. The 96.54% of total water present in earth is marine water and it cannot be used for drinking as well as agricultural purposes. The 1.74% water is frozen in the ice caps and glaciers. Water in this form cannot be applicable for human consumption. The rest 1.69% water is ground water. Only about 0.0072% share of freshwater, in the lakes and rivers, is available to the mankind (Major, 2000) which is being polluted day by day and the biodiversity of water is

getting damaged due to varied human activities. The pollution results in the loss of aquatic life form and pose a significant threat on aquatic biodiversity (J.I., 1997). Pollution is an unwanted alteration in the physical and/or chemical and/or biological characteristics of our environment (including air, land and water). Such unwanted changes in environment harmfully affect human life, industrial progress, living conditions and cultural assets (Odum, 2005). The properties of water make the life possible in earth, and the study of all aspects (including physical, chemical, geological and biological) of fresh water is termed as Limnology (Wetzel, 2001). The freshwater reservoir is of great importance for humans and this freshwater habitat is classified in two types: Lentic Environment and Lotic Environment. This classification is based on the flow of water (Table 1).

Table 1: Classification of freshwater habitat

Freshwater Environment				
Lentic Environment (Flowless)			**Lotic Environment** (Flowing)	
Natural	**Artificial**	**Either**	**Natural**	**Artificial**
Lake Fresh Water Salt Water	Reservoirs Dam Tanks Pools Sewage pond	Ponds Ditches	Rivers Streams Creeks Brooks Water falls Springs	Canals Sewage water Canal

1.1 LENTIC ENVIRONMENT

This is the environment in which the water does not flow, the term lentic originated from Latin word lentus meaning slow or motionless (Marsh and Fairbridge, 1999). The examples of lentic water reservoirs are lakes and ponds. This ecosystem or environment is divided into three zones,

a) **Littoral Zone:** It is a shallow water area. The sunlight can reach up to the bottom of this zone. For this obvious reason the littoral zone is naturally populated by rooted plants.
b) **Limnetic Zone:** This is the open zone that stretches to the effective light penetration. Here the photosynthesis and respiration are balanced and planktons, nektons are found.

c) **Profundal Zone:** The bottom zone where effective penetration of light is absent. This zone is populated by the benthos organisms. The zone is generally absent in ponds.

1.2 LOTIC ENVIRONMENT

In this type of environment the water is in flowing stage. The word lotic was originated from Latin word lotus that means washing. It refers to running water (fluvial) (Marsh and Fairbridge, 1999). The examples of lotic water reservoirs are rivers, streams, brooks, and creeks. This lotic ecosystem is divided into following zones:

a) **Rapids Zone:** This is the zone where the water currents are very strong and high in velocity with clear bottom and other loose materials. Here fishes and periphytic organisms are found.

b) **Pool Zone:** The water is deeper and velocity of current is slow or reduced that may permit the loose materials to settle in the bottom. This zone is suitable for some planktons and nektons.

2.0 THE COMPONENTS OF AQUATIC BIODIVERSITY

Based on the food habit of the aquatic organisms they have been classified into following types.

a) **Autotrophs (Producers):** The autotrophs are the organisms that are capable of producing their own food or energy source from inorganic sources, major divisions of plants, cyanobacteria, green-sulphur bacteria, purple sulphur bacteria etc. falls under this group. However, in aquatic ecosystem, algae are the most important producers. Macrophytes ranks second after the algae community.

b) **Phagotrophs (Consumers):** Usually, phagotrophs are not capable of synthesizing their food, they obtain their food or energy from autotrophs and other phagotrophs. In aquatic system small fishes obtain their food from algae and other autotrophs. Molluscs, aquatic insects, crustaceans and fishes make the major biomass in aquatic system.

c) **Saprophytes (Decomposers):** The saprophytes consume and live on certain dead organic matters. In aquatic system, bacteria and aquatic fungi show equal importance in reducing complex organic matter to simple inorganic form.

Another classification of biodiversity of aquatic ecosystem is based on the mode of life of the organisms.

a) **Benthos:** Organisms that live or reside on the bottom or attached to bottom sediments.

b) **Periphyton:** Plants and animals that are attached to the stems and leaves of other plants.

c) **Plankton:** Floating organisms that are slightly or heavily dependent on the movements of water currents.

d) **Nekton:** Freely swimming organisms like fish and other higher animals like amphibians.

e) **Neuston:** Organisms resting on or swimming on water surface.

3.0 WATER POLLUTION AND ITS EFFECT ON AQUATIC BIODIVERSITY

The word "pollution" is very common and we all are aware of it. Nowadays the global problem faced is aquatic pollution. This pollution is related to the water bodies like rivers, lakes, oceans, groundwater, etc. Most of the aquatic pollution happens because of the industrial waste, sewage and waste water, mining activities, accidental oil leakage, and urban development. This aquatic pollution happens because of the human activities through which the chemical compounds, whether it is organic or inorganic, and also the pathogens are introduced to the natural water bodies and affecting the marine life as well as the human life. In humans there are many water-borne diseases like cholera, typhoid, paratyphoid fever, jaundice and malaria. All these diseases are the result of polluted water bodies. Major pollutions are observed in river, ocean, lakes and ground water.

3.1 RIVER POLLUTION

In every industry (textile, oil and gas, pulp and paper mills, and many more) and in the farming process water plays essential role. The main lands for the farming and to development of the any industry are connected to the nearer area where the river is situated because of the water source. In the farming process farmer uses the fertilizers and the pesticides to grow the plants. These pesticides and the fertilizers are not going to absorb fully by the plants and therefore because of the rain water they are washed off from the soil and end up in the river. The concentration of the nitrate and phosphate get increased in the water due to flow of pesticides and fertilizers into the river (Agrawal et al., 2010). Moving water dilutes the pollutants and also decomposes them very quickly compared to the stable water. Algae in the water use these elements to grow and multiply itself rapidly and turning the water into the green. Eutrophication is the name for the massive growth of algae. The bacteria in the water are used to break down and decompose the algae when it dies. These bacteria quickly multiply and use all the oxygen present in the water leading to death of many animals. Chemicals discharging from the industrial waste containing very high concentration

of cyanide, lead, zinc, copper, cadmium and mercury pollutants are released in the water. This leads to death of fish, birds and mammals.

3.2 LAKE POLLUTION

The lake pollution is happening because of the metals, sediments, total dissolve solids, nutrients and other factors. Metals like mercury and lead are the major elements for lake pollution (Zaidi and Pal, 2017). Mercury is very toxic element and it is activated by the atmospheric deposition of pollution coming from the coal-fired plants. Lead is resulted from lead shot in the shotgun shell. It remains persistent and gets bioaccumulated in the body over time. The sediments come from many ways like from construction or the deforestation or the agricultural activities and they are like the powder form particles of clay and slit, this may enter into the lake in the large quantity, becoming a serious pollution problem. From the total dissolved solid (TDS), one can measure the saltiness of the water, generally because of the presence of high concentration of potassium, chloride, sodium, calcium and phosphate ions. These elements are mostly used in the fertilizers which are used in the farming. Nutrient pollution occurs when the nitrogen and phosphors enter into the lake in very large quantity. These nutrients are being uptaken by aquatic algae for their own growth. Water gets polluted due to algal bloom.

3.3 OCEAN POLLUTION

Chemicals and trashes thrown in ocean are the main reasons of ocean pollution. They are mostly coming from the land wash or blown into the ocean. The pollution happening because of the chemicals in the ocean are same as the river and lake pollution. Trashes like plastics and metals did not get dissolved in the water and take a long time to degrade. The plastic is thrown in the ocean in many forms like shopping bags, beverage bottles, food wrappers, cigarette butts, fishing gear, etc. These plastic items took hundreds of years to decompose. The micro-plastics are very tiny plastic particles with length of less than 5 micrometre (Haward, 2018). Due to overuse of plastics for packaging of food and beverages, the micro-plastic particles get inside the human and other organisms during eating and drinking. The plastic is dangerous for the animals and also for the human life. The marine creatures like fish, turtles, sharks and many others eat plastic by seeing the plastic bags as a food for them. If we look into the stomach of the sea turtle, one in three of them are having the plastic bags.

3.4 GROUND WATER POLLUTION

Ground water may get polluted due to any of the reasons mentioned in previous sections. If the soil gets polluted then the ground water also gets polluted. There are so many

reasons for the ground water pollution like on-site sanitization systems, sewage and sewage sludge, fertilizers and pesticides, commercial and industrial leaks, hydraulic fracturing, landfill leach, over pumping, etc (Stefanakis et al., 2015). Liquids from on-site sanitization set ups, such as pit latrines or septic tanks, infiltrated into ground leads to pollution of ground water with nitrates and pathogenic microorganisms. The hydraulic fracturing is a well stimulation technique in which the high-pressure injection of fracking fluid is applied into the wellbore to create cracks in the deep rock formations through which natural gases, petroleum substances and brine can flow easily. Due to this, the leakage of gases and petroleum materials are responsible for increased ground water pollution.

4.0 CONCLUSION

Despite the fact that the quantity of water on earth is very large, we, the humans, are facing water scarcity. We are lacking consumable water because our water reservoirs have been and are being polluted by various activities. All the points mentioned in previous sections are very common reasons for causing pollution in aquatic environment. Water pollution is manifested as accumulation of increased amount of chemicals, plastic and other wastes. The largest source of water pollution is untreated sewage. The plastic is very dangerous for all the lives whether it is animal, insects or human life. We all are surrounded by the plastics nowadays. Plastics are very hazardous for marine life and also for humans. Living creatures get severely affected by plastic bags and humans beings are affected by micro-plastics. Studies have shown that up to 70,000 pieces of micro-plastics are eaten by the average person each year. Consumption of plastics and micro plastics, knowingly or unknowingly are responsible for serious health conditions such as cancer. In order to maintain the balance of aquatic ecosystem and sustaining its biodiversity we must take some specific measures for prevention of water pollution. We must also take some major steps for purification and cleanup of already polluted water. Apart from physical and chemical processes, we must rely on biological and biotechnological processes for cleanup of contaminated water. By implementing such strategies water can be used in a sustainable manner. Clean and pollution free water is also important for maintaining the balance of aquatic ecosystem.

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CHAPTER 12

BIODIESEL (ALTERNATIVE FUEL) PRODUCTION FROM WASTE COOKING OIL USING DIFFERENT TECHNIQUES

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ABSTRACT

Due to its environmentally sound qualities and sustainable nature, biodiesel production deserves continuous review and optimization of production procedures. Waste cooking oil (WCO) has been chosen as a raw material for biodiesel production because it's cheap and pollution-free. This research paper presents the specifics of the biodiesel process using low frequency ultrasonic energy (20 kHz), stirring system (combined heat and stiring) and the method of stirring. Soybean Waste Oil (SWCO) as a biological diesel feedstock is used for this purpose. The molar ratio (alcohol / oil) tests were conducted 6:1, with 3 separate percentages of sodium (NaOH) (0.5, 0.75 and 1 wt. percent) of the catalyst. Results shows that the ultrasonic method is more effective that other conventional techniques.

Keywords: Transesterification, biodiesel, Soybean Waste Cooking Oil, ultrasonication

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1.0 INTRODUCTION

Biodiesel production, because it is important for researchers because of the increase in petrol prices and environmental benefits it is gaining on a daily basis (Parag et al., 2005). Biodiesel is a combination of mono-alkyl esters of long-chain fatty acids which constitute alternative fuel made from renewable sources such as vegetable oils and animal fats (Kumar et al., 2010). The emission profiles are non-toxic and therefore environmentally advantageous. Biodiesel is traditional diesel compatible and can be combined to produce a robust biodiesel blend to some degree with fossil diesel (Kumar et al., 2011). Biodiesel has thus grown into one of the world's most popular biofuels. Fuel for bio-diesel pollution is lower than for petrodiesel, both regulated and unregulated. Its lubricity also extends the life of motors and is a biodegradable commodity. Depending on ownership of production plants and the mixture and marketability of useful co-products, biodiesel could be of benefit to farmers and rural communities. And biodiesel could cut back on foreign oil reliance and related price and availability volatility (Lang et al., 2001; Topare et al., 2015).

In comparison to other developed nations, the United States consumes highly per capita transport petrol (Marchetti et al., 2008). In 2001, for instance, 522 gallons of petroleum fuels were spent, compared to 421 gallons per head in Canada, 211 gallons in Germany, and 196 gallons in Japan, on each man, woman and child in this region. Many of the emissions of biodiesel benefit from the high efficiency of the ignition. Biodiesel can be made from almost any form of vegetable oil—new or used. In the 2003 energy department, the biodiesel was sold to approximately 26.7 million gallons. In the US, over 39.9 billion gallons of diesel were consumed in total this year (Renge et al., 2012; Ma and Hanna, 1999).

Rising demand for energy and global warming are main factors that drive renewed interest in renewable. The world energy market remains dominated by fossil fuel consumption. But future volatility, possible unsustainable energy use trends and the expense of increasing proven fossil reserves lead many energy analysts and managers around the world on alternative sources, such as biodiesel, to renewable energy (Mahamuni and Adewuyi, 2009). The increasingly growing trend in petrol prices over the reason for cheaper supply choices. Biodiesel has continued to attract increased support from those who work to promote sustainable agriculture and the atmosphere by reducing

carbon emissions, an important part of mitigation of climate change. Some also regard biodiesel as a possible contributor to economic growth in rural areas and a way to reduce poverty through job creation and income. Biodiesel is now increasingly regarded as a promising and largely unspent renewable source of energies and its potential environmental and economic benefits are increasingly evident with the advent of technological advances (Stavarache et al., 2006).

1.1 Biodiesel Fuel Feedstock's

One of the simplest alternative fuels to use is biodiesel gasoline. For the manufacture of fuel, different oils are used as biodiesel fuel feedstocks.

1.1.1 Virgin oil feedstock

The most common raw material used for biodiesel fuel is cured seed and soybean oil. In the US, soybean oil alone makes up about 90% of all biodiesel fuel supplies. The pennycress and jatropha can also be obtained. A variety of other plants are a good source of Soybean oil, such as mustards, flax, sunflower, palm oil, coconut, hemp (Stavarache et al., 2007).

1.1.2 Waste vegetable oil

Water from a restaurant is becoming a common source of biodiesel waste as a feedstock. Many supporters believe that waste vegetable oil is the best raw material for the manufacture of biodiesel fuel.

1.1.3 Animal fats

The production of omega-3 fatty acids made from fish oil is increasingly used as biodiesel fuel feedstock for tallow, lard, yellow grass, chicken fat and by-products.

1.1.4 Algae

Algae can be cultivated using waste materials like wastewater and without using the land used to manufacture foodstuffs. They are also considered a good source of feedstocks for biodiesel.

1.1.5 Waste cooking oil

WCO refers to vegetable oil used in food processing and that is no longer viable for its intended use this term refers to the use of waste cooking oil. WCO comes from various sources, including domestic, commercial and industrial sources. WCO is an issue-specific waste source that needs to be handled properly. When the oil is improperly disposed of the disposal of WCO can be troublesome down kitchen sinks, where the

waste pipes can be blocked easily if the oil solidifies. Any source of fatty acid can be used for biodiesel preparation. Thus a ready substratum for biodiesel manufacture should be any animal or plant lipid. Recently it has become highly serious to use edible vegetable oils and animal fats in biodiesel production because they compete with foodstuffs the food versus fuel conflict. There are concerns that biodiesel feedstock will compete in the long-term with food supplies (Mahamuni and Adewuyi, 2010).

2.0 MATERIALS AND METHODS

2.1 Ultrasonic method

2.1.1 Materials Requirements for ultrasonic method:

- Raw material : Soybean Waste Cooking Oil (SWCO)
- Chemicals : Methanol (CH_3OH) , Catalyst (NaOH)
- Equipments: Slash machine , Ultrasonic processor (probe type 20kHz) , Beaker , Funnels

2.1.2 Experimental method

The basic configuration consists of a 500 ml sample beaker that immerses the ultrasound examination. The 20 kHz probe is connected to the transducer, which is operated by the generator of the ultrasound. To calculate the internal temperature shown on the generator, a thermocouple is inserted into the beaker. Temperature can be set on the generator in all parameters such as reaction time. The entire configuration remains in a wood box serving as a sound shield. Non-oil WCO (soybean) components were removed by filter separation, and by heating the oil at approx. 120°C moisture was removed for 30 to 45 minutes. The best way to get the oil up to a required temperature is to heat the electric heater.

In the ultrasonic reactor form of the horn, the transesterification reactions were performed. The horn is attached to the transducer in the horn form reactor and induces ultrasonic irradiation. The frequency of the ultrasonic processor is between 20 kHz and 30 minutes. An integrated device is available to assist the beaker (500 ml) such that the transducer horn is immersed in two immiscible liquids at the separating boundary. The transducer horn was roughly submerged. Methanol and fatty acid oils 2 cm in reactive mixture. A water bath regulated the temperature of the reaction blend. Initially, the reactor was packed with heated fatty acid oil. The reaction began when a blend of desired

NaOH in methanol liquor was dissolved and NaOH was poured into the heated reactor. The mixture temperature is about 40-55°C during the reaction.

Figure 1: Actual Experimental Setup for Biodiesel Production for ultrasonic

The reaction takes place through the acoustic horn of the rod inserted into the transducer ultrasonic irradiation. Irradiation of the ultrasonic energy into immiscible fluid (oil and alcohol are not miscible to one another) produces cavities, resulting in the creation of microfinous bubbles, which are collapsed in different locations of the reactor and disrupt the phase line between two immiscible fluids, which leads to mixture emulsification. The beaker is held for separation when the reaction is complete. Fatty acid has a higher weight, so it'll calm down.

It takes 2-3 hours to isolate methyl ester from glycerol. Biodiesel (methyl ester) is used in the upper and lower layers in the same manner as glycerol after complete separation. For the purification process, bio-diesel is removed from beaker. Water is combined with the methyl ester and left for installation to extract the catalyst at about 600°C. Water accumulated at the bottom due to its higher gravity. By distillation phase, excess of methanol contained in biodiesel has been extracted.

2.2 Stirring Method (Combined Heating and Stirring)

2.2.1 Material Requirements for Stirring Method:

- Raw material : Soybean waste cooking oil (SWCO)
- Chemicals : Alcohol (Methanol) (CH_3OH) , Catalyst (NaOH)
- Equipments: Mechanical stirrer, Beaker, Funnels, Thermometer.

2.2.2 Experimental method

Non-oil components of the WCO were separated through the filter separation and moisture was taken away by heating the oil for 30 to 45 minutes at approximately 120°C. The

best way to get the oil up to the appropriate temperature normally is by using electric heater. Methanol and the catalyst (NaOH) are intended to react to form methoxide in both substances. The methanol consumed is 20% of the oil volume. The reactor process and water bath method are used. The transesterification reaction has been performed in the system as shown in figure 2. The reactor was a flask, which had been mounted within the heat jacket. Heat jacket to the reactor was used as a means of heat transfer. Thermostat was part of a heat jacket that held the reactants' temperature at the optimal value. Approximately 65-70°C is responded.

Figure 2: Experimental set up for Biodiesel Production in stirring method

2.3 Simple Stirring Method (Without Heating)

2.3.1 Material Requirements for Simple Stirring Method

- **Raw material :** Soybean waste cooking oil (SWCO)
- **Chemicals :** Alcohol (Methanol) (CH_3OH) , Catalyst (NaOH)
- **Equipments :** Stirrer , Beaker , Funnels

2.3.2 Experimental method

Taken in a beaker 50 ml of methanol. A beaker containing methanol has been taken in NaOH of various concentrations, i.e. 1.25 gm and 1.875 gm and 2.5 gm. By shaking it, Beaker was covered and mixed well. When it gets warm and sticky, oil has been mixed. Sodium meth oxide had been the mixture. For thirty minutes, 250 ml of SWCO was blended

in a mixer with sodium meth oxide. Afterwards the combination was dumped into the funnel and wait 10 – 12 hours for the substance to isolate glycerin from biodiesel. The bottom of the glycerin. Divide the biodiesel into a glass container. The biodiesel was washed in half a liter of warm water and mixed with methyl ester. Repeat the process of washing until the biodiesel is clear. This can be done several times before the procedure is finalized.

Figure 3: Experimental Work for Simple Stirring Process

3.0 RESULTS AND DISCUSSIONS

Raw Soybean Waste Cooking Oil (SWCO), have been used for biodiesel production. These non-edible oils are gathered from the hotesl, canteen local area. The experiments were performed with catalyst (NaOH) and methanol (99.5 percent). Table-1 displays the characteristics of SWCO. Table-2 indicates the volume of oil, Alcohol and Catalyst taken during the ultrasonic, mixing and basic mixing experiments.

Table 1: Properties of Soybean Waste Cooking Oil (SWCO)

Sr. No	Property	Unit	Value
1	Viscosity	(mm_2/s)	47
2	Acid value	(mg KOH/gm)	6.171
3	Saponification value	(mg/g)	198.5
4	Iodine value	(mg iodine/g)	227
5	Free fatty acid	-	2.555

Table 2: Molar ratio (Oil/alcohol) and catalyst concentration during the experimentation for Ultrasonic, stirring method and simple stirring method

Ultrasonic, stirring method And Simple Stirring Method		
Sr. no.	**Optimizing parameters**	**Level selected**
1.	Molar ratio (oil /alcohol)	1:6
2.	Quantity of SWCO (gm)	250
3.	Quantity of Methanol (gm)	50
4.	Catalyst (NaOH) 0.5%	1.25 gm
5.	Catalyst (NaOH) 0.75%	1.875 gm
6.	Catalyst (NaOH) 1.0%	2.5 gm

3.1. Yield produced for the SWCO

Ultrasonic cavitation processes, stirring (combined heating and stirring) and basic stirring (without heat) experiments have been performed in the preparation of SWCO biodiesel. The main objective is to experiment with a 3% catalyst yield at constant molar (alcohol/oil) and a stable reaction time for development of biodiesel with full yield in relation to other methods. At molar ratios of 6:1 (alcohol/oil) the experiment is conducted over reaction time of 30 minutes and the effect of the catalyst on the fame production is shown in figure-4, 5, 6 for ultrasonication, Stirring Method, simple Stirring Method respectively. The graph shows that 0.5% of the catalyst achieves optimum yield.

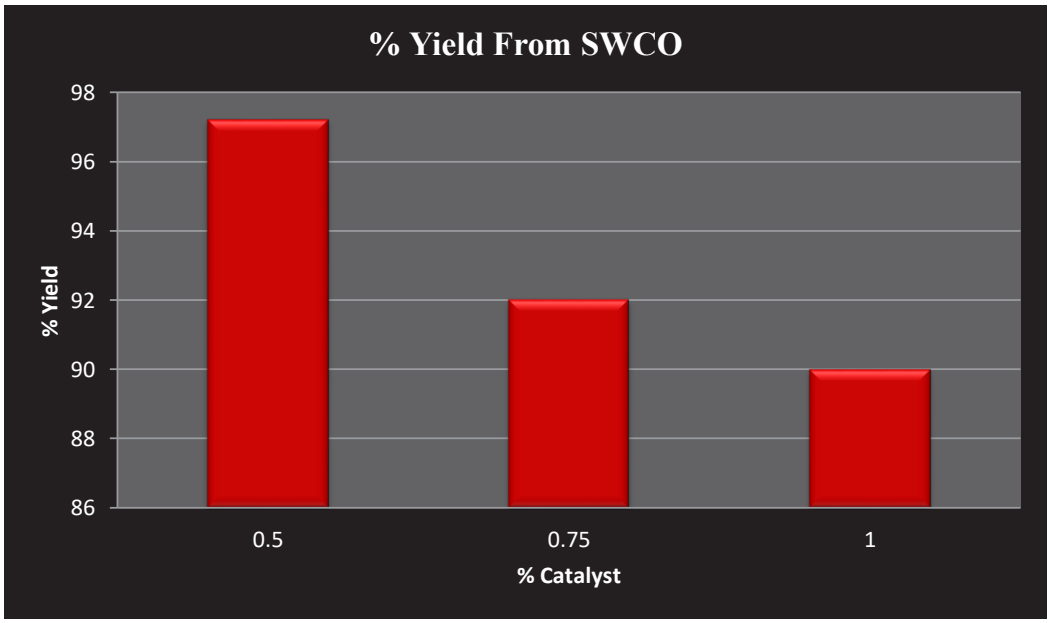

Figure 4: Percentage Yield from SWCO via Ultrasonic Method

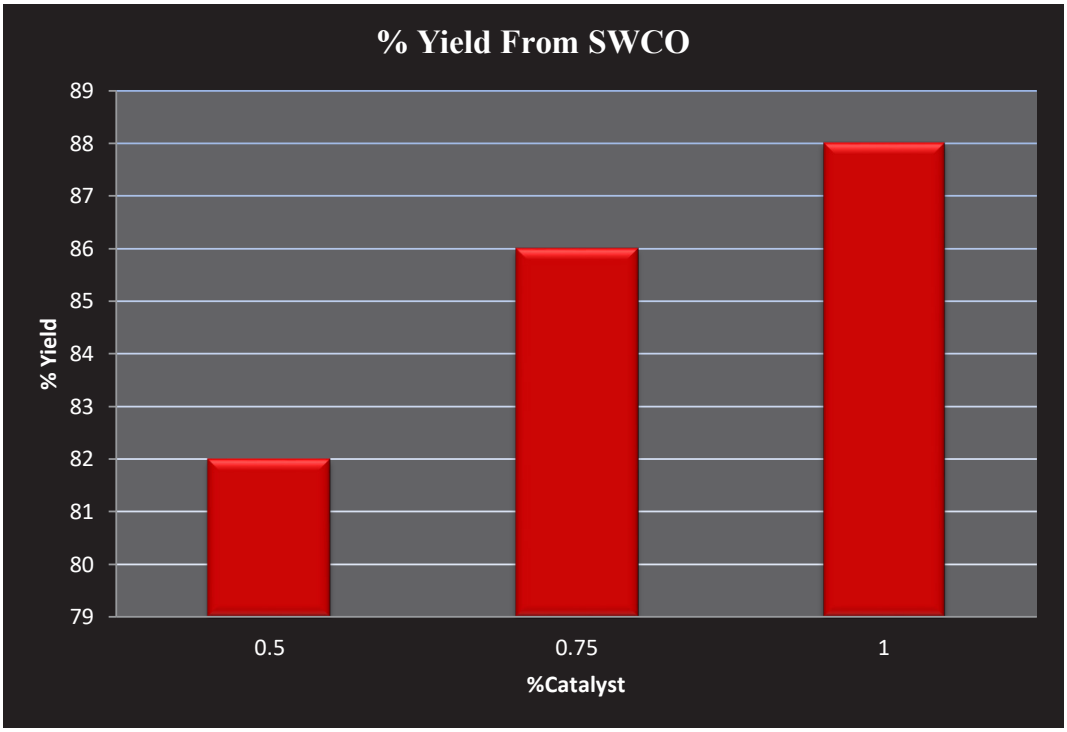

Figure 5: Percntage Yield from SWCO via Stirring Method

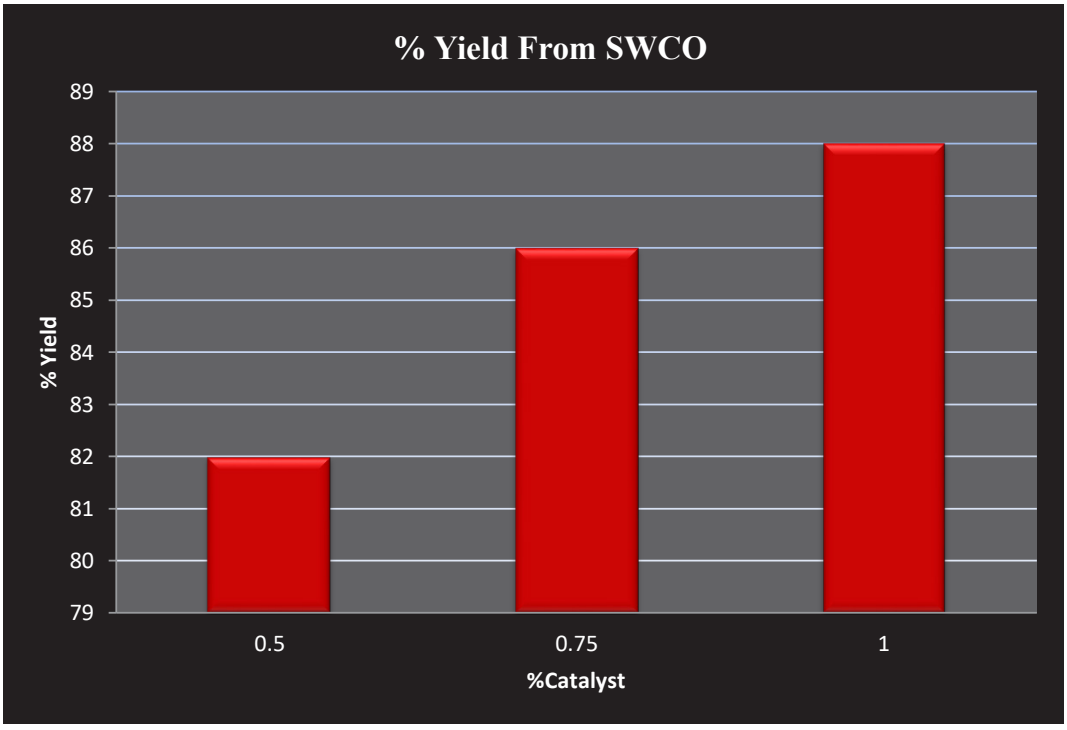

Figure 6: Percentage Yield from SWCO via Simple Stirring Method

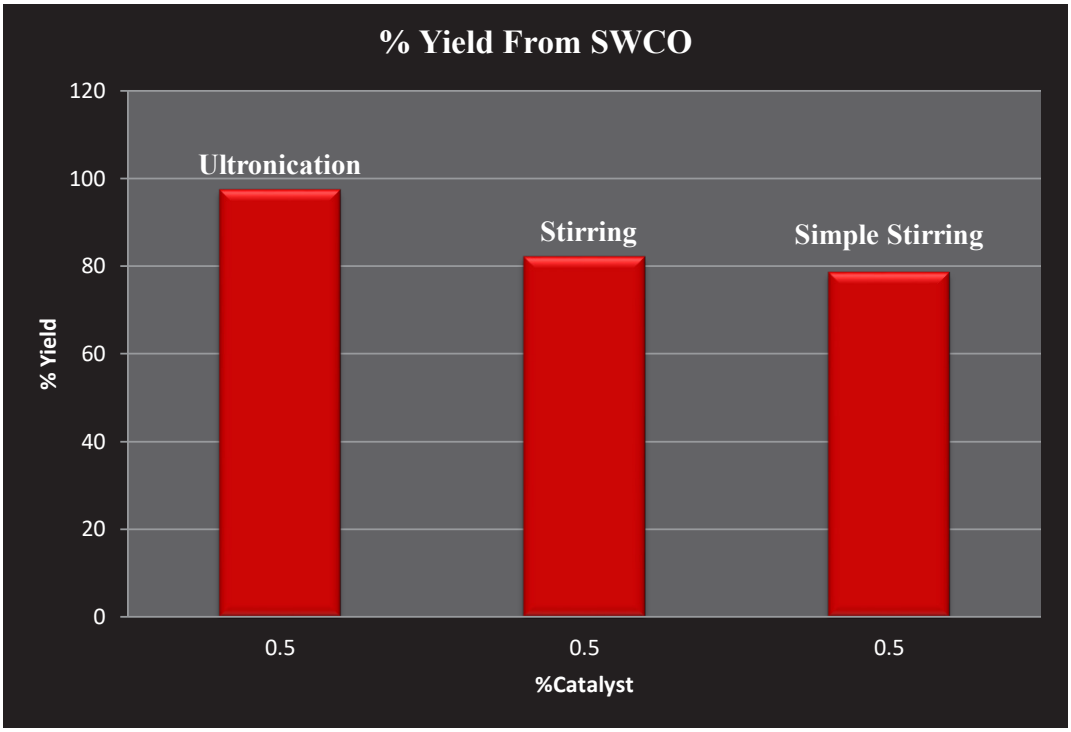

Figure 7: Percentage Yield from SWC O at 0.5 % Catalyst for Three Different Methods

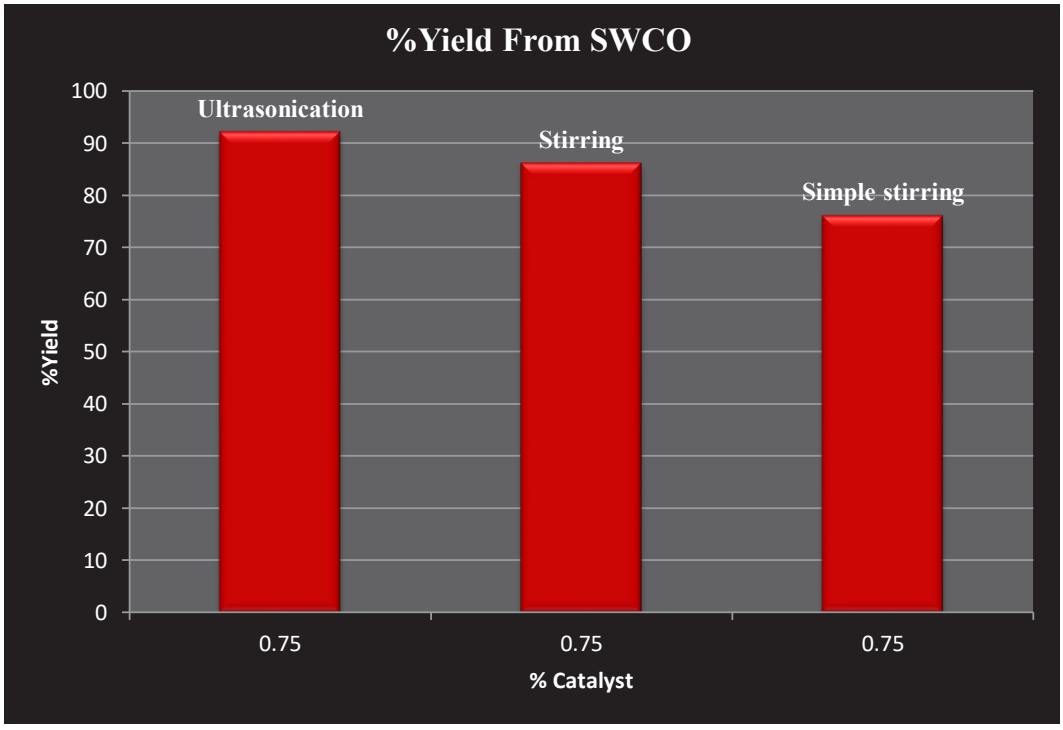

Figure 8: Percentage Yield from SWCO at 0.75 % Catalyst for Three Different Methods

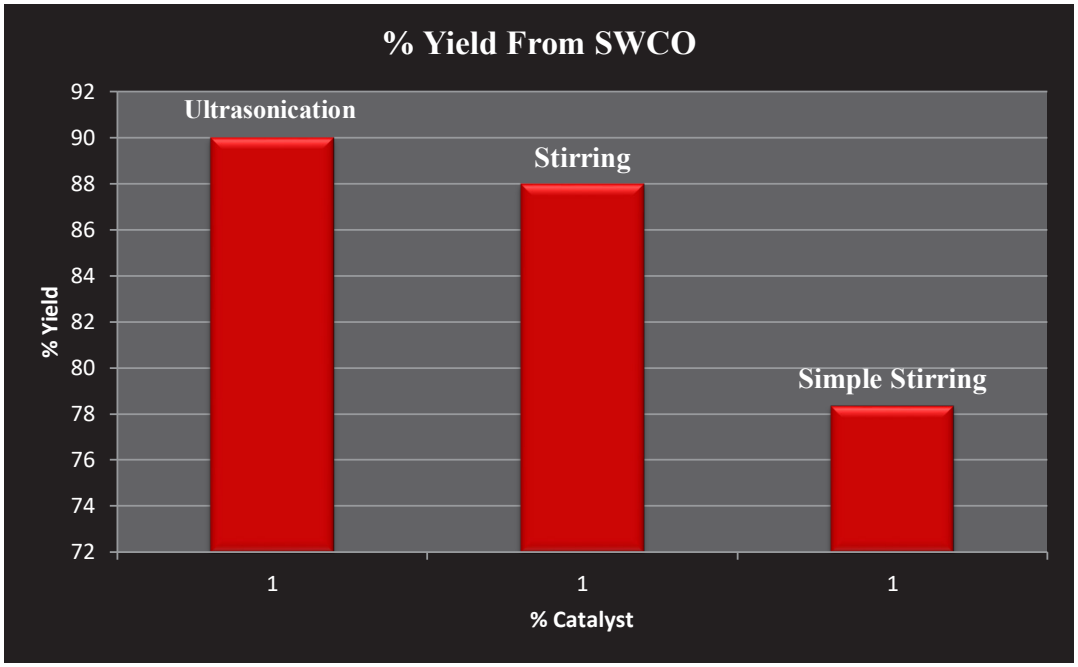

Figure 9: Percentage Yield from SWCO at 1.0 % catalyst for Three Different Methods

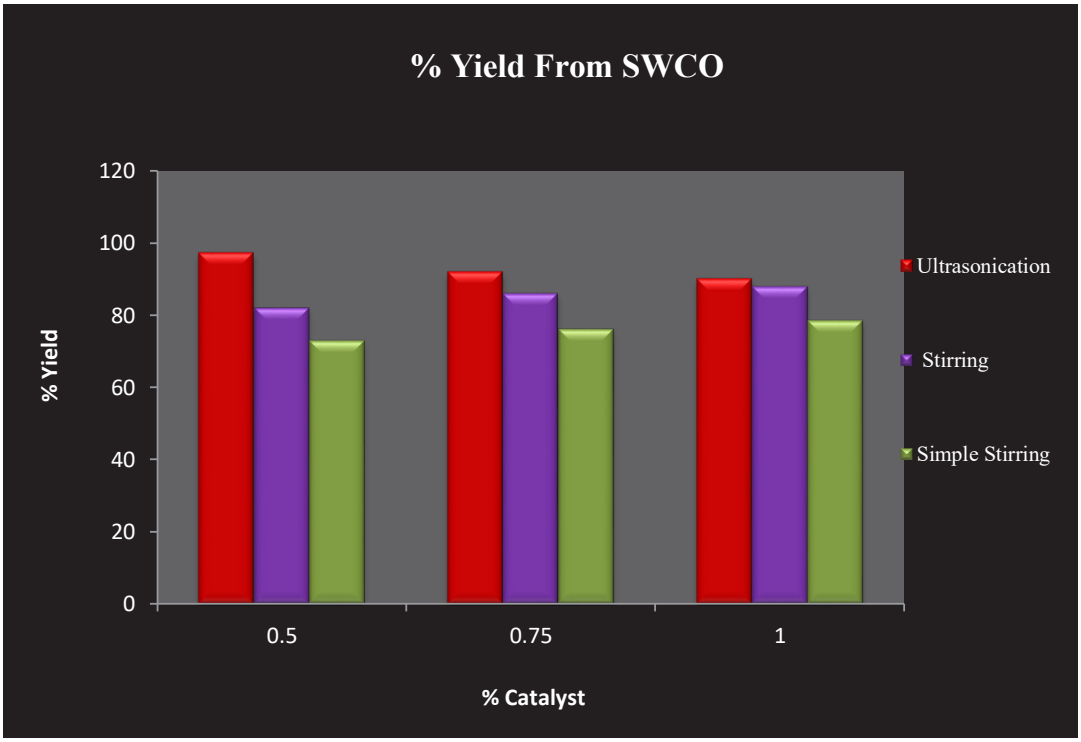

Figure 10: Comparative Study of Effect of Catalyst Concentration on FAME Yield for Three Different Methods

4.0 CONCLUSION

The research centered on sustainable alternative energy sources because of the increasing need for energy and environmental problems. Biodiesel is one of the main sources of renewable energy used as an alternative diesel fuel in many countries around the world. Due to the economical reasons, it has become necessary in recent years to choose an effective transesterification procedure for biodiesel production. Homogenous catalysts, heterogeneous catalysts (ZnO,SiO, MgO, BaO, SrO etc and enzyme catalytic catalysts (lipases) are conveniently used in ultrasonic processes rather than traditional processes (sulphuric acid, sodium hydroxide, potassium hydroxide etc.) This study presents the comparative descriptions of the production process for biodiesel using low frequency ultrasonic (20 kHz) energy and the traditional mechanical stroke technique. Soybean Waste Cooking Oil (SWCO) is used for this purpose as a feedstock for the biodiesel industry. The experiments were performed for the 6:1 alcoholic/oil ratio of 3 different percent (0.5 percent, 0.75 percent and 1 percent respectively, of sodium hydroxide (NaOH).The comparative study with the two methods indicates that, compared to conventional methods, the yield obtained by the ultrasound method is 97-92 percent.

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CHAPTER 13

NOISE POLLUTION

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ABSTRACT

Noise pollution can cause health problems for people and wildlife, both on land and in the sea. From traffic noise to rock concerts, loud or inescapable sounds can cause hearing loss, stress, and high blood pressure.In this chaptervarious effect of noise pollutionhas been discussed.

Keywords: Noise pollutionha, humans, wild life and communication

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1.0 INTRODUCTION

Noise pollution, also known as environmental noise or sound pollution, is the propagation of noise with ranging impacts on the activity of human or animal life; most of them are harmful to a certain degree. The source of outdoor noise worldwide is mainly caused by machines, transport, and propagation systems. Poor urban planning may give rise to noise disintegration or pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas. Some of the main sources of noise in residential areas include loud music, transportation (traffic, rail, airplanes, etc.), lawn care maintenance, construction, electrical generators, explosions, and people.

Documented problems associated with noise in urban environments go back as far as ancient Rome. Today, the average noise level of 98 decibels (dB) exceeds the WHO value of 50 dB allowed for residential areas. Research suggests that noise pollution is the highest in low-income and racial minority neighborhoods, and noise pollution associated with household electricity generators is an emerging environmental degradation in many developing nations.

High noise levels can contribute to cardiovascular effects in humans and an increased incidence of coronary artery disease. In animals, noise can increase the risk of death by altering predator or prey detection and avoidance, interfere with reproduction and navigation,

and contribute to permanent hearing loss. A substantial amount of the noise that humans produce occurs in the ocean. Up until recently, most research on noise impacts has been focused on marine mammals, and to a lesser degree, fish. In the past few years, scientists have shifted to conducting studies on invertebrates and their responses to anthropogenic sounds in the marine environment. This research is essential, especially considering that invertebrates make up 75% of marine species, and thus compose a large percentage of ocean food webs. Of the studies that have been conducted, a sizable variety in families of invertebrates has been represented in the research. A variation in the complexity of their sensory systems exists, which allows scientists to study a range of characteristics and develop a better understanding of anthropogenic noise impacts on living organisms.

While the elderly may have cardiac problems due to noise, according to the World Health Organization, children are especially vulnerable to noise, and the effects that noise has on children may be permanent. Noise poses a serious threat to a child's physical and psychological health, and may negatively interfere with a child's learning and behavior.

2.0 EFFECT ON HUMANS

Figure 1: Noise Level from a Leaf Blower, using the NIOSH Sound Level Meter App

Noise pollution affects both health and behavior. Unwanted sound (noise) can damage physiological health. Noise pollution is associated with several health conditions, including cardiovascular disorders, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful and disturbing effects. According to a 2019 review of the existing literature, noise pollution was associated with faster cognitive decline.

Across Europe, according to the European Environment Agency, an estimated 113 million people are affected by road traffic noise levels above 55 decibels, the threshold at which noise becomes harmful to human health by the WHO's definition.

Sound becomes unwanted when it either interferes with normal activities such as sleep or conversation, or disrupts or diminishes one's quality of life. Noise-induced hearing loss can be caused by prolonged exposure to noise levels above 85 A-weighted decibels. A comparison of Maaban tribesmen, who were insignificantly exposed to transportation or industrial noise, to a typical U.S. population showed that chronic exposure to moderately high levels of environmental noise contributes to hearing loss.

Figure 2: A Sound Level Meter, Is One of the Main Tools for Measuring Sounds in the Environment and the Workplace

Noise exposure in the workplace can also contribute to noise-induced hearing loss and other health issues. Occupational hearing loss is one of the most common work-related illnesses in the U.S. and worldwide. It is less clear how humans adapt to noise subjectively. Tolerance for noise is frequently independent of decibel levels. Murray Schafer's soundscape research was groundbreaking in this regard. In his work, he makes compelling arguments about how humans relate to noise on a subjective level, and how such subjectivity is conditioned by culture. Schafer also notes that sound is an expression of power, and as such, material culture (e.g., fast cars or Harley Davidson motorcycles with aftermarket pipes) tend to have louder engines not only for safety reasons, but for expressions of power by dominating the soundscape with a particular sound. Other key research in this area can be seen in Fong's comparative analysis of soundscape differences between Bangkok, Thailand and Los Angeles, California, US. Based on Schafer's research, Fong's study showed how soundscapes differ based on the level of urban development in the area. He found that cities

in the periphery have different soundscapes than inner city areas. Fong's findings tie not only soundscape appreciation to subjective views of sound, but also demonstrate how different sounds of the soundscape are indicative of class differences in urban environments.

Noise pollution can have negative affects on adults and children on the autistic spectrum. Those with Autism Spectrum Disorder (ASD) can have hyperacusis, which is an abnormal sensitivity to sound. People with ASD who experience hyperacusis may have unpleasant emotions, such as fear and anxiety, and uncomfortable physical sensations in noisy environments with loud sounds. This can cause individuals with ASD to avoid environments with noise pollution, which in turn can result in isolation and negatively affect their quality of life. Sudden explosive noises typical of high-performance car exhausts and car alarms are types of noise pollution that can affect people with ASD.[24]

3.0 EFFECT ON WILDLIFE

Noise can have a detrimental effect on animals, increasing the risk of death by changing the delicate balance in predator or prey detection and avoidance, and interfering the use of the sounds in communication, especially in relation to reproduction and in navigation. These effects then may alter more interactions within a community through indirect ("domino") effects. Acoustic overexposure can lead to temporary or permanent loss of hearing.

European robins living in urban environments are more likely to sing at night in places with high levels of noise pollution during the day, suggesting that they sing at night because it is quieter, and their message can propagate through the environment more clearly. The same study showed that daytime noise was a stronger predictor of nocturnal singing than night-time light pollution, to which the phenomenon often is attributed. Anthropogenic noise reduced the species richness of birds found in Neoptropical urban parks.

Zebra finches become less faithful to their partners when exposed to traffic noise. This could alter a population's evolutionary trajectory by selecting traits, sapping resources normally devoted to other activities and thus leading to profound genetic and evolutionary consequences.

Underwater noise pollution due to human activities is also prevalent in the sea. Cargo ships generate high levels of noise due to propellers and diesel engines. This noise pollution significantly raises the low-frequency ambient noise levels above those caused by wind. Animals such as whales that depend on sound for communication can be affected by this noise in various ways. Higher ambient noise levels also cause animals to vocalize more

loudly, which is called the Lombard effect. Researchers have found that humpback whales' song lengths were longer when low-frequency sonar was active nearby.

Noise pollution may have caused the death of certain species of whales that beached themselves after being exposed to the loud sound of military sonar. Even marine invertebrates, such as crabs (*Carcinus maenas*), have been shown to be negatively affected by ship noise. Larger crabs were noted to be negatively affected more by the sounds than smaller crabs. Repeated exposure to the sounds did lead to acclimatization.

4.0 WHY INVERTEBRATES ARE AFFECTED

Several reasons have been identified relating to hypersensitivity in invertebrates when exposed to anthropogenic noise. Invertebrates have evolved to pick up sound, and a large portion of their physiology is adapted for the purpose of detecting environmental vibrations. Antennae or hairs on the organism pick up particle motion. Anthropogenic noise created in the marine environment, such as pile driving and shipping, is picked up through particle motion; these activities exemplify near-field stimuli. The ability to detect vibration through mechanosensory structures is most important in invertebrates and fish. Mammals, also, depend on pressure detector ears to perceive the noise around them. Therefore, it is suggested that marine invertebrates are likely perceiving the effects of noise differently than marine mammals. It is reported that invertebrates can detect a large range of sounds, but noise sensitivity varies substantially between each species. Generally, however, invertebrates depend on frequencies under 10 kHz. This is the frequency at which a great deal of ocean noise occurs. Therefore, not only does anthropogenic noise often mask invertebrate communication, but it also negatively impacts other biological system functions through noise-induced stress. Another one of the leading causes of noise effects in invertebrates is because sound is used in multiple behavioral contexts by many groups. This includes regularly sound produced or perceived in the context of aggression or predator avoidance. Invertebrates also utilize sound to attract or locate mates, and often employ sound in the courtship process. For these reasons, one can infer that the opportunity for noise in marine ecosystems may have the potential to impact invertebrates just as much, if not more, than marine mammals and fish.

5.0 STRESS RECORDED IN PHYSIOLOGICAL AND BEHAVIORAL RESPONSES

Many of the studies that were conducted on invertebrate exposure to noise found that a physiological or behavioral response was triggered. Most of the time, this related to stress, and provided concrete evidence that marine invertebrates detect and respond to noise. Some

of the most informative studies in this category focus on hermit crabs. In one study, it was found that the behavior of the hermit crab *Pagurus bernhardus*, when attempting to choose a shell, was modified when subjected to noise. Proper selection of hermit crab shells strongly contributes to their ability to survive. Shells offer protection against predators, high salinity and desiccation. However, researchers determined that approach to shell, investigation of shell, and habitation of shell, occurred over shorter time duration with anthropogenic noise as a factor. This indicated that assessment and decision-making processes of the hermit crab were both altered, even though hermit crabs are not known to evaluate shells using any auditory or mechanoreception mechanisms. In another study that focused on *Pagurus bernhardus* and the blue mussel (*Mytilus edulis)* physical behaviors exhibited a stress response to noise. When the hermit crab and mussel were exposed to different types of noise, significant variation in the valve gape occurred in the blue mussel. The hermit crab responded to the noise by lifting the shell off of the ground multiple times, then vacating the shell to examine it before returning back inside. The results from the hermit crab trials were ambiguous with respect to causation; more studies must be conducted in order to determine whether the behavior of the hermit crab can be attributed to the noise produced.

Another study that demonstrates a stress response in invertebrates was conducted on the squid species *Doryteuthis pealeii*. The squid was exposed to sounds of construction known as pile driving, which impacts the sea bed directly and produces intense substrate-borne and water-borne vibrations. The squid reacted by jetting, inking, pattern change and other startle responses. Since the responses recorded are similar to those identified when faced with a predator, it is implied that the squid initially viewed the sounds as a threat. However, it was also noted that the alarm responses decreased over a period of time, signifying that the squid had likely acclimated to the noise. Regardless, it is apparent that stress occurred in the squid, and although further investigation has not been pursued, researchers suspect that other implications exist that may alter the squid's survival habits.

6.0 IMPACTS ON COMMUNICATION

Terrestrial anthropogenic noise affects the acoustic communications in grasshoppers while producing sound to attract a mate. The fitness and reproductive success of a grasshopper is dependent on its ability to attract a mating partner. Male *Corthippus biguttulus* grasshoppers attract females by using stridulation to produce courtship songs. The females produce acoustic signals that are shorter and primarily low frequency and amplitude, in response to the male's song. Research has found that this species of grasshopper changes its mating call in response to loud traffic noise. Lampe et al., (2012) found that male

grasshoppers from quiet habitats have a local frequency maximum of about 7319 Hz. In contrast, male grasshoppers exposed to loud traffic noise can create signals with a higher local frequency maximum of 7622 Hz. The higher frequencies are produced by the grasshoppers to prevent background noise from drowning out their signals. This information reveals that anthropogenic noise disturbs the acoustic signals produced by insects for communication. Similar processes of behavior perturbation, behavioral plasticity, and population level-shifts in response to noise likely occur in sound-producing marine invertebrates, but more experimental research is needed.

7.0 IMPACTS ON DEVELOPMENT

Boat-noise has been shown to affect the embryonic development and fitness of the sea hare *Stylocheilus striatus*. Anthropogenic noise can alter conditions in the environment that have a negative effect on invertebrate survival. Although embryos can adapt to normal changes in their environment, evidence suggests they are not well adapted to endure the negative effects of noise pollution. Studies have been conducted on the sea hare to determine the effects of boat noise on the early stages of life and development of embryos. Researchers have studied sea hares from the lagoon of Moorea Island, French Polynesia. In the study, recordings of boat noise were made by using a hydrophone. In addition, recordings of ambient noise were made that did not contain boat noise. In contrast to ambient noise playbacks, mollusks exposed to boat noise playbacks had a 21% reduction in embryonic development. Additionally, newly hatched larvae experienced an increased mortality rate of 22% when exposed to boat noise playbacks.

8.0 IMPACTS ON ECOSYSTEM

Anthropogenic noise can have negative effects on invertebrates that aid in controlling environmental processes that are crucial to the ecosystem. There are a variety of natural underwater sounds produced by waves in coastal and shelf habitats, and biotic communication signals that do not negatively impact the ecosystem. The changes in behavior of invertebrates vary depending on the type of anthropogenic noise and are similar to natural noisescapes.

Experiments have examined the behavior and physiology of the clam (*Ruditapes philippinarum*), the decapod (*Nephrops norvegicus*), and the brittlestar (*Amphiura filiformis*) that are affected by sounds resembling shipping and building noises. The three invertebrates in the experiment were exposed to continuous broadband noise and impulsive broadband noise. The anthropogenic noise impeded the bioirrigation and burying behavior of *Nephrops norvegicus*. In addition, the decapod exhibited a reduction in movement. *Ruditapes*

philippinarum experienced stress which caused a reduction in surface relocation. The anthropogenic noise caused the clams to close their valves and relocate to an area above the interface of the sediment-water. This response inhibits the clam from mixing the top layer of the sediment profile and hinders suspension feeding. Sound causes *Amphiura filiformis* to experience changes in physiological processes which results in irregularity of bioturbation behavior.

These invertebrates play an important role in transporting substances for benthic nutrient cycling. As a result, ecosystems are negatively impacted when species cannot perform natural behaviors in their environment. Locations with shipping lanes, dredging, or commercial harbors are known as continuous broadband sound. Pile-driving and construction are sources that exhibit impulsive broadband noise. The different types of broadband noise have different effects on the varying species of invertebrates and how they behave in their environment.

Another study found that the valve closures in the Pacific oyster *Magallana gigas* was a behavioral response to varying degrees of acoustic amplitude levels and noise frequencies. Oysters perceive near field sound vibrations by utilizing statocysts. In addition, they have superficial receptors that detect variations in water pressure. Sound pressure waves from shipping can be produced below 200 Hz. Pile driving generates noise between 20–1000 Hz.

Figure 3: The sound tube in Melbourne, Australia is designed to reduce roadway noise without detracting from the area's aesthetics.

Figure 4: A man inserting an earplug in his ear to reduce the noise exposure

In addition, large explosions can create frequencies ranging from 10–200 Hz. *M. gigas* can detect these noise sources because their sensory system can detect sound in the 10 to < 1000 Hz range. The anthropogenic noise produced by human activity has been shown to negatively impact oysters. Studies have revealed that wide and relaxed valves are indicative of healthy oysters. The oysters are stressed when they do not open their valves as frequently in response to environmental noise. This provides support that the oysters detect noise at low acoustic energy levels. While we generally understand that marine noise pollution influences charismatic megafauna like whales and dolphins, understanding how invertebrates like oysters perceive and respond to human generated sound can provide further insight about the effects of anthropogenic noise on the larger ecosystem. The Hierarchy of Controls concept is often used to reduce noise in the environment or the workplace. Engineering noise controls can be used to reduce noise propagation and protect individuals from overexposure. When noise controls are not feasible or adequate, individuals can also take steps to protect themselves from the harmful effects of noise pollution. If people must be around loud sounds, they can protect their ears with hearing protection (e.g., ear plugs or ear muffs). In recent years, Buy Quiet programs and initiatives have arisen in an effort to combat occupational noise exposures. These programs promote the purchase of quieter tools and equipment and encourage manufacturers to design quieter equipment.

Noise from roadways and other urban factors can be mitigated by urban planning and better design of roads. Roadway noise can be reduced by the use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design. An important factor in applying these strategies is a computer model for roadway noise, that is capable of addressing local topography, meteorology, traffic operations, and hypothetical mitigation. Costs of building-in mitigation can be modest, provided these solutions are sought in the planning stage of a roadway project.

Aircraft noise can be reduced by using quieter jet engines. Altering flight paths and time of day runway has benefited residents near airports.

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CHAPTER 14

CHANGE OF CLIMATE AND ITS IMPACT ON HUMAN HEALTH AND ENVIRONMENT

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ABSTRACT

According to this chapter, Climate change is one in all the most important challenges of our time and its considerable stress to our society health and to the environment. Change of weather patterns that Threaten food production; to rising sea water levels that increase the chance of catastrophic flooding, the impacts of temperature change are global in scope and unusual in scale. Without drastic action today, adapting to those impacts within the future are going to be harder and expensive. This chapter deals with the concept of world global climate change, the associated terms, causes, consequences, solutions and its potential human health impact. It shows the necessity to act urgently if we are to avoid an irreversible build-up of greenhouse gases (GHGs) and heating at a potentially huge cost to the economy and society globally. Therefore, addressing global climate change requires an "unprecedented level of cooperation, not only between countries, but also between different levels of Governments, private sector and individual.

Keywords: Climate change, global warning, environment and temperature

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1.0 INTRODUCTION

Change of climate can be a significant world environment concern. It is mainly reason by the increase of Green house gases with in atmosphere. The world wide increase in CO_2 concentration is due firstly to fuel attain and land while those of methane and nitrous oxide are beginning due to agriculture. Heating could be a specific example of the broader term global climate change and refers to the observed rise with in the average temperature of the

air near earth's surface and oceans in present decades. Its outcome especially on developing countries is adverse as their capacity and resources to hand out with the challenge is limited.

The key environmental challenges in India are sharper within the last twenty years. Temperature change is impacting the standard ecosystems and to posses acceptable adverse effects in India, totally on agriculture on which 58% you look after the population till depends for livelihood water storage within the Himalayan glaciers which are most source of major rivers and H_2O recharge, sea-level rise and warning to a protracted coastline and habitations. Global Climate change also will cause grows frequency of utmost activities like floods and droughts. This will impact India's food security difficulty and water security.

India's emissions are approximated to be of the order of 1331.6 million tonnes of the dioxide equivalent green house gas (GHG) emissions in 2012. The emissions show an annual growth of 4.2% from the levels in 1994. While India's CO_2 emissions are only about 4% of total global CO_2 emissions and really less if the last concentrations are examined. Still India has been known of the worldwide challenge of temperature change.

Source: climate.nasa.gov

Figure 1: Global Climate change

2.0 GLOBAL WARMING

Worldwide warming refers to the increment within the average temperature of worldwide surface air and oceans. This can be greater of Earth's average surface temperature

because of effect of greenhouse gases such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap temperature that might if not throw from Earth.

3.0 CLIMATE CHANGE AND HEALTH

Global Climate change affects the social and environmental determinants of healthy air, safe drink water, sufficient food and secure shelter. Heating that has occurred since the 1970s caused over 140000 excess deaths annually by the year 2009. The direct damage costs to health (i.e excluding costs in health–determining sectors like agriculture and water and sanitation) is estimated to be between Rs. 120-240 billion/year by 2030.

Many of the prime killers like diarrhoeal diseases, malnutrition, malaria and dengue are most climates –sensitive and are wait to worsen because the climate changes.

Places with weak health basic needs mostly in developing countries are going to be the smallest manage without assistance to arrange and respond.

Decreasing emissions of greenhouse gases through greater transport, food and energy use choices may result in upgrade health.

Over the last 50 years, human activities particularly the burning of fossil fuels have released sufficient quantities of CO_2 and other green house gases to trap extra heat within the lower atmosphere and act on the worldwide climate. Within the last 100 years, the global has accelerated, at over 0.18°C per decade. Sea levels are rising, glaciers are melting and precipitation patterns are changing. Extreme weather events are getting more intense and frequent.

Although world warming may increase some basic benefits like fewer winter deaths in temperature climates and increased food production in certain places, the entire health effects of a challenging climate are likely to be overwhelmingly negative. Climate changes affects social and environmental determinants of health clean air, safe water, and sufficient food and secure shelter.

Maximum high air temperatures contribute directly deaths from cardiovascular and respiratory illness, particularly among old age persons. Within the wave of summer 2003 in Europe for example, over 70000 excess were recorded.

High temperatures also raise the degree of ozone and other pollutants within the air that exacerbate cardiovascular and respiratory illness. Urban pollution causes about 1.2 million deaths per annum. Pollen and other aeroallergen levels are more in maximum heat. These can trigger asthma, which affects around 300 million people. Ongoing temperature increases are expected to extend this burden.

4.0 NATURAL DISASTERS AND VARIABLE RAINFALL PATTERNS

Worldwide the amount of reported weather –related natural disasters has increased than tripled since the 1960s. Yearly this disasters result in over 60000 deaths, basically in developing countries.

Increasing sea standards and increasingly utmost weather activities will destroy homes medical facilities and other important services. Quite half of the world's population lives within 60 km of the ocean. People may be forced to move, which in turn heightens the risk of a range of health effects from mental disorders to communicable diseases.

Increasingly variable rainfall patterns are likely to affect the availability of H_2O. An absence of safe water can compromise hygiene and increase the risk of diarrhoeal disease, which kills 2.2 million people once a year. In utmost cases, water scarcity increase to drought and famine. By the 2090s global climate change is probably going to widen the place full of drought, double the frequency of ultimate droughts and increase their average time six-fold.

Floods are increasing in frequency and intensity. Floods contaminate freshwater supplies, heighten the danger of water-borne diseases and make breeding grounds for disease –carrying insects such as mosquitoes. They also cause drowning and physical injuries, damage homes and disrupt the provision of medical and health services.

Increasing temperatures and variable precipitation are probable to decrease the production of staple foods in many of the poorest places by up to 50% by 2020 in some African countries. This may increase the prevalence of malnutrition and under nutrition, which currently cause 3.5 million deaths per annum.

5.0 THE WAY OF INFECTION ON HUMAN BODIES

Climate conditions strongly affect water-borne diseases and diseases transmitted through insects, snails or other cold blooded animals.

Changes in climate are likely to elongate the transmission seasons of important vector-borne diseases and to change their geographic range. For example global climate change is projected to widen significantly the place of India where the snail–borne disease schistosomiasis occurs.

Malaria is strongly influenced by climate. Transmitted by Anopheles mosquitoes, malaria kills almost 1 million people once a year mainly African children under five years old. The Aedes mosquito vector of dengue is additionally sensitive to climate conditions. Studies suggest that weather change could expose an extra 2 billion people to dengue transmission by the 2080s.

6.0 MEASURING THE HEALTH EFFECTS

Measuring the health effects from weather change can only be very approximate. Nevertheless, a WHO assessment, taking into consideration only a subset of the possible health impacts concluded that the modest warming that has occurred since the 1970s was already causing over 140000 excess deaths annually by the year 2004.

All populations are going to be littered with weather climate change, but some are more vulnerable than others. People living in small island developing states and other coastal regions, megacities and mountainous and polar regions are particularly vulnerable.

Children specifically, children living in poor countries are among the foremost liable to the resulting health risks and can be exposed longer to the health consequences. The health effects are expected to be more severe for elderly people and folks with infirmities or pre-existing medical conditions. Areas with weak health infrastructure mostly in developing countries are going to be the smallest amount ready to cope without assistance to arrange and respond.

Many policies and individual choices have potential to curtail greenhouse gas emissions and produce major health co-benefits. For instance: promoting the safe use of public transportation and active movement like cycling or walking as alternatives to using private vehicles could reduce CO_2 emissions and improve health.

The global Health Assembly endorsed a brand new WHO work plan on global climate change and health. This includes:

i. **Advocacy**: To raise awareness that global climate change could be a fundamental threat to human health.
ii. **Partnerships**: To coordinate with partner agencies within the UN systems make sure that health is correctly represented within the global climate change agenda.
iii. **Science and evidence**: To coordinate reviews of the scientific evidence on the links between global climate change and health and develop a worldwide research agenda.
iv. **Health system strengthening**: To help countries to assess their health vulnerabilities and build capacity to curtail health vulnerability to weather change.

7.0 THE NATIONAL ACTION PLAN ON CLIMATE CHANGE (NAPCC)

The National Action plan on climate change (NAPCC) coordinated by the ministry of Environment and Forests is being implemented through the nodal ministries in specific sectors /areas On June 30, 2008, prime minister Dr. Manmohan Singh released India's first National Action plan on climate change (NAPCC) outlining existing and future policies and programs addressing climate mitigation and adaptation. The plan identifies eight core

"national missions" viz. National solar mission, National mission for Enhanced Energy efficiency, National mission on sustainable Habitat, National water Mission, National Mission for Sustaining the Himalayan Ecosystem , National Mission for a "Green India" , National Mission for Sustainable Agriculture, National mission on Strategic Knowledge for Weather Change.

Emphasizing the overriding priority of maintaining high economic process rates to boost living standards the plan "identifies measures that promote our development objectives while also yielding co-benefits for addressing weather change effectively".

The NAPCC also describes other ongoing initiatives, including (i) power Generation; (ii) Renewable Energy; and (iii) Energy Efficiency

All national missions have been approved by the Prime Minister's Council on global climate change and are at different stages of implementation. Under advice of the Central Government, state Governments are preparing state Action plans on global climate change that are aimed toward creating institutional capacities and implementing sectoral activities to address climate change. So far, 21 states namely Andaman and Nicobar, Andhra Pradesh, Arunachal Pradesh, Assam, Delhi, Jammu & Kashmir, Kerala, Karnataka, Lakshadweep, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Odessa, Punjab, Rajasthan, Sikkim, Tripura, Uttarakhand and West Bengal have prepared document on State Action Plans on Climate Change (SAPCC).

Source: edf.org

Figure 2: Global Climate Change

8.0 IMPACT OF WORLD WARMING ON CLIMATE CHANGE

Global warming has serious worldwide implications, though the kind and magnitude of local effects varies considerably by region. This section highlights the implications of world warming on a broad level. Unless we take immediate action to curtail global warming emissions, these impacts will continue to intensify, grow ever more costly and damaging and increasingly affect the whole planet.

i. Accelerating sea level rise and increased coastal flooding

Average global sea water level has increased eight inches since 1880, but is rising much faster on the U.S East coast area and Gulf of Mexico. Global warming is now accelerating the speed of sea water level rise, increasing flooding risks to low-lying communities and high risk coastal properties whose development has been encouraged by today's flood insurance system.

ii. Longer and more damaging wildfire seasons

Wild fires are increasing and wildfire season is getting longer within the western U.S as temperatures rise. Higher spring and summer temperatures and earlier spring snow-melt lead to forests that are hotter and drier for extended periods of your time priming conditions for wildfires to ignite and spread.

iii. More frequent and Intense Heat waves

Dangerously weather condition is already occurring more frequently than it did 60 years ago and scientists expect heat waves to become more frequent and severe as worldwide global warming intensifies.

iv. Costly and growing health impacts

Climate change has significant implications for our health. Rising temperatures will likely result in increased air pollution, a longer extended and more intense allergy season the spread of insect borne diseases, more frequent and dangerous heat waves and heavier rainstorms and flooding. All of those change pose serious and more risks to public health.

v. An increase in Extreme weather events

Strong scientific evidence shows that global warming is increasing certain kinds of extreme weather events, including heat waves, coastal flooding, extreme precipitation events and more severe droughts. It is also creates conditions that may result in more powerful hurricanes.

vi. Heavier precipitation and flooding

As temperature increase, more rain falls during the heaviest down pours, increasing the harmful of flooding events. Very heavy precipitation events defined because the heaviest

1% of storms now drop 67 percent more precipitation within the Northeast, 31 percent more within the Midwest and 15 percent more within the great plains of North America than they did 50 years ago.

vii. Growing risks to the electricity supply

Our aging electricity infrastructure is increasingly at risk of the growing consequences of world warming, including sea water level rise, extreme heat heightened wildfire risk and drought band other facility issues.

viii. Changing seasons

Spring arrives much sooner than it attained to -10 days before on average within the northern hemisphere. Snow melts earlier. Reservoirs fill too early and water must be released for flood control. Vegetation and soils dry out earlier, setting the stage for extended and more damaging wildfire seasons.

ix. Melting ice

Temperatures are rising within the planet's Polar Regions, especially within the Arctic and the overwhelming majority of the world's glaciers are melting faster than new snow and ice can replenish them. Scientists expect the speed of melting to accelerate, with serious implications for future sea water level rise.

x. Disruptions to Food supplies

Rising temperatures and therefore the accompanying impacts of world global warming including more frequent heat waves, heavier precipitation in some regions and more severe droughts on others has significant implications for crop and meat production. World Global warming has the potential to rapidly disrupt our food supply, drive costs upward and affect everything from coffee to cattle from staple food crops to the garden in your backyard.

xi. Destruction of coral reefs

As global temperatures rise, so do average sea surface temperatures. These elevated temperatures cause long period damage to coral reefs.

xii. Plant and Animal Range shifts

A changing climate affects the range of plants and animals, changing their behaviour and causing disruptions up and down the food chain. The range of some warm –weather species will expand, while people who depend upon cooler environments will face shrinking habitats and potential extinction.

xiii. The potential for abrupt climate change

Scientists know that Earth's climate has changed abruptly within the past. Even although it is unlikely to occur in the near future, global warming may increase the harmful

of such events. One amongst the foremost significant potential mechanisms could be a shift in an ocean circulation pattern called thermohaline circulation, which might have widespread consequences for Europe and also the U.S. East Coast.

9.0 CONCLUSION

Climate change is going on and it's caused more by human activities. Its impacts are getting down being felt and can be worsen within the decades forward unless we take action. The increasing rate level of worldwide global warming reason of greenhouse emission (CO_2) and other green house gas emissions from human activities have led to climatic changes and environmental degradation, which successively have resulted to risk of challenges in reference to diseases and human health. Many illnesses which were previously unknown in certain climatic changes are now finding their way to those places, due to changes within the climate conditions. Further, many diseases that had been thought destroys remerging in areas with altered climate conditions that favour their comeback. It is so that a vital that associates and decision makers at industrial, government and international policy levels come up with stringent and workable means of reducing on green house gases emission to combat the spread of world warming effects, and therefore that the resultant weather change, which has produced devastating impacts especially among poor countries. Further, there should be increased funding of adaptation and coping programs and projects in affected areas to reduce the impacts on human health and curtail the spread of diseases.

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CHAPTER 15

EMERGING TRENDS IN GEOGRAPHY AND ENVIRONMENTAL DYNAMICS

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If we shrink the limits of geography, the greater field will still exist: it will be only our awareness that is diminished. Carl Sauer (1956, 394)

ABSTRACT

Geography is the science which deals with spatial distributions and space relations on the earth's surface. It studies the human space interaction and it deals with space and humans who uses it for economic purposes. What honestly topics in this human-environment interplay are that benefits ought to emerge as everlasting and sustainable. This phenomenon is extraordinarily crucial for future generations if we desire them to continue to enjoy the geographical surroundings. When we observe the contemporary perception of the environment and the associated application, the existing kingdom isn't very encouraging consisting of destruction of tropical forests for agriculture and settlement functions, oil drilling practices in the open seas, growing presence of nuclear centers and so on. Such human sports result in irreversible damages to the natural environment. Additionally because of misapplication of human activities including settlement and industrialization, mankind confronts such a bad environment in which the soil lost all contact with the sky, international warming, intense pollutants inside the environment and hydrographic elements. With a powerful environmental education, it's miles viable to prevent the excessive and mistaken use which nature cannot compensate anymore. Ever-increasing world populace creates the largest trouble that forestalls sustainable use of scarce sources. At this factor, the place of geography comes to the fore in an effective environmental training. This study emphasizes powerful environmental education, and attempts to provide an explanation for the capabilities of the geography and how it has to be utilized in environmental education.

Keywords: Geography, trends, environmental dynamics, sustainability

1.0 INTRODUCTION

Geography is an old discipline whose roots can be traced back to ancient times. The word geography is derived from two Greek words namely 'Geo' meaning earth and 'Graphy' meaning description of earth. The term “Geography” was coined by a Greek scholar Eratosthenes in 234 B.C. The literal meaning of geography is “description of the earth’s surface”. In the beginning of 1st century AD Geography was focused on description of earth's surface. Roman Writers like Strabo, Pliny and Ptolemy were great roman writers who stressed descriptive geography. Till few decades, the study of geography was given importance to listing of names e.g. names of continents and oceans, rivers, lakes etc. There was no attempt to understand why and how these forms came into existence. But modern geography has not remained confined to only the description of earth`s surface, rather its dimensions have expanded very much beyond mere description. The subject of geography has been defined differently by different geographers and philosophers from time to time according to the aims of the study and prevalent methodology.

Geography was born with man's exploration for water, soil, path and places and the development of geography is closely associated with the development of human and society. In the preliminary stage geography fostered up with the exploration and mapping of the area which was the man's quest to know about the environment. Modern geography deals with the study of earth`s features, both natural and anthropogenic, its inhabitants, various processes and principles influencing these features and different kinds of relationships in spatial context. Geography helps us to understand the differences in patterns, phenomena and the processes, interrelationship between human society and the physical environment and utilization of earth’s surface by man in spatio-temporal context. Understanding the nature and causes of aerial differentiation on the earth’s surface has been prime concern of geographers since ages as man observed differences among different places. Geography is no longer treated as catalogue of earth; rather modern geography has emerged as a spatial science on the horizon of knowledge. The foundations of geography as a science were laid down by the work of the Indian, Greek and Arab scholars. They tried to understand the universe around us and the place of our planet in it. During 18th century discoveries of new continents and ocean routes provided interesting geographical accounts of voyages, new places and people. Since then Geographical discovery has progressed enormously and hence geography became a discipline which gives us an ever increasing knowledge of the earth. By 19th century a systematic study of geography has started. Carl Ritter and A.V. Humbolt were the German geographers who were the pioneers of scientific studies of geography.

Figure 1: Carl Ritter

Figure 2: Alexandervon Humboldt

Geography as a field of advance studies first developed in Germany followed by France and Britan. Richthofen coined the world "Chronology" for regional studies, Ratzel coined the word 'anthropogeography 'and 'living space', Hettner claimed geography to be an idiographic subject. Later French geography notably Vidal de La Blache brought Human at the helm of geography through his monumental book' Human Geography'.

Figure 3: Ratzel, Friedrich

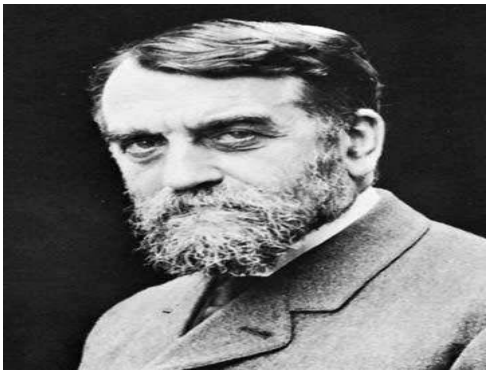


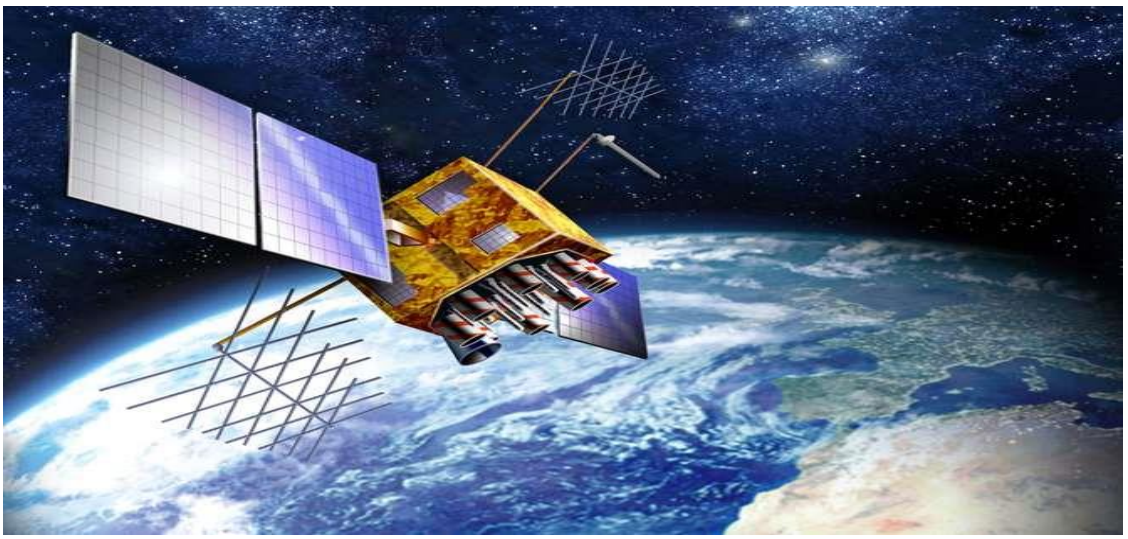
Figure 4: Vidal de La Blache

The qualitative revolution later gave to Behavioral Approach in geography with main contribution from Haggerstrand, Kirk and White. Teleology, Darwinism, possibilism, Regional concept, Positivism, Humanism, Radical Geography, Phenomenology, Environmental Geography etc. has been the theme of geographic studies till recent times. Though Geographical Paradigm seems to sway with time, the focus on space has been the central theme of geography all through time.

The study geography on a scientific footing has been developed in the nineteenth century. The scientific approach to geography was christened by the emergence of quantitative revolution and the incorporation of model in geography. The world war saw a great interest in the development of cartography with the main theme of geography as maps

which were in great demand in those times. After the world wars, the geographers were caught in the argument over dualism in geography. Richard Hartshone in his book' The Nature of Geography'; defined geography, 'to provide accurate, orderly and rational description and interpretation of the variable character of the earth's surface. GIS technologies, is currently flourishing as it amalgamates both physical and social sciences and has led to an inter-disciplinary/multi-disciplinary/trans-disciplinary research approach in geography.

Geographers through the world are still contemplating on what should be the real approach to geography, and there has been different approach to the study of geography within different university departments of the world, yet there is a consensus among geographers over the use of technology in the study of geography and geographic phenomena. The advent of Geographic Information System and Remote sensing has led to the development of the term called 'Geosciences', commonly stressed by different scholars. Development of Remote sensing has led to the analysis and handling of large spatial data with ease. The advent of so called Geosciences has led to a new trend in Geography where in every scholar are eager to apply the GIS tools in the study of Geography.



Source: https://images.app.goo.gl/b9LW6e6AzXPecHiB7

Figure 5: GPS satellite: A Global Positioning System (GPS) satellite orbiting Earth.

GIS has led to a new trend in thematic mapping as crime mapping, disaster prone area mapping, urban sprawl trend mapping and real time traffic movement analysis through maps are being practised. The development of industries and its impact on the environment, the human demand for alternative resources has led to new awareness regarding the environment

and protecting the environment is becoming a central theme of many disciplines and geography is also highly influenced by the current theme of global warming, climatic change and the like. Humanism and Regional studies is also on the forefront with demographers working on human aspect of geographers and urban geographers and planners contributing a great deal on the regional study of geography.

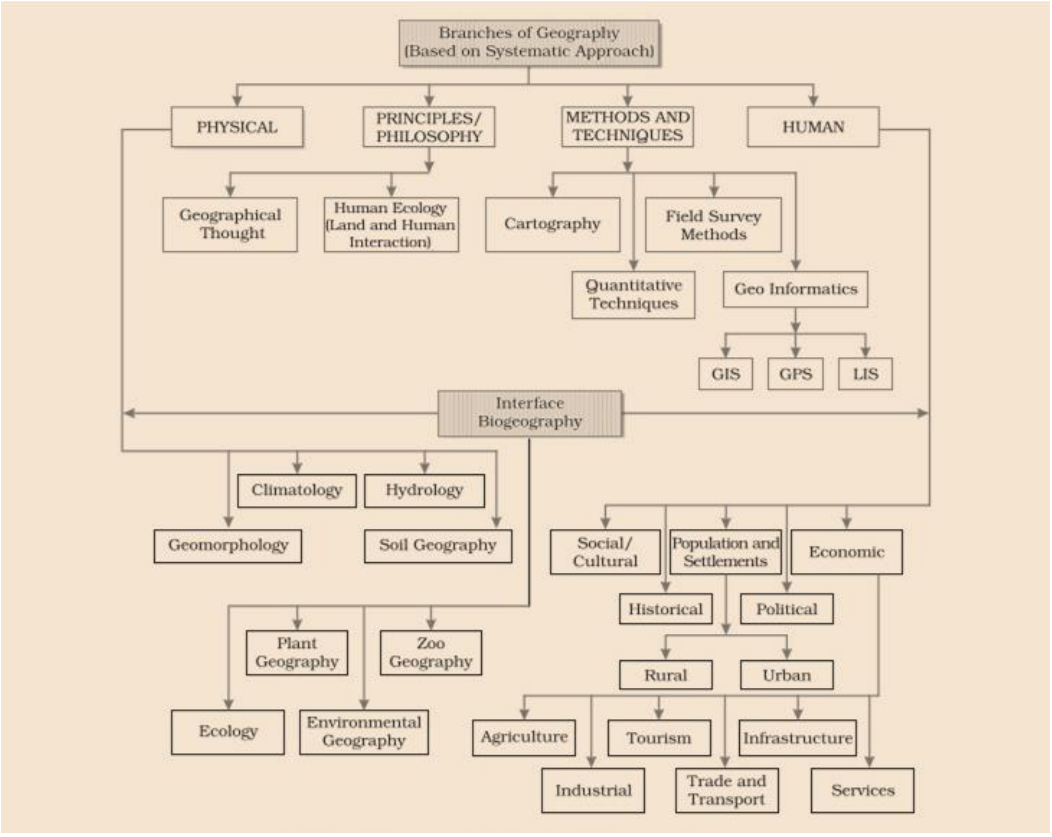


Figure 6: Branches of Geography

Lot of work is done on the physical aspect of geographers spearhead by geologists and disaster management agencies. In real sense many aspects of geography is trending in recent times, but with more specific approach wherein accuracy and subjectivity is maintained. It can be stated with no doubt that geography in recent times is approaching to be a true scientific discipline.

Geographers often approach the study of environmental dynamics from the vantage point of natural science (Mather and Sdasyuk, 1991). Society and its roles in the environment remain a major theme, but human activity is analyzed as one of many interrelated mechanisms of environmental variability or change. Efforts to understand the feedbacks among environmental processes, including human activities, also are central to the

geographic study of environmental dynamics (Terjung, 1982). As in the other natural sciences, advancing theory remains an overarching theme, and empirical verification continues to be a major criterion on which efficacy is judged.

Physical geography has evolved into a number of overlapping subfields, although the three major subdivisions are biogeography, climatology, and geomorphology (Gaile and Willmott, 1989). Those who identify more with one subfield than with the others, however, typically use the findings and perspectives from the others to inform their research and teaching. This can be attributed to physical geographers' integrative and cross-cutting traditions of investigation, as well as to their shared natural science perspective (Mather and Sdasyuk, 1991). Boundaries between the subfields, in turn, are somewhat blurred. Biogeographers, for example, often consider the spatial dynamics of climate, soils, and topography when they investigate the changing distributions of plants and animals, whereas climatologists frequently take into account the influences that landscape heterogeneity and change exert on climate. Geomorphologists also account for climatic forcing and vegetation dynamics on erosional and depositional process. The three major subfields of physical geography, in other words, not only share a natural science perspective but differ simply with respect to emphasis.

Geographers approach spatial representation in a number of ways to study space and place at a variety of scales. Tangible representations of geographic space may be visual, verbal, mathematical, digital, cognitive, or some combination of these. Reliance on representation is of particular importance when geographic research addresses intangible phenomena (e.g., atmospheric temperature or average income) at scales beyond the experiential (national to global) and for times in the past or future. Tangible representations (and links among them) also provide a framework within which synthesis can take place. Geographers also study cognitive spatial representations—for example, mental models of geographic environments—in an effort to understand how knowledge of the environment influences peoples' behavior in that environment and make use of this knowledge of cognitive representation in developing approaches to other forms of representation.

One recent outgrowth of the spatial representation traditions of geography is a multidisciplinary effort in geographic information science. This field emphasizes coordination and collaboration among the many disciplines for which geographic information and the rapidly emerging technologies associated with it are of central importance. The University Consortium for Geographic Information Science (UCGIS), a nonprofit organization of universities and other research institutions, was formed to facilitate this

interdisciplinary effort. UCGIS is dedicated to advancing the understanding of geographic processes and spatial relationships through improved theory, methods, technology, and data.

From Stockholm 1972 to UNCED-RIO 2012, the international community has been acutely concerned about changes being imposed by humankind on the biosphere and the consequences of these changes for such important issues as Sustainable development, biodiversity and climate change. Both researchers and policy makers understand that such changes are anchored in human environment relationship are created by complex human activities and have important consequences that vary significantly by locale. Geography remains central in setting the agenda for scientific research to address the complexity of human and social behavior related to global environmental change. Geographers have helped to launch international collaborative research on greenhouse gases and climate change through the Scientific Committee on Problems of the Environment (Bolin et al., 1986).

At the local scale, geographers have helped public and private decision makers recognise the importance of geographic context when addressing resource management issues.

2.0 CONCLUSION

Our daily lives are interwoven with geography. Each of us lives in a unique place and in constant interaction with our surroundings. Geographic knowledge and skills are essential for us to understand the activities and patterns of our lives and place, and lives of others. We move from place to place, aided by transportation and navigation systems. We communicate using global networks of computers and Satellites. We strive to live in healthy physical and social environments. We search for interesting destinations for recreation and vacations. We observe and learn about our own cultures around the world. Geographic knowledge and understanding is fundamental to reaching our goals and in attaining a higher quality life.

Geography has an ancient history but is a young scientific discipline. Geographers are currently contributing to every sphere of knowledge and helping man to sustain in the evolving natural and cultural environment. We have seen the blooming of Information Technology, Bio-technology and Nano-Technology but the new age belongs to Geo-Technology.

Current trends in geography's techniques suggest a future in which researchers, students, business people, and public policy makers will explore a world of shared spatial data from their desktops. They will request analyses from a rich menu of options, select the geographic area and spatial scale of analysis, and display their results in multimedia formats that are unanticipated today. Geo-technology will lead the world in the coming generation

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CHAPTER 16

A COMPARATIVE STUDY OF STUDENTS OF PROFESSIONAL AND CONVENTIONAL COURSES REGARDING AWARENESS OF ENVIRONMENT

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ABSTRACT

The objective of this research was to evaluate the major factors contributing to environmental awareness among the students of professional and conventional courses in NCR. Three hundred students from different colleges participated in the survey and completed the questionnaire in the fall of 2009. The questionnaire consisted of 39 questions grouped into the several categories. The target population encompassed students with different backgrounds including gender, age, education levels, location of residency, and social status. The questionnaire was distributed according to the students 'density throughout four major cities in NCR. Analysis of Variance was conducted on the means of the sample populations determined by gender, age, education, to verify that the apparent differences of the means were statistically significant. The environmental awareness among the students of professional courses and traditional courses were compared. The statistical results of the survey revealed that the students of government colleges were more aware than the other students of professional courses. Environmental awareness among university students increased linearly. The education level of the survey respondents played a significant role in the degree of environmental awareness in all cities and villages surveyed. As a profession, students don't want to pursue. Lack of opportunities is the important factor. The methodology which is generally adopted by the faculty members is lecture method, which lacks case studies, assignment, and role play.

Keywords: Environmental awareness, environmental education, awareness

1.0 BACKGROUND

The work of Bruce Joyce & Marsha Weil (1972) has transformed different theories into different models of teaching, which can be easily used by teachers for classroom teaching in schools. These models are based on dependable theories of teaching established only during last decade.

In a survey, the text-books of standards 8^{th}, 9^{th} and 10^{th} were studied to know the scope of environment related topics in the syllabus. Therefore, a simple questionnaire on environmental pollution, and its effects on health, was prepared. The children were the target to be posed questions to obtain their opinions on factors responsible for causing and controlling pollution. With due permission from the Heads of Schools, the survey was conducted in ten schools in Ulhasnagar. A brief presentation on the importance of nature conservation and the problems of environmental pollution was made before handing over the questionnaire to the children. A conclusion that the status of the environmental awareness of the school children of Ulhas Nagar was poor was made.

University of Michigan officials also conducted a similar survey at the school's environmental stewardship in light of its first Annual Environmental Report.

Based on the above said surveys, we thought that there is a need to understand the perception & expectations of students pursuing higher education in traditional and conventional courses.

2.0 RESEARCH DESIGN

We have adopted the following research design:

i. Designing the methods of data collection

The method of data collection has been chosen as a primary survey method.

ii. Selecting the sample

The students from MBA, MCA, BBA, BCA, MSc, M.Com, MA, BA, BSc, B.Com from universities, colleges from NCR are chosen to fill up the questionnaire.

iii. Collection of data

The questionnaire was prepared to collect the responses.

iv. Processing and analysis of the data

Tools like SPSS 12.0 are used to analyze data.

v. Sample

The Universe of the population is all the students in graduation and post graduation studying in NCR.

vi. Sample Size

300 Respondents

3.0 RESULT & DISCUSSION

The score included 28 components among the students had been taken for factor analysis in order to narrate these components.

The exploratory factor analysis (EFA) had been administered. As a conservative heuristic, items with a factor loading smaller than 0.4 on any factor were deleted. More over, items that demonstrated cross-loadings greater than 0.4 on more than one factor were dropped because they do not provide pure measures of a specific construct.

In addition, the screen test and the Kaiser (1960) Eigen value one intention were both used to identify the number of factors. The remaining factors had been deleted by the factor analysis because of the above mentioned intention. The number of factors extracted by the factor analysis, the components in each factor, its factor loading, reliability coefficient and percent of variation explained by each factor in the illustrated table.

Table1: Naming of Factors

Name of Factors	Statements	Factor Loading	Eigen Value	Percentage of Total Variance
Factor 1: Application of Subject	Statement 6	-.604	7.908	21.373
	Statement 15	.591		
	Statement 16	.681		
	Statement 17	.729		
	Statement 21	.542		
	Statement 22	.822		
	Statement 24	-.613		
	Statement 25	.731		
	Statement 27	.702		
	Statement 30	-.674		
	Statement 31	-.520		
	Statement 33	.870		
	Statement 35	.414		
	Statement 36	-.682		
	Statement 37	.837		

Factor 2: Acceptance to Study	Statement 4	-.629	5.359	14.483
	Statement 5	-.415		
	Statement 7	.492		
	Statement 9	-.484		
	Statement 11	.538		
	Statement 12	.626		
	Statement 13	.613		
	Statement 18	-.826		
	Statement 19	-.529		
	Statement 29	.439		
	Statement 32	.541		
Factor 3: Marks & Subject	Statement 2	.614	2.325	6.284
	Statement 8	.531		
Factor 4: Content of Syllabus	Statement 3	.372	2.106	5.691
	Statement 14	.568		
Factor 5: Career of an Individual	Statement 10	.442	1.563	4.226
	Statement 20	.559		
Factor 6: Level of Understanding among students	Statement 1	.490	1.499	4.050
	Statement 23	.485		
	Statement 26	.400		
Factor 7: Methodology Adopted by Teacher	Statement 34	.350	1.430	3.866
Factor 8: Faculty Member	Statement 28	.708	1.113	3.007

Source: Compiled from SPSS output

The components were narrated into eight important factors –

i. Application of subject
ii. Acceptance to study
iii. Marks & Subject
iv. Content of syllabus

v. Career for individual

vi. Level of understanding among students

vii. Methodology adopted by teacher

viii. Faculty member

- All these factors explain the components of work life to the extent of 62.981%. The most important factor was **Environmental Subject and Its application** since its Eigen value and the per cent of variance explained were 7.908 and 21.373 per cent respectively.
- The next two factors were **Acceptance to opt it as profession** and **Suggestions from students** since there Eigen values were 5.359 and 2.325 respectively. The next factor was **Changes required** with Eigen value 2.106
- The fifth and sixth factors were **Syllabus Affecting Individual** and **Level of Understanding among Students** with the Eigen values 1.563 and 1.499.
- The next last factors were **Teaching Methodology Adopted by Faculty Member** and with their **Faculty** Eigen values 1.430 and 1.113

Table 2: Commonalties

Factor loading statements	Initial	Extraction
Nature of course	1.000	0.584
Department	1.000	0.712
Age of student	1.000	0.643
Gender	1.000	0.634
Medium	1.000	0.607
Environmental education studying	1.000	0.723
Application of environment	1.000	0.589
Willingness to give new ideas	1.000	0.631
Experience to study this subject was good	1.000	0.651
I welcome this subject happily	1.000	0.521
I am aware of my career	1.000	0.601
I am willing to make my career in environmental challenges	1.000	0.724
I accept that syllabus is quite old	1.000	0.792
The introduction of this subject is good.	1.000	0.722
The contents of the subject are not applicable in daily life.	1.000	0.683
With the syllabus, I got mostly influenced	1.000	0.738

The other students take keen interest	1.000	0.814
Students concentrate on the subject	1.000	0.872
I read it with the guide (not with text books)	1.000	0.567
I am/ was unhappy with the additional load of the subject like this.	1.000	0.529
I was least interested in this subject when I heard about it.	1.000	0.807
There is a huge gap between the differences in individual and national values	1.000	0.730
I am in stress due to this subject.	1.000	0.679
There is unclarity in this subject.	1.000	0.764
There is a least interest among the students	1.000	0.670
There is lack of opportunities in career	1.000	0.731
I reach late in my class	1.000	0.748
Lack of concentration in other subjects prevails because of this subject.	1.000	0.621
I am in tension due to this subject.	1.000	0.767
I know that theoretically it is boaring but it is also necessary to apply.	1.000	0.631
Colleges also don't consider it as "serious subject."	1.000	0.845
Students get happy when the subject teacher does not come.	1.000	0.523
Methodology of the subject shall be different from lecture.	1.000	0.721
Faculty member are not interested in conducting the session with practical examples in this subject.	1.000	0.906
Extraction Method: Principal Component Analysis.		

Table 3: Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.908	21.373	21.373	7.908	21.373	21.373
2	5.359	14.483	35.856	5.359	14.483	35.856
3	2.325	6.284	42.141	2.325	6.284	42.141
4	2.106	5.691	47.832	2.106	5.691	47.832
5	1.563	4.226	52.058	1.563	4.226	52.058
6	1.499	4.050	56.108	1.499	4.050	56.108

7	1.430	3.866	59.974	1.430	3.866	59.974
8	1.113	3.007	62.981	1.113	3.007	62.981
9	1.046	2.826	65.807	1.046	2.826	65.807
10	1.000	2.704	68.511	1.000	2.704	68.511
11	0.938	2.535	71.046			
12	0.854	2.309	73.354			
13	0.822	2.223	75.577			
14	0.762	2.060	77.637			
15	0.739	1.997	79.635			
16	0.672	1.817	81.452			
17	0.629	1.701	83.153			
18	0.578	1.563	84.716			
19	0.568	1.535	86.251			
20	0.537	1.452	87.703			
21	0.515	1.392	89.095			
22	0.508	1.372	90.467			
23	0.425	1.148	91.615			
24	0.396	1.071	92.686			
25	0.372	1.006	93.692			
26	0.346	0.936	94.628			
27	0.303	0.819	95.447			
28	0.280	0.757	96.204			
29	0.264	0.713	96.917			
30	0.225	0.609	97.526			
31	0.206	0.556	98.082			
32	0.181	0.490	98.572			
33	0.163	0.441	99.013			
34	0.124	0.336	99.349			
35	0.103	0.278	99.626			
36	0.080	0.217	99.843			
37	0.058	0.157	100.000			

Extraction Method: Principal Component Analysis.

Using the output, there were 10 Eigen values greater than 1.0. But we have taken 8 values because the remaining two values are almost equal to 1.

The 8 component explain 62.981% of the total variance in the variable which are included on the components

A big percentage of students were not able to apply those concepts in their daily life; they were interested in attending the classes just for the sake of attendance. The lecture method was not appealing to all of them. Contents are outdated; students further feel that there is not any avenue of environment where they can make their career. Universities/ colleges students were found more aware and sensitive towards environment.

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QUESTIONNAIRE

Name (optional):

Class: Age:

Gender: Course:

Medium of learning:

1. Environmental education studied/studying: Yes/ No
2. I know the application of environment? Yes/ a little/ No
3. My experience to study this subject is / was good.
4. I join/ed this subject happily.
5. I am aware of my career related with this subject.
6. I am willing to make my career in environmental challenges.
7. I understand that syllabus is quite old.

8. The changes done in recent past in syllabus is good.
9. Changes in syllabus are not applicable in daily life.
10. From these changes in syllabus, I got mostly influenced positively.
11. From changes in syllabus, students were influenced most.
12. Students concentrate on the subject.
13. With the changes in syllabus I read it with the guide book. (an unauthorized book, not with text books).
14. I am/ was unhappy with the additional load of the subject like this.
15. I was least interested in this subject when I heard about it.
16. There is a huge gap between the differences in theory and application.
17. I am in stress due to this subject.
18. There is lack of clarity in this subject.
19. There is a least interest among the students.
20. There is lack of opportunities in career.
21. I reach late in my class.
22. Lack of concentration in other subjects prevails because of this subject.
23. I am in tension due to this subject.
24. I know that theoretically it is less interesting but it is also necessary to apply.
25. Colleges also don't consider it as "serious subject."
26. Students get happy when the subject teacher does not come.
27. Methodology of the subject shall be different from lecture.
28. Faculty members are not interested in conducting the session with practical examples in this subject.

CHAPTER 17

ROLE OF SCHOOL TEACHERS IN ENVIRONMENTAL AWARENESS AND CONSERVATION

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ABSTRACT

The school is known as the second home of child. The child spends his 6-7 active hours in school. Students are not only the best medium for dissemination of information on Green Good Deeds to others but they can also live their lifetime with the green good deed feelings, thus passing it on to the future generations. When we reinforce the importance of environment preservation in children from a young age, they will be conscious of the decisions they make. They will also correct their elders when they see them doing things that are harmful for the environment. What we need is a conscious set of youngsters to take on this mantle and drive it through. The present research article emphasizes the role of school teachers in imparting and suggesting ways and means for environmental awareness and conservation.

Keywords: *Environmental awareness, environmental conservation*

1.0 INTRODUCTION

Environmental education should not only be supposed as preparation for future healthy and hygienic life but it should be for living the current healthy life. Recently we all have witnessed the fall in rate of pollution due to the lockdown period implemented in the Covid-19 pandemic crisis.

The transaction of environmental education should be conducted smoothly and swiftly and should be included in the daily routine of teaching and learning. Environmental education may be best taught in school through formal teaching of all the subjects and informally by planning various activities inside and outside the school.

2.0 ROLE OF SCHOOL IN ENVIRONMENTAL AWARENESS AND CONSERVATION

i. Integration with school subjects

'Environment preservation' should be integrated with core subjects right from preschool. Environmental education must not be taught as a separate subject. An integrated approach by all the faculty, teaching and non-teaching is required for undertaking the initiatives towards total environmental conservation.

ii. Moral/Ethical Education

As like the teacher teaches basic habits and trains the child, he/she also should teach the basic environmental manners and ethics.

iii. Using ICT for creating environmental awareness

Recent technological advances also can be used for creating environmental awareness. E.g. Broadcasting the disaster management activities to the students.

iv. Creating Awareness about adverse effects of Pollution

Teacher can teach the various causes and effects of pollution on human health and environment. E.g.. Teacher can spread awareness about protection of ozone layer, and ozone depleting substances.

v. Arranging Class Discussions

Formal and Informal discussions in and outside the classroom can be undertaken related to the topics of enhancing the campus environment.

vi. Assigning Small Group projects on Environmental Conservation

Voluntary groups may be formed in each school, which can be the medium for the message of clean air, clean water, and clean environment.

vii. Arranging Guest Lecture on Environmental Conservation

School can organize lectures on topics like energy conservation, use of organic products etc. for developing awareness among the students.

viii. Conducting Poster Competitions

Organize drawing competitions and seminars to encourage students in the Green Good Deeds.

ix. Forming Environmental Club

An environmental club can be formed for spreading Go Green awareness and environmental conservation in the campus. The clubs can actively undertake activities related to environmental education.

x. **Celebrating Green Day**

Green day can be celebrated by taking an oath to protect and conserve environment. Various activities and programmes can be undertaken on green day.

xi. **Organizing cleanliness drives**

Schools can have cleanliness drives on campus where children make sure that everything is kept clean and litter free. From classes to school playgrounds - they should be made to feel responsible for keeping all areas spotlessly clean. They should also be encouraged to participate in cleanliness drives in their communities.Encouraging student's participation in field activities.

xii. **Assigning projects on Alternative sources of Energy**

Schools may encourage – walk to school, Cycle to School, School Bus Transport Facilities, rather than personal motorised transport. Teach them to avoid unnecessary lights and share used books, toys, clothes to conserve the environment and reduce carbon footprints.

xiii. **Preferring methods involving Learning by Doing**

Learning by doing is the best method of teaching through which the child can be very successfully brought close to the nature. It has an additional advantage of direct experience which enables permanent fixation of knowledge. Students can also plant saplings and make the area green and inspire others also in doing so.

xiv. **Forming Birds Feeder Club**

Bird Feeder club can be established in the school which can undertake activity of bird feeder installation in the campus.

xv. **Teaching Best out of Waste**

Also teach the students not to discard used books, clothes, etc. and generate unnecessary waste, better to give to the ones who need them. Don't use thin plastic bags-develop a habit of using cloth bag while going for shopping.

xvi. **Organizing Field Trips**

Visit areas to help local community understand the concept of Blue and Green bins. Visit local parks to assist in keeping the park s clean and green.

xvii. **Emphasizing on Local Cleanliness**

Teach students to ensure proper disposal of wrappers and plastic waste. Don't litter in school and ensure optimum use of paper. Encourage them to don't waste paper-use it on both sides.

xviii. Encouraging the students to use recyclable and reusable material

Teach the students to maintain tradition of reuse. Don't throw away old toys and generate waste-better give these to the kids who need them. E.g. don't make use of 'use and throw' pens.

xix. Encouraging the students for water conservation

Save water in schools and also at home. Ensure them to keep the water taps off when not in use. Teach them to don't waste water - when the water bottle is to be emptied, pour the remaining water to plants instead of draining it into sinks.

xx. Preparing Compost From Organic waste in School

xxi. Visit to Sanctuaries/National parks

xxii. Conducting Environmental drives

xxiii. Showing Television Programs /Short Films related to Environmental Conservation

xxiv. Bringing the children closer to nature

xxv. Exploring the Nature

xxvi. Organizing Tree Plantation Programmes

3.0 CONCLUSION

Schools may involve the young students in the whole process of new concepts and trend-setting requirements of the society. The idea is to go about doing this through teachers. Once the teachers are made aware of the challenges of the future, the knowledge is passed onto the students simply and easily.

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CHAPTER 18

UNDERSTANDING AND ANALYZING THE PARADIGM OF SUSTAINABLE AGRICULTURE IN INDIA

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ABSTRACT

Agriculture sector has always the backbone of Indian economy and its structure in all possible forms, be it economic, political, territorial or structural. It has given immense support for the betterment of Indian society in the form of contribution towards GDP, employment generation, food security, stability etc. India has always strived for sustainability in its economic and social activities at micro and also at macro level believing that this is the only way for better future for the entire world. And agricultural sector has again proved its mettle by contributing for the task of maintaining sustainability in economic activities in Indian context but couldn't prove to be successful till date. The aim of this paper is to focus on the aspects to show how sustainability has been characterized by the agricultural sector in Indian economy with the emphasis on the phenomenon of Sustainable Agriculture. It also aims at understanding its existing system of working and analyzing the challenges faced by this emerging paradigm. The interesting results of the study highlight the immediate need to cater to the problems in the system and ensure that the working of Sustainable Agriculture Sector is well laid and effective in its results.

Keywords: Sustainability, agriculture, economy

1.0 INTRODUCTION

Agricultural sector has always given immense strength to the base of Indian economy not only in the form of increasing GDP numbers but also in ensuring food security and self-sufficiency to quite an extent. Its contribution can't be neglected with the emerging manufacturing and services sectors. With fulfilling the core needs of the individuals in Indian society, Agricultural sector has evolved a lot over the period of time, in many ways from

using traditional tools with manual efforts to modern equipment and techniques which is quite common in the recent picture of agriculture sector. There is no denial to the fact that increasing demand for food has put immense and rising pressure on agricultural domain to perform even better in terms of higher production of crops and of better quality. This pressure has been well taken up by the sector concerned but during the process of fulfilling its responsibility, has caused many ecological and environmental problems, damaging the natural systems and processes. This causes a threat not only to Indian economy but also to the world as a whole as these issues deteriorate the quality of our food intake and also lead to wastage of our 'limited' natural resources. Thus, there arises an urgent need for a phenomenon of 'Sustainable Agriculture' where the emphasis was on 'non-use of chemicals' in the form of pesticides, insecticides etc. This idea of farming has been well accepted by majority of Indian farmers but demanded extra efforts on their parts but the success of this phenomenon does depend on many other factors like availability of resources, state efforts and its constant financial support, awareness, timely updating of knowledge of farmers and other people concerned, transmission of new ideas, innovative techniques with complete information etc. It is observed that availability and accessibility of such factors play a crucial role in establishing a well-designed effective structure of Sustainable Agriculture. The very idea of Sustainable Agriculture focuses on meeting society's current food needs without comprising the ability of the future generation to meet their own requirements. It is well noticed that sustainable agriculture serves as a potential solution to the recent problems of constantly growing food demand in relation to its supply without comprising on environmental satiety. Traditional way of farming is hampering the environment with its side effects for instance: excessive tilling of the soil causing soil erosion, irrigation without proper drainage system leading to salinization, use of inadequate quantity of manures and fertilizers, nutrient depletion from soil, untreated disposal of agricultural waste leading to other forms of pollution, and such long lasting harmful effects can be reduced to a larger extent with the extensive yet appropriate application of sustainable farming practices.

2.0 SUSTAINABLE AGRICULTURE IN INDIA

Agriculture is the base of the Indian economy since the time immemorial. Majority of the India's workforce is still a part of agricultural sector and also in its allied activities, in many formats. With its constant and still ongoing contribution to the economy, along with appreciable number of employment opportunities available, it is difficult to side pass the problems faced by it. And the increasing population and thus, rising food and non-food demands have led to conversion of large scale of forest areas, grazing lands and waste lands

into crop lands which have caused a lot of ecological imbalance leading to climatic problems. Such rapidly changing demands and thus need for continuous improvement in the functioning of agricultural sector takes a toll on the 'limited' natural resources available in the nature and on those which are accessible for agricultural activity. So, there arises an immediate requirement for such a method of farming which fulfills the increasing need of food items for the rising population and at the same time, preserves the resources and their quality. The answer to this serious environmental problem lies in the sustainability aspect of the activity. The phenomenon is 'Sustainable Agriculture' which focuses on complete abolition of harmful chemicals-based agriculture and emphasizes on the use of more of nature-based fertilizers, pesticides and insecticides. It is basically a broader concept in terms of use of correct inputs, awareness about such products to be made available to the farmers concerned and also constant additions to the set of knowledge of farming activities and its allied services for further improvement. It mainly illuminates the objective of satisfying the needs and wants of the current generation and also maintains the ability of the future generation to fulfill its needs and desires without comprising in any form. To ensure this happen, there requires a method of farming which doesn't disturb the ecological cycle but also utilizes the limited number of resources in an efficient manner so that there would be more production of higher quality. The current scenario highlights the maximum use of harmful and devastating chemicals for the higher production of crops without analyzing the long term effects of such materials not only the grains being produced but also on the subsequent health of the citizens and on the nature as the residues of the agricultural sector goes back to nature in various forms causing different variants of pollution. Sustainable Agriculture completely avoids the use of any such substances and purely focuses on enhancing the production of food grains using natural based supplements which can not only better the products but also have further positive benefits popularly known as positive externalities. The most fruitful advantage of the sustainability form of agriculture is the health benefits of the individuals with the consumption of no-chemically produced-crops, grains and cereals and also with least possible harm on farmers' health too. This form of agriculture also shows its positive effects in the form of comparatively higher production as against harmful chemical-based farming. Thus, this system can help India in combating the issue of malnourishment to a large extent without much burden on environment. Therefore, in country like India, Sustainable Agriculture reaches out to solve many problems concerning the nature and the individual of the society; with growing population, rising state level migration and highly variable concentration of agricultural scope and accessibility, it's quite relevant to switch to sustainable form of

farming. India has already started making headway towards the goal of achieving sustainability in agriculture. By relying on traditional scientific ways of growing crops, using homemade solutions, cost free residues for enhancing the quality of farming is the core aspect of sustainable agriculture. So, it seems quite important to switch to nature-based forms of growing crops in Indian context which can project many environmental and ecological advantages for the entire world.

3.0 UNDERSTANDING THE PARADIGM OF SUSTAINABLE AGRICULTURE

There is no denial to the fact that India needs to urge for sustainability in its agricultural sector for immense benefit in the form of higher production of improved quality along with limited burden on the nature and surroundings. Now the question arises is how can India embark upon the path of achieving sustainable agriculture given the dynamics of the economy and also of the global economy. Given the many advantages of Sustainable agriculture like environment preservation, sustaining all kinds of communities, upholding animal welfare etc., it is the only structure which can reduce the harmful effects of human agricultural activities on the environment and also on ecological balance. Indian economy had already onto the path of achieving the sustainability in agricultural process with many initiatives already been taken and many in pipeline.

There have been many steps taken by Indian government sustainable reform in agriculture. Implementing the National Mission of Sustainable Agriculture (NMSA), one of the eight missions under the National Action Plan on Climate Change. This mission has been designed to focus on development of rainfed areas, resource conservation, water use efficiency through on-farm water management technologies and soil health management including residue management, organic farming practices, managing micro and macro nutrients usage, and minimizing soil erosion. Another effort which is quite recognizable is by BASF, a company which has already started production and distribution of products like biodegradable mulch film and other seed treatments. These are such products which help the farmers in producing crops with least chemicals. BASF has also created an outreach programme, Samruddhi in 2007 to train and educate farmers for higher productivity and thus production. The agronomists work towards the goal of imparting education to farmers for better yield, higher productivity per hectare of cultivable land and thus sustainable cropping techniques viable.

There is also Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), launched to converge irrigation at micro and macro level, expand cultivable land under assured irrigation, promote on-farm water efficiency for better utilization of water resources etc. It envisaged

"More Crop Per Drop" to promote such irrigation techniques to save water. There is also a push towards cluster based organic farming in the form of the program 'Paramparagat Krishi Vikas Yojana' (PKVY). This program aims at integrating the climate smart practices with those of Indian council of Agricultural Research (ICAR) and also with state governments. The result of this mission is vividly seen in the case of Haryana which has taken up stringent and quite effective steps towards climate smart practices-based farming. In this region, this program aims to cater to 250 villages of 10 paddy/wheat growing districts more resilient against climate change. In Karnal district, this mission was successfully adopted through intervention in managing water, weather, nutrients and carbon energy was done in a more elaborated manner. This mission also empathizes on proposing adoption of sustainable agricultural practices on community lands like zero tillage, raised bed planting, direct seeded rice, residue management and cropping diversification which includes bee keeping, horticulture, mushroom cultivation etc. There are many technological leverages implemented for instance ICT based weather advisories and seed/fodder banks for easily accessible of inputs.

Department of Agriculture, Cooperation and Farmers' Welfare (DoACFW), Government of India is taking steps to promote and create conducive environment for sustainable farming in India keeping in mind the fact that climatic changes can affect agricultural growth adversely in long run. The department gives enough support for sustainable practices like growing perennial crops in diverse variety in a single field so that each crop could grow in different seasons so as not to have any competition for natural resources. This is one of those steps that is quite logical in a country like India where due to rapidly increasing population, there is immense pressure on conversion of cultivable land into housing complexes or manufacturing units.

There are many Non-for-profit organizations which work rigorously for achieving sustainability in farming practices, Rythu Sadhikara Samstha, whose main aim is to transit from chemical based farming to zero budget natural farming by 2024. This was initially started in Karnataka to end reliance on loans and other financial sources and to focus on alternative farming method with least finance, and then later moved to Andhra Pradesh. There have been many climate resilient farming ways adopted in states heavily dependent on agriculture like Punjab, Bihar etc.

Collaboration of private firms with the task of controlling negative effects of farming activities is quite commendable. India's largest online delivery store, Big Basket, collaborated with Cropin, a mobile based information service provider. Its artificial

intelligence uses satellite data to gather weather and field conditions and provides customized crop advisories to small framers around 1500 in number under Big Basket through experts' suggestions and demanded interventions. Big Basket also uses the opportunity to support farmers in planning field operations, recording usage of inputs' applications and also assessing yields.

In short, there have been many appreciable steps taken under the aegis of Government of India, also many support mechanisms by NPOs, private sector which have been contributing to achieve climate resilient agricultural system which can give long term positive benefits and at the same time, reduce the abnormal burden on ecology and environment.

4.0 CHALLENGES

In the process of achieving sustainable practice of farming, there are many challenges which need to be catered to in the territory of India. According to DoACFW, major challenges faced in the districts of India include problem of temperature alterations, over exploitation of groundwater resources which have reduced the groundwater table over the period of time, lack of micro irrigation facilities, declining use of organic matter in soil preparation, crop season shifting is also a major problem for farmers. But above than all these explicit issues, there are many other inbuilt or inherent problems in a country like India where majority of workforce is a part of agricultural sector in mostly disguised form or in many incidents working as casual laborers in farms owned by others with no direct impact of their actions on the production or productivity of the land. It is noted that the barriers of 'why' and 'how' are still relevant in the realms of small farmers, women, marginalized actors who requires intensive training and frequent efforts to teach them the relevance and further beneficiary effects of such sustainable actions.

So, given so many hurdles or challenges in the path of climate friendly farming, the task of fulfilling sustainability of the agricultural act becomes more intense and requires continuous efforts by all parties' concerned and dynamic steps in the timeline.

5.0 CONCLUSION

It is well known to all that farming activity needs immediate steps in the form of change in its course action plan to not to create more harm to the environment. Given the ever-increasing climatic problems, it is very important for all the actors to take such actions in the direction of sustainability of the farming sector so that there is less burden on resources and also ensure that the food prepared is of higher quality and in greater quantity. In the process of achieving the aim, there have been many reformative measures taken by the state, private players, nonprofit and non-governmental organizations and their actions are well

commendable but lack in quantity given the enormous problem in front of the global economy. So, it is much needed that the practices should be implemented by each and every farmer involved in the activity irrespective of his/her contribution. There should also be additions to the knowledge set of sustainable farming practices with the continuous use of technologies like cloud computing, sensor-driven automation etc. There should be appropriate efforts by the government in terms of availability of information, timely updating of knowledge base, funds and technical support and at the same time, it is also important for the farmers to be more approachable in gaining new set of ideas, implementing them in their action plans.

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CHAPTER 19

TECHNOLOGICAL INNOVATIONS IN MODERN FARMING: OPPORTUNITIES AND PROBLEMS

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ABSTRAC
Agriculture is main occupation in India especially in rural areas. Modernization of Indian agriculture requires an innovative technology to overcome the Problems faced by farmers. Present paper attempt to study the various technologies like Cropln technological solutions, Supply Chain management in agriculture, Eruvaka technologies, Barrix Agro Sciences and Agrostar for developing the agriculture sector. NABARD introduce the Kisan Credit Card scheme that helps the farm to raise the short term funds to meet their financial needs. Grand total of active KCC as on 31st Jan 2020 is 67,602,109. The paper also explores the crop insurance schemes that cover the risks of farmers. In year 2018-19 total number of farmers insured is 575.5 (in lakhs) and 204.9 lakh farmers got benefited of Pradhan Mantri Fasal Bima Yojana (PMFBY) and Restructured Weather Based Crop Insurance Scheme (RWBCIS). Government of India is also aiming to double farmers' income by 2022. Union budget 2019-20 provided minimum fixed pension of Rs. 3000 to small and marginal farmers under Pradhan Mantri Samman Nidhi Yojana This study also explains the problems faced by farmers like Rain fed agriculture, Primitive farming, Low level of formal education and skills, indebtedness and Soil erosion. Government of India invest in various projects to meet with these problems.
Keywords: Agriculture, technology innovation, financial services, problems

1.0 INTRODUCTION

Agriculture is backbone of every economy. India is one of the largest productions of

agriculture in the world. About 58% of India's population earn their livelihood from agriculture. In FY 20 Gross Value Added (GVA) by agriculture, forestry and fishing was estimated at Rs.19.48 lakh crore. Indian food grocery market is world's sixth largest market, with retail contributing 70% of the sales. Government of India plays a vital role to promote the agriculture sector because soundness of agriculture sector directly or indirectly influences the other sectors. To promote the technological innovations, major developments and investments in agriculture are as follows:

- Nestle India construct its ninth factory in Gujarat with the investment of Rs. 700 crore.
- Coca-Cola launched 'Rani Float' fruit juices in November 2019 to step out its trademark fizzy drinks.
- Pradhan Mantri Krishi Sinchai Yojana (PMKSY) has been launched with an investment of Rs 50000 crore for development of irrigation sources for providing a permanent solution from drought.
- NABARD announced an investment of Rs.700 crore for venture capital fund for equity investment in agriculture and rural focused start-ups in May 2019.
- Government of India provide Rs. 2000 crore for computerization of primary agriculture credit society.

2.0 REVIEW OF LITRATURE

Dev (2012) focused on Small Farmers in India: Challenges and Opportunities. It showed that agriculture provides employments to 56 per cent of the Indian work force. It showed that numbers of innovative institutional models are emerging and there are many opportunities for marginal and small farmers in India like land and water management, group and cooperative approach for inputs and marketing and value chains and super markets but small holding agriculture faces many challenges like water problems, impact of climate changes, credit and indebtedness etc.

Dhurandhar (2016) studied transforming Indian agriculture through innovative technologies. It showed some innovative technologies used for agriculture development. Some of them are Barrix Agro Science, Mitra, Eruvaka Technologies and skymet. Innovative technologies allow the farmers to produce crops effectively and efficiently with use of minimum resources. India has put a lot of effort for food production and this led India to the green revolution.

Goyal and Rai (2016) emphasized Indian agriculture and farmers- problems and

reforms. It showed the problems of Indian agriculture. Problems related to market infrastructure, transport infrastructure add significant cost to farmers operations and it leads the farmers left their farming work and went to some nearly industries. It also showed that farming corporatization would be a solution to Indian agrarian sector but it needs a deep innovating better policies so that neither the corporate nor the farmers be at loss.

Ahmad and Hannef (2019) studied Kisan Credit Card (KCC): A tool to answer problems of farmers. It showed that KCC scheme was introduced by NABARD to fulfill the financial needs of farmers at various stages of farmers through institutional credit. This scheme is to be implemented by commercial banks, RRBs and cooperative banks. Security will be applicable as per RBI guidelines prescribed from time to time. KCC can be issued for short term credit requirements for cultivation of crops, produce market loan, working capital for maintenance of farm assets and post harvest expenses etc.

Deepa (2019) focused on a study on supply chain management of agriculture marketing in Kanniya Kumari district. It showed that agri supply chains in India and their marketing are developed due to globalization. Agri supply chain management involves the effective production from farmer to the consumers to match the consumer demands with respect to quantity, quality and price. Lack of good quality crops and low processing capacity are the reasons for broken of supply chain in agriculture.

3.0 OBJECTIVES

i. To explore the technological innovations in modern farming.
ii. To study the various financial services in agriculture sector.
iii. To find out the main problems faced by farmers in agriculture sector.

4.0 RESEARCH METHODOLOGY

This study is based on secondary data collected from published reports, survey books and from various prominent sites. Various articles and thesis are also studied. Looking into the requirements of the objectives of the study the research design employed for the study is of descriptive type.

5.0 TECHNOLOGICAL INNOVATIONS

5.1 Cropln technological solutions

This farming technology solutions startup was founded in 2010 in Bangalore. It is self evolving system that provides information about future ready farming solutions to the agriculture sector. Its vision is to ‘maximize per acre value’. Cropln dizitized over five million acres of farmland that enriched the lives of nearly 2.1 million farmers and it gathered data on 3500 crop varieties. Cropln product portfolio includes:

i. **mWarehouse**: mWharehouse is comprehensive pack house solution that helps farm-to-fork traceability and compliance

ii. **Smart sale:** It is input channel management solution to forecast and maximize sale performance during pre season, season and post season with a swift prompt and intelligent system.

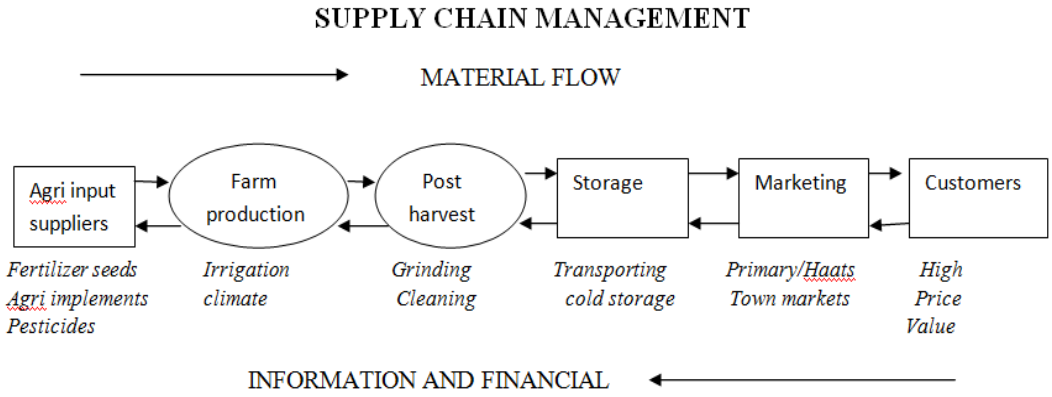
iii. **Smart Farm:** It is a robust digital farming technology that provides complete visibility of resources, process and performance on the field and drives digital strategy.

iv. **Acre Square:** It is unique farming application system that helps companies to directly interact with farmers for educate them and provide consultancy services.

v. **Smart Risk:** It is prescriptive business intelligence solution that leverages agri-alternate data for effective credit risk assessment and loan recovery assessment.

5.2 Supply Chain management in agriculture

Supply chain management is a set of three or more organisations linked directly by one or more of the upstream or downstream flows of product & services, finance and information from a source to a customer. This system should operate with the objectives of timeliness and quality.



Source: https://images.app.goo.gl/PeF4MPAZ8cmbGdHD8

There are several factors that are driving an emphasis on supply chain management

i. Cost and availability of information resources between entities in the supply chain.

ii. Level of competition in both domestic and international market

iii. Customer expectations and requirements.

5.3 Eruvaka technologies

An organisation in Vijayawada (Andhra Pradesh) develop solar powered floating buoys

that measure water parameters such as temperature, oxygen level and PH range crucial for the growth and survival of fish and shrimp. It focus on developing farm diagnostic equipments for aquaculture farmers to reduce their risk and increase productivity. It helps farmers to monitor their ponds and work on following functions:

- Voice call alert
- Automatic control panel
- Pond protection
- Automatic feeds
- Real time monitoring

5.4 Barrix Agro Sciences

The Bangalore based start up offers eco friendly pest control measures in agriculture to support and encourage organic farming. It develop eco friendly crop protection methods using pheromones through their latest dispersion technologies, further they forayed in to plant nutritional supplements which boosted their yields up to 317%. It provides following products:

i. Ag Pest Management Solutions
ii. Cosmopolitan Pest Management Solution
iii. Nutritional Management Solution

5.5 Agrostar

Agrostar is Pune based 'direct to farm' commerce platform that work on the mission of helping the farmers by providing them a complete range of agrisolutions. It provides a combination of agronomy advice coupled with service and agri input products that enable farmers to improve their productivity and income. It's main focus on

ADVICE + PRODUCTS

Agrostar currently operates in the state of Maharashtra, Gujarat, Rajasthan, Madhya Pradesh and Uttar Pradesh. It covers 5 lakh farmers on its digital platform. Farmers can avail agrisolutions with a simple missed call or through android app.

6.0 FINANCIAL SERVICES IN AGRICULTURE SECTOR

6.1 Kisan Credit Card (KCC)

National Bank for Agriculture and Rural Development prepared the model of KCC. This scheme is introduced in august 1998 by Indian banks on the recommendations of R.V. Gupta committee to provide long term loans for agriculture needs. Under this scheme,

beneficiaries are issued with a credit card and pass book or credit card cum pass book incorporating the name, address, particulars of land holding, borrowing limit, passport size photos of holders and validity period etc. Grand total of active KCC as on 31 January 2020 is 67,602,109.

6.2 Features of KCC

i. Interest rate can be low as 2%

ii. 1.60 lakh collateral free loans

iii. It also provides the crop insurance schemes to farmers

iv. It covers the insurance upto Rs.50000 against Permanent Disability and Death and upto Rs. 25000 against other risks

v. Card holders can take loan amount upto 3.00 lakhs

Table 1: State/UT Wise Number of Active KCC as on 31 Jan 2020

STATE	KCC	STATE	KCC
Uttar Pradesh	11,112,690	Uttarakhand	51336
Maharashtra	6,415,573	Himachal Pradesh	368,863
Madhya Pradesh	5,901,187	Tripura	270,970
Rajasthan	5,727,665	Jammu and Kashmir	119,515
Andhra Pradesh	4,855,746	Meghalaya	90,504
Karnataka	4,185,333	Nagaland	34,226
Telangana	4,239,359	Manipur	25,156
Odisha	4,123,977	Mizoram	20,889
Bihar	3,138,038	Puducherry	14,207
West Bengal	3,069,582	Arunachal Pradesh	14,053
Gujarat	2,417,779	Sikkim	13,864
Tamil Nadu	2,011,373	Goa	6,633
Haryana	2,083,526	A&N Islands	5,345
Punjab	1,881,187	Delhi	3,599
Chattisgarh	1,512,318	Chandigarh	494
Kerala	1,372,645	Dadra Nagar Haveli	438
Jharkhand	1,114,772	Lakshadweep	413
Assam	907,540	Daman and DIU	314

Source: https://pmkisan.gov.in

6.3 Pradhan Mantri Fasal Bima Yojana

PMFBY launched on 18 February 2016 by PM Narendra Modhi is an insurance service for farmers for their yields. It replacing earlier two schemes National Agriculture Insurance Scheme (NAIS) and Modified National Agriculture Insurance Schemes (MNAIS) and formulated in line with **One Nation One Scheme.**

6.3.1 Feature of the scheme

- **i.** It covers oil seeds, food crops and annual commercial/ annual Horticulture crops.
- **ii.** Uniform premium of only 2% to be paid by farmer for Kharif crops & 1.5% for Rabi crops.
- **iii.** In case of annual commercial and horticultural crops the premium to be paid by famers will be only 5%.
- **iv.** The farmers paid very low premium rate and balance of premium paid by government to provide full insured amount to the farmers against crop loss on the account of natural calamities.

6.4 Restructure Weather Based Crop Insurance Scheme (RWBCIS)

RWBCIS was launched on 18 Feb 2016 by PM Narendra Modhi. This scheme is implemented in 12 states in Kharif (2016) and 9 states in Rabi (2016-17). Its main aim is to mitigate the hardship of the insured farmers against the financial loss resulting from adverse weather conditions relating to humidity, rainfall, wind and temperature.

Table 2: PMFBY & RWBCIS

State /UT Name	Number of farmers insured (in lakhs)	Number of farmers benefited (in lakhs)
A&N Islands	0.007	-
Andhra Pradesh	24.462	13.440
Assam	.738	.001
Chhattisgarh	15.704	6.549
Goa	0.003	0.000
Gujarat	21.710	13.847
Haryana	14.437	4.196
Himachal Pradesh	2.690	1.272
Jammu &Kashmir	1.537	0.197
Jharkhand	12.936	0.580
Karnataka	19.534	13.261

Kerala	0.570	0.393
Madhya Pradesh	73.533	16.467
Maharashtra	148.073	77.153
Manipur	0.015	0.000
Meghalaya	0.009	-
Odisha	20.985	6.581
Puducherry	0.101	0.005
Rajasthan	71.821	19.447
Sikkim	0.002	0.000
Tamil Nadu	24.219	17.122
Telangana	7.889	0.362
Tripura	0.021	0.002
Uttar Pradesh	61.270	6.088
Uttarakhand	1.928	0.840
West Bangal	51.266	7.122
Grand Total	**575.5**	**204.9**

Source: PMFBY & RWBCIS Combined annual report 2018-19

7.0 PROBLEMS FACED BY FARMERS

i. Rain fed agriculture

Indian agriculture is largerly dependent on rainfall. The behaviour of summer monsoon is highly erratic. Regular rainfall is usually vital to healthy plants but too much and too little rainfall can harmful for agriculture. Drought can increase erosion and kill crops where over wet water can cause harmful fungus growth.

ii. Primitive farming

Primitive farming is the oldest form of agriculture. In this farming farmers grow food only for themselves and their families and farming is done on the basis on self sufficient. Some small surpluses either exchanged by barter or sold for cash. It resultant a little change for improvement in economy.

iii. Low level of formal education and skills

In India a very little attention is being paid for training and education of farmers for the adoption of new techniques and innovations to increase their agriculture production. There is no coordination between farm and research laboratories. It is important for farmers to have a reasonable level of awareness regarding information on agriculture.

iv. Credit and indebtedness

NABARD's financial inclusion survey 2018 showed 52.5 percent of all agriculture households in India were indebted with the average debt of 1.04 lakh. The main reason of indebtedness is unproductive and wasteful expenditure of the loans, poverty and lack of education, inherited debts and waste of money on litigation.

v. Soil erosion

Erosion is divided into water erosion, wind erosion, zoogenic erosion, anthropogenic erosion and snow erosion. Soil erosion is the displacement of the upper layer of soil. Main causes of soil erosion are rainfall and flooding, agriculture, logging and mining, grazing and constructions etc. All there causes are prompt to lose the fertility of land.

8.0 CONCLUSION

It is conclude that for economic development of a nation, agriculture plays a significant and effective role. Present scenario of agriculture and its working techniques are changed with the development of technological innovations. But problems related to irrigation infrastructure, market infrastructure and transport infrastructure increases the cost of farmers operations. Various financial services such as KCC helps the farmers to meet the financial needs and crop insurance schemes are helpful to farmers for reducing the risk. Government of India invest in various projects to modernisation of Indian farming.

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CHAPTER 20

SUSTAINABLE USE OF NATIVE ETHNOMEDICINAL PLANTS GROWING IN TRADITIONAL PLANTATIONS BY THE KHASI TRIBE RESIDING NEAR ASSAM - MEGHALAYA BORDER IN KAMRUP DISTRICT, ASSAM

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ABSTRACT

The paper documents the use of native ethnomedicinal plants growing in traditional plantations by the Khasi tribe residing in Langpi village, near Assam - Meghalaya interstate border, in Boko sub-division of Kamrup district, Assam. Personal interviews and in-depth discussions were held with the local medicine men to collect data on medicinal plant utilization. Total 30 medicinal plants belonging to 28 families were recorded which are used in treating different diseases like diarrhea and dysentery, gout and rheumatism, cough and cold, high-blood pressure, malaria, liver aliments, cuts and wounds, boils and abscess, bone fracture, etc. The medicinal plants are arranged according to their scientific names, followed by family, English and local names, and detail use. Systematic documentation of medicinal plant knowledge is vital in preserving the traditional knowledge of the tribe and in understanding the sustainable human-environment interactions.

Keywords: Ethnomedicinal plants, indigenous knowledge, langpi, sustainable, khasi

1.0 INTRODUCTION

Ethnomedicine is a complex multi-disciplinary system constituting the use of plants, spirituality and the natural environment and has been the source of healing for people for millennia (Lowe *et al*., 2000). The knowledge and practice of using locally available ethnomedicinal plants by different tribal communities worldwide to cure different diseases bears a testimony of their indigenous knowledge system (IKS). According to the WHO, about three-quarter of the world population relies upon traditional remedies (mainly herbs) for the health care of its people (Gilani *et al.*, 1992). The age-old IKS of ethnomedicine include vital

components like extensive knowledge of the tribal people about their surrounding floral resources, the rich heritage of herbal medicines prepared from various plant species and the practice of transmitting such knowledge orally from generation to generation; which is seldom, if ever, documented. An estimated 25% of prescribed drugs and 11% of drugs considered essential by WHO are derived from plants, and a large number of synthetic drugs obtained from precursor compounds originates from plants (Rates, 2001). The indigenous knowledge of ethnomedicinal plants is useful not only for conservation of biodiversity and cultural traditions, but also for community healthcare and is one of the most successful criteria used by the pharmaceutical industry in finding new therapeutic drugs for the various fields of biomedicine. Traditional plantations include homestead gardens, bamboo plantations, firewood reserve forests, clan jungles, etc. which are easily accessible within minutes and located either in the backyard of the house, outer margin of the village boundary, vacant or abandoned plot of land within the village, and sidewalk of village footpaths and roads. Traditional plantations both private and community owned are maintained by most of the hills and plains tribal communities of Assam, where varieties of trees are integrated in the crops and livestock production systems according to the agro-climatic and other prevailing conditions. These systems are managed indigenously with practices having been evolved by farmers through trial and error over long periods of time (Rai and Proctor, 1986). A wide variety of local rhizomatous crops, vegetables, medicinal herbs, creepers, climbers and bamboo species are grown (as well as grow naturally) with a number of fruits and other trees in the traditional plantations which are valuable for the day-to-day life of the tribal people.

North East (NE) India represents an important part of the Indo-Myanmar biodiversity hotspot, one of the 25 global biodiversity hotspots recognized currently (Myers *et al*., 2001). The region possesses an abundance of floral species and many are accredited with medicinal value. The tribal communities viz. the Rabhas, the Garos, the Khasis, etc. inhabiting the interior areas of Assam - Meghalaya interstate border have a vast store of traditional knowledge of their local landscape and its floral diversity. The ethnomedicinal plant species in traditional plantations and their therapeutic uses in this region need to be explored in detail and documented. In this backdrop, an attempt has been made in the present brief study to identify and document the use of some prominent local medicinal plants available in traditional plantations by the Khasi tribe of Langpi village, Assam-Meghalaya border. It is hoped that the data contained in this paper will be a useful lead for further phyto-chemical and pharmacological studies.

2.0 MATERIALS AND METHODS

2.1 Study area

Langpi village is located in an interior area near the Assam-Meghalaya interstate border of Kamrup district in Assam and West Khasi Hills district in Meghalaya. It falls under the Boko sub-division of Kamrup district, Assam. The village lies approximately between 25°50″ and 10.65″N latitude and 91°10″ and 9.78″E longitude. The village is surrounded by hills (of the Eastern Himalayan Region) and sub-tropical semi-evergreen forests; there are a number of fresh water streams which gives it a scenic beauty, and the temperature remains cool even during the summer. Langpi has a population of about 11000, mostly belonging to the Khasi tribe. The Khasis are a schedule tribe; an indigenous ethnic community of Meghalaya with a significant population in the bordering state of Assam. They speak Mon-Khmer, classified as part of the Austroasiatic language family. They follow the matrilineal system of descent and inheritance. Agriculture and live stock rearing are the main economic activity of Langpi. *Jhum* cultivation is still prevalent.

2.2 Data collection and analysis

Field work was conducted in July, 2019. Data was collected through interviews and in-depth discussions held with the traditional medical practitioners or traditional healers. Traditional plantations maintained by the people were visited to have a firsthand knowledge. The documented ethnomedicinal plants are identified by consulting standard literature on local flora (Dutta, 1985; Kanjilal *et al*., 2005). Plant species are enumerated according to their scientific names, followed by family, English and local names; part/s used; methods of medicine preparation; route of administration and application in the treatment of a particular disease/s.

3.0 RESULTS AND DISCUSSION

i. **Acorus calamus L.** (Araceae; Sweet flag; Ryniaw) **–** Leaf decoction is taken daily in cases of paralysis. Decoction of root/rhizome is fomented on the body of paralytic patient.

ii. **Ageratum conyzoides L.** (Asteraceae; Goat's weed; Kynbat myngai) – Fresh leaf paste is applied on cuts and wounds.

iii. **Allium tuberosum Roxb.** (Liliaceae; Garlic Chives; Gyllang) **-** Leaf decoction is given in urinary problems as diuretic.

iv. **Amomum aromaticum Roxb.** (Zingiberaceae; Bengal cardamon; Ilashi saw) **-** During nausea and vomiting, the rhizome is smashed and made into paste, mixed in hot water and the filtrate taken directly.

v. **Areca catechu Burm.f.** (Arecaceae; Betel nut; Kwai) - Nut crushed and mixed with lime is applied on cuts.

vi. **Azadirachta indica A.Juss** (Meliaceaae; the Margosa tree; Dieng nim) - Extract of fresh boiled leaves are used for curing diarrhea and dysentery.

vii. **Begonia roxburghii A.DC.** (Begoniaceae; East Himalayan Begonia; Dieng jajew) - Root stock is taken in bile dysentery. Fresh leaf decoction is used for bathing a person with measles for quick relief.

viii. **Centella asiatica L.** (Apiaceae; Indian Pennywort; Khliangsyiar) - Leaves are taken to cure blood deficiency, helps in purification of blood.

ix. **Cheilanthes albomarginata C.B.Clarke** (Pteridaceae; Lipfern; Jyrkhanglieh) - Crushed leaf paste is applied over boils and abscess.

x. **Citrus latipes (swingle) Yu. Tanaka** (Rutaceae; Sweet lime; Sohkymphor) - Paste of leaves is applied on joints to cure gout and rheumatism.

xi. **Clerodendrum colebrookianum Walp.** (Verbenaceae; East Indian glory bower; Sla jarem) - Leaf decoction is taken against high-blood pressure, malaria and liver aliments.

xii. **Coix lachryma-jobi L.** (Poaceae; Job's tear; Sohriew) - Leaf juice extract is taken in diarrhea, dysentery, fever, small pox and also as a tonic.

xiii. **Crassocephalum crepidiodies (Benth.) S. Moore** (Asteraceae; Fireweed; Gathymmai) - Leaf paste is applied on cuts and wounds.

xiv. **Dendrobium chrysanthum Wall.ex. Lindl.** (Orchidaceae; the Golden Yellow Flowered Dendrobium; Jiew Lyngskaw) - Stem paste is mixed with little water and applied externally on injuries.

xv. **Dischidia nummularia R.Br.** (Apocynaceae; String of Nickels; Kynbatnudam) - Leaf pastes are applied on wounds, injuries and bone fractures.

xvi. **Drymaria cordata (L.) Willd.ex Roem & Schult** (Caryophyllaceae: Heart Leaf Drymary; Kynbatthalap) - Whole plant paste is applied in case of leprosy and in snake bite.

xvii. **Erythrina arborescens Roxb.** (Papilionaceae; Himalayan Coral Tree; Diensong) - Smoke from burnt stem pieces give relief from toothache.

xviii. **Flemingia procumbens Roxb.** (Fabaceae; Ajhar; Sop-hlang) - Tuber skin is taken for de-worming.

xix. **Gaultheria fragrantissima Wall.** (Ericaceae; Wintergreen; Lathynrait) - Leaf juice is massaged over the body of persons suffering from rheumatism and paralysis.

xx. **Geranium nepalense Sweet** (Geraniaceae; Nepal Geranium; Baltmeing) - Leafs are chewed for relieve from toothache and bleeding gums.

xxi. **Hedyotis scandens Roxb.** (Rubiaceae; Mo-shoh shu) - Tender raw leaves taken for gastric trouble; decoction of the fresh leaves is taken for curing cough and cold.

xxii. **Houttuynia cordata Thunb.** (Saururacae; Fish mint; Gamyrdoh) - Leaf paste is used for cholera, dysentery, curing of blood deficiency and purification of blood.

xxiii. **Mallotus philippensis (Lam.) Mull. Arg.** (Euphorbiaceae; Monkey face tree; Dieng chandan) - Powdered dry fruits mixed with little sugar are taken to get rid of tapeworm.

xxiv. **Oxalis corniculata L.** (Oxalidaceae; Indian sorrel; Jabuit) - Leaf paste is used as medicine for diarrhea.

xxv. **Pouzolzia hirta Blume ex. Hassk.** (Urticaceae; Memsleh) - The root extract is used as hair tonic.

xxvi. **Prunella vulgaris L.** (Lamiaceae; Woundwort; Gahy mwet) - Tender leaf paste is applied on cuts and wounds for quick healing.

xxvii. **Psidium guajava L.** (Myrtaceae; Gauva; Soh priam) - The crushed leaves extract is taken orally in case of chronic dysentery.

xxviii. **Rubia cordifolia L.** (Rubiaceae; Indian Madder; Rhoi) - Paste of leaves is applied for ulcer and the crushed roots for poisonous stings of insects.

xxix. **Smilax glabra Roxb.** (Smilacaceae; Glabrous greenbrier; Khong) - The juice of fresh leaves is applied for curing skin diseases.

xxx. **Terminalia chebula Retz.** (Combretaceae; Chebulic Myrobalans; Soh salukah) - Roasted fruits are eaten as a diuretic. Paste prepared from roots is used for curing conjunctivitis.

The present study documented a total of 30 native medicinal plant species belonging to 28 families that are used to cure different diseases and disease conditions. For medicine preparation, fresh collected leaves are the most frequently used plant part; while, stem, fruit, seeds, roots, bark and latex are the other plant parts suitably used. They are crushed to a paste when applied externally; and squeezed for juice and made decoction in combination with water when taken internally. Dose regimen is determined by the type of disease and its severity. It is observed that, sometimes a single medicinal plant is used to cure more than one disease. *B. roxburghii*, *C. colebrookianum*, *C. lachryma-jobi*, *G. fragrantissima* and *H. cordata* are found to be used in such manner. Plants species like *A. calamus*, *C. asiatica*, *C. lachryma-jobi*, *D. cordata*, *H. cordata* and *T. chebula* recorded in the present study are also

used by other tribal communities' viz. Apatani, Tai Khamti, Angami Naga and Lepcha inhabiting the NE Indian states of Arunachal Pradesh, Nagaland and Sikkim respectively in their respective ethnomedicine preparation (Kala, 2005; Das and Tag, 2006; Pradhan and Badola, 2008; Chase and Singh, 2013); however, the utilization pattern differs. The traditional medicine men of the study village have vast ethnomedical knowledge and are expert service providers. They detect and diagnose diseases based on general observation of the patient, the symptoms told by the patient as well as their personal knowledge about specific descriptions of the disease characteristics.

Most of the medicinal plants are collected fresh from their natural habitat i.e. traditional plantations just before use. A good number of medicinal plants were found to be grown by the medicine men/traditional healer as well as by the people in their homestead gardens. This is an important aspect of the traditional knowledge (TK) of the people in preserving the native plant genetic resource. The selective and judicious use of the native medicinal plants from the natural environment provides enough breathing space to the plant species to grow and propagate. This nature based TK has been responsible for maintaining the man-nature equilibrium and sustainable use of plant resources (Sonowal and Sonowal, 2017), which is an important element of their rural livelihood and traditional culture. The documented plants species proves that the study area is rich in biodiversity with the availability of abundant high value medicinal plants. Thus, the present study will further help in conservation of traditional ethnomedicinal knowledge as well as formulating a feasible roadmap to harness the enormous potential of the region's medicinal plant diversity towards human welfare through scientific research for new and possibly more effective drug discovery.

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CHAPTER 21

CONSERVATION OF SUNDARBANS MANGROVE ECOSYSTEM AND SUSTAINABLE USE OF BIODIVERSITY: A SOLUTION TO COASTAL ENVIRONMENTAL DISASTERS

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ABSTRACT

Indian Sundarbans, being the UNESCO's world heritage site and holding the largest coastal mangrove ecosystem in the world provides a wide range of ecosystem services with highly productive ecological communities. The largest salt-tolerant mangrove forest is acting as a natural shield protecting our shoreline facing Bay of Bengal from major erosion damages due to frequent natural calamities. Being one of the most fertile regions in the world, Sundarbans mangrove efficiently modulate ecological, biogeochemical as well as anthropogenic functions on a range of time scales, thus providing a great source of natural experiments for studies on biodiversity and ecosystem functions. Unfortunately, due to overexploitation and rapidly growing anthropogenic challenges, there is prime need of conservation and restoration of the valuable heritage ecosystem. The climate change and sea level rise poses another threat to this area and its biodiversity. Its sustainable development can only be ensured through adopting a set of policies especially related to the accessibility of forest resources. Hence, the prime objective of this article is to aware people for conserving the world's largest mangrove ecosystem for sustained production and resource utilization for present and future generations.

The unique ecosystem is acting as 'bioshield' or 'biowall' providing first line of defence against devastating cyclones, typhoon or tsunamis by reducing water flow pressure, wind velocity and saline water intrusion. The records of 21st century cyclonic hits to West Bengal reveal that the mesmerizing mangrove forest of Sundarbans had been saving the coastal region of Bengal and Kolkata repeatedly from the devastating impact of cyclones. The mangrove ecosystem was recently threatened by a super cyclone, Amphan on 20th May 2020, which was one of the strongest recorded tropical cyclones of 21st century originated from Bay of Bengal.

The deterioration of mangroves can lead to serious consequences, including reduction in biodiversity, species decline, extinction, increased flooding, and decline in water quality. Hence, there is an urgent need to protect the remaining mangrove areas and accelerate mangrove plantation campaign by Government and local governess. The sustainable ecosystem approach lies in the conservation of each and every component of this valuable ecosystem for maintaining the biodiversity and equilibrium. Thus, the existence of heritage forest of Indian Sundarbans and sustainability of its valuable resources depend on effective future developmental measures and successful implementation of sustainable management plans, which could be achieved by sound management strategies involving local beneficiaries, stakeholders and governments at all levels.

Keywords: Mangroves, biodiversity, Sundarbans, sustainability, environmental disasters

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1.0 INTRODUCTION

The Sundarbans, which means 'beautiful forest' is the largest coastal mangrove ecosystem of the world and derives its name from Sundari trees found there. The world's largest mangrove forest covers an area of about one million hectare, whose major part is situated in Bangladesh (~ 60%), while remaining portion lies within India (~ 40%). The western part of Sundarban constitutes the Indian Sundarbans, whose southern proximity meets the Bay of Bengal. It is also the world's largest coastal wetland and unique of its type, and recognized as a site of national and international importance. The major forest types of Sundarbans heritage forests include Tidal swamp forests, saline water type mixed forests, brackish water type mixed forests and palm swamp type forests.

The Indian Sundarbans listed as a World heritage site by UNESCO in 1989, is a part of World's largest delta formed by the super confluence of three major rivers, the Ganges, Brahmaputra and Meghna in the lap of Bay of Bengal. Spanning across the Ganges-Brahmaputra river, the delta comprises of closed and open mangrove forests, agricultural lands, mudflats, and is webbed by numerous tidal streams and channels. The total area of Sundarbans consists of 102 islands, of which 48 are forested and 54 are tiny habitable islands crisscrossed by innumerable tributaries of the Ganges.

The whole Sundarbans area was declared as Biosphere reserve in 1989, within which 1330.12 square km. is the core area representing the Sundarban National Park, which holds world's largest estuarine mangrove forest. The buffer zone of area 362.338 square km. surrounding the core zone includes Sajnekhali Wildlife Sanctuary. The prime objective of the

marine biosphere reserve is the protection, conservation and scientific utilization of marine environment. Out of the total area of 4263 sq. km of Indian Sundarbans, an area of about 2585 sq. km falls under Sundarbans Tiger Reserve, which is further divided into four territorial ranges.

2.0 SUNDARBANS MANGROVES – THE MESMERIZING ECOSYSTEM AND WEALTH OF COUNTRY

In India, mangrove forest accounts for about 5% of the world's mangrove vegetation, spreading along the coastal states and Union territories of the country. Sundarbans support the single largest contiguous block of mangrove forest ecosystem in the world and constitutes over 60% of the country's total mangrove forest area. The Indian Sundarbans mangrove forest accounts for 4263 sq. km spreading over two districts of West Bengal, South 24 Parganas and North 24 parganas. The ecosystem is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests dominated by mangrove swamps. The major rivers flowing through this ecosystem are Saptamukhi, Thakurain, Matla and Gosaba. Indian Sundarbans is bounded on the west by river Muriganga and on the east by rivers Harinbhanga and Raimangal. Out of the 50 species of mangroves recognized world over, only 35 species is known to occur in Sundarbans. The most abundant tree species of the forest include Sundri, Goran, Byne, Gewa Garjan etc.

Mangrove forests are highly productive and biodiverse wetlands supporting unique ecosystems and provide wide range of ecosystem services. Mangroves act as natural carbon sinks by taking carbon dioxide out of the atmosphere and storing in their biomass for many years. The locked carbon in these plants is termed as Blue carbons. The mangrove trees lining the eastern coast that faces Bay of Bengal, act as critical membrane between terrestrial and marine ecosystems by trapping sediments flowing down rivers and off the land. They are soft tolerant trees having complex root system and salt filtration system to cope with salt water immersion and wave action. The characteristic root systems of mangrove trees comprised of aerial pneumatophores and underground anchoring roots slows down the movement of tidal waves resulting into building of sediments and muddy bottom. The biodiversity rich ecosystem also provides food security to coastal communities through coastal fisheries in east coast of India providing one of the solutions to poverty reduction. Besides mangrove system supports a wide range of wildlife species and home to a large variety of fish, crab, shrimp, and mollusc's species. Interestingly, it is one and only mangrove forest in the world inhabited by Royal Bengal Tiger (*Panthera tigris tigris*).

3.0 ECOSYSTEM SERVICES PROVIDED BY SUNDARBANS MANGROVE

The extraordinary mangrove ecosystem is performing multiple ecological functions, from wildlife habitat to stabilization of shorelines/riverbanks. The unique mangrove forest is also providing a wide range of economic functions, thus helping in improving socio-economic conditions of the coastal communities. The various ecosystem services offered by Sundarbans mangrove ecosystem are as follows:

3.1 Provisioning services

- Economically, mangroves are serving as source of timber charcoal, food, fodder and variety of products for coastal communities.
- The coastal mangrove wetlands are efficiently balancing the energy requirements in the coast by supporting the agriculture, coastal fisheries, and shrimp farming.
- Providing pharmaceutical compounds.

3.2 Supporting services

- Anaerobic mangrove swamps are having the capacity to trap heavy metals and pesticides, thereby improving water quality of coastal areas.
- Mangroves are also providing a natural filtering system for runoff water thereby helping water quality of coastal areas by extracting chemical pollutants from water.
- The presence of some cyanobacterial strains are serving as important source of biofertilizer.
- Maintaining valuable ecosystem services.
- Maintaining the biodiversity and lifecycle.

3.3 Regulating services

- The mangroves of Indian Sundarbans are protecting our shoreline facing Bay of Bengal from major erosion damages due to waves, tropical storms and water runoff, thus acting as a first line of defence against coastal erosion.
- Sundarbans mangrove acting as ‘Bioshield’ or ‘Biowall’ against natural calamities like cyclones, typhoon or tsunamis by reducing water flow pressure, wind velocity, and saline water intrusion.
- Acting as ‘living buffer’ preventing coastal flooding and damage to infrastructure, thereby reducing loss of life. Actually, they have reserve capacity to absorb large quantities of storm waters.
- They exert a breakwater effect in absorbing most of the energy of wave action, thus protecting housing and service structures.

- The mangroves are efficiently involved in carbon sequestration because of their quality to absorb high quantity of atmospheric CO_2 by efficient photosynthesis.
- In this way the dense mangrove canopy stores the maximum green house gases thereby reducing the atmospheric heat and imparting cooling effect by mitigating global warming and climate change.
- Regulation of water quality.
- Finally regulation of natural hazards and climate.

3.4 Cultural services

- Recreational, aesthetic enjoyment, spiritual benefits
- Physical and mental health benefits
- Coastal tourism

4.0 BIODIVERSITY OF SUNDARBANS HERITAGE FOREST

Indian Sundarbans being the largest coastal mangrove ecosystem in the world is a home to almost 500 species of reptile, fish, bird and mammals. The region provides ideal habitats for a variety of unique flora and fauna. Sundarbans mangroves are habitats of many rare and threatened wildlife species like Royal Bengal Tiger (*Panthera tigris tigris*), Rhesus monkey, Spotted deer, Fishing cat, Wild pig, Jungle fowl, Estuarine crocodiles (*Crocodilus porosus*), Marsh crocodiles (*Crocodilus palustris*), Water monitor lizard, Gangetic dolphin, Olive ridley turtle etc.

i Floral biodiversity

334 species of plants, 105 species of flowering plants, 150 species of algae, 32 lichens and 32 species of shrubs.

ii Faunal biodiversity

49 species of mammals, 320 species of birds, 53 reptilian species, 11 amphibian species, 210 species of fishes, invertebrates, benthic invertebrates, phytoplankton, zooplankton, fungi, and bacteria.

iii Invertebrate diversity

104 species of Protozoans, 68 species of Nematodes, 78 species of Annelids, 240 species of Crustaceans, 201 species of Insects and 143 species of Molluscs.

5.0 THREATS TO BIODIVERSITY AND HABITATS OF HERITAGE FOREST OF INDIAN SUNDARBANS

Sundarbans are considered as one of the most threatened ecosystems of the world due to anthropogenic activities and global climatic changes. The valuable ecosystem is losing its

beauty and declining at faster rates (1 to 2% per year) than any other ecosystems on earth because of its ecological fragility and climatically vulnerability. Their destruction and degradation will eventually bring about tremendous ecological, social and economical losses in future. A number of species like Javan rhinoceros (Rhinoceros sondaicus), water buffalo (Bubalus bubalis), swamp deer (Cervus duvauceli), hog deer (Axis porcinus) and marsh crocodile (Crocodilus palustris) became extinct during the last 100 years from the Sundarbans. Also for the last two centuries, major areas of mangroves have been converted into agricultural fields and recently into shrimp farms. The mangroves forming the important and dominant flora of Sundarbans, have been extensively exploited over centuries. However, degradation of mangrove ecosystems on east coast of India are mainly due to continuous increase in anthropogenic activities such as conversion of mangrove wetlands for aquaculture and degradation of mangrove forest for timber. Further, the world famous Royal Bengal tiger (Panthera tigris tigris), which represents the flagship species and keystone species, is losing its unique habitat due to habitat shrinking. The future of the Sundarbans seems in real threat unless a holistic approach is made towards its conservation.

5.1 Anthropogenic causes

i Development of Shrimp aquaculture industry, Tourism industry.

ii Coastal development and Land development.

iii Conservation of mangrove wetland for agriculture.

iv Increasing demand for timber and fuel wood for consumption.

v Human encroachment and reclamation.

vi Habitat destruction through human encroachment.

vii Diversion of freshwater for irrigation and land reclamation.

5.2 Natural causes

i Climate change leading to natural calamities.

ii. Include salinity variations, coastal erosion, huge silt deposition and recurrent coastal flooding due to climate change.

iii. Reduction in the periodicity and quantity of freshwater reaching the mangrove areas.

6.0 CONSERVATION CONCERN OF THE WORLD'S LARGEST MANGROVE ECOSYSTEM AND SOLUTION TO ENVIRONMENTAL DISASTERS

There are evidences that the thick canopy of mangrove forest saved the city, Kolkata, from the devastating impact of Aila in 2009. Further, the dense canopy of mangroves reduced the wind speed of one of the most recent tropical cyclonic storms, Bulbul by 20 kilometres an hour, saving the rest of southern Bengal and more than 300 years old city, Kolkata from the

wrath of severe cyclonic effect. Once again the thick mangrove forest acted as defensive shield against the ferocity of very recent super cyclonic storm, Amphan, which hit the West Bengal coast on 20th May, 2020.

6.1 Records of 21st century cyclonic hits to Bengal

6.1.1 Cyclone AILA

- Severe cyclonic storm Aila hit Sundarbans with highest wind speed of 110 km/hr.
- Sundarbans mangrove canopy saved the city, Kolkata, from devastating impact by absorbing most of cyclone's fury.

6.1.2 Cyclone BULBUL

- The cyclone formed in Bay of Bengal hit the Sundarbans on 9th Nov, 2019 with a gusting wind speed of 130 km/hr.
- Dense canopy of mangroves reduced the wind speed of cyclone, Bulbul by 20 kilometres an hour, saving the rest of southern Bengal and Kolkata.

6.1.3 Cyclone AMPHAN

- Strongest super cyclone storm of 21st century, hit Sundarbans on 20th May, 2020 with a wind speed of 155-165 kmph.
- Destroyed about 1200 sq km of mangrove forest (>28 %) of Indian Sundarbans.
- West Bengal coast with thick mangrove forest acted as first line of defence against the ferocity of cyclone by reducing its intensity before it hit the other regions of West Bengal.

The heritage forest not only withstand the high velocity of cyclonic storm and reduced the speed drastically, but also helped to break the large tidal waves impinging on the coast, thereby saving the inhabitants and to larger extend biodiversity. Mangrove roots exerted a breakwater effect of storm surge in absorbing most of the energy of wave action, thus protecting housing and service structures.

6.2 Conservation and management

Sundarbans is losing its unique habitats and diverse flora and fauna due to pollution, rapidly growing human population, poaching, natural calamities and global climatic changes. Though mangrove ecosystem is fairly resistant to environmental perturbations and possess high resilience ability, the effects of anthropogenic pressures are often irreversible. Due to continuous increase in anthropogenic stresses, such as conversion of mangrove areas to residential, commercial, industrial and agricultural area by land filling, forests and habitats are in the verge of destruction. Mangrove wetlands are mainly converted for aquaculture like

shrimp farming and forests are destroyed mainly for timber. According to present scenario, 50% of the remaining mangrove forests are in the process of gradual degradation and thereby struggling for existence. Hence, irreversible long-term changes will definitely alter the ecological balance and sustenance of the valuable ecosystem. Therefore, strict protection measures and necessary steps should be taken in national as well as international level for the conservation of biodiverse ecosystem and its resources. More plantations of mangroves must be done in a scientific way so that the loss from the super cyclones can be recovered, as protection and conservation of mangroves ultimately leads to the large number of Blue carbon sinks which in context of cyclones acts as a dampener.

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CHAPTER 22

URBAN PLANNING

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1.0 INTRODUCTION

Urban planning is also referred to as **urban and regional planning**, **regional planning**, **town planning**, **city planning**, **rural planning**, **urban development**, **physical planning**, **urban management** or a similar combination in various areas worldwide.

Urban planning is a technical and political process that is focused on the development and design of land use and the built environment, including air, water, and the infrastructure passing into and out of urban areas, such as transportation, communications, and distribution networks. Traditionally, urban planning followed a top-down approach in master planning the physical layout of human settlements. The primary concern was the public welfare, which included considerations of efficiency, sanitation, protection and use of the environment, as well as effects of the master plans on the social and economic activities. Overtime, urban planning has adopted a focus on the social and environmental bottom-lines that focus on planning as a tool to improve the health and well-being of people while maintaining sustainability standards. Sustainable development was added as one of the main goals of all planning endeavors in the late 20th century when the detrimental economic and the environmental impacts of the previous models of planning had become apparent.

Similarly, in the early 21st century, Jane Jacob's writings on legal and political perspectives to emphasize the interests of residents, businesses and communities effectively influenced urban planners to take into broader consideration of resident experiences and needs while planning.

Urban planning answers questions about how people will live work and play in a given area and thus, guides orderly development in urban, suburban and rural areas. Although predominantly concerned with the planning of settlements and communities, urban planners are also responsible for planning the efficient transportation of goods, resources, people and waste; the distribution of basic necessities such as water and electricity; a sense of inclusion and opportunity for people of all kinds, culture and needs; economic growth or business development; improving health and conserving areas of natural environmental significance that actively contributes to reduction in CO_2 emission as well as protecting heritage structures and built environments. Urban planning is a dynamic field since the questions around how people live, work and play changes with time. These changes are constantly reflected in planning methodologies, zonal codes and policies making it a highly technical, political, social, economical and environmental field.

Urban planning is an interdisciplinary field that includes social science, architecture, human geography, politics, and engineering and design sciences. Practitioners of urban planning are concerned with research and analysis, strategic thinking, architecture, urban design, public consultation, policy recommendations, implementation and management. It is closely related to the field of urban design and some urban planners provide designs for streets, parks, buildings and other urban areas. Urban planners work with the cognate fields of architecture, landscape architecture, civil engineering, and public administration to achieve strategic, policy and sustainability goals. Early urban planners were often members of these cognate fields though today, urban planning is a separate, independent professional discipline. The discipline of urban planning is the broader category that includes different sub-fields such as land-use planning, zoning, economic development, environmental planning, and transportation planning. Creating the plans requires a thorough understanding penal codes and zonal codes of planning.

Another important aspect of urban planning is that the range of urban planning projects includes the large-scale master planning of empty sites or Greenfield projects as well as small-scale interventions and refurbishments of existing structures, buildings and public spaces. Pierre Charles L'Enfant in Washington DC, Daniel Burnham in Chicago and Georges-Eugene Haussmann in Paris planned cities from scratched, and Robert

Moses and Le Corbusier refurbished and transformed cities and neighbourhoods to meet their ideas of urban planning.

Figure 1: Partizánske in Slovakia – an example of a typical planned European industrial city founded in 1938 together with a shoemaking factory in which practically all adult inhabitants of the city were employed.

Figure 2: Berlin - Siegessäule. Spacious and organized city planning in Germany was official government policy dating back to Nazi rule. August 1963

1.1 History: Further information: History of urban planning

There is evidence of urban planning and designed communities dating back to the Mesopotamian, Indus Valley, Minoan, and Egyptian civilizations in the third millennium BCE. Archaeologists studying the ruins of cities in these areas find paved streets that were laid out at right angles in a grid pattern. The idea of a planned out urban area evolved as different civilizations adopted it. Beginning in the 8th century BCE, Greek city states were primarily centered on orthogonal (or grid-like) plans. The ancient Romans, inspired by the Greeks, also used orthogonal plans for their cities. City planning in the Roman world was developed for military defense and public convenience. The spread of the Roman Empire subsequently spread the ideas of urban planning. As the Roman Empire declined, these ideas slowly disappeared. However, many cities in Europe still held onto the planned Roman city center. Cities in Europe from the 9th to 14th centuries often grew organically and sometimes chaotically. But in the following centuries with the coming of the Renaissance many new cities were enlarged with newly planned extensions. From the 15th century on, much more is recorded of urban design and the people that were involved. In this period, theoretical treatises on architecture and urban planning start to appear in which theoretical questions around planning the main lines, ensuring plans meet the needs of the given population and so forth are addressed and designs of towns and cities are described and depicted. During the Enlightenment period, several European rulers ambitiously attempted to redesign capital cities. During the Second French Empire, Baron Georges-Eugène Haussmann, under the direction of Napoleon III, redesigned the city of Paris into a more modern capital, with long, straight, wide boulevards.

Planning and architecture went through a paradigm shift at the turn of the 20th century. The industrialized cities of the 19th century grew at a tremendous rate. The evils of urban life for the working poor were becoming increasingly evident as a matter of public concern. The laissez-faire style of government management of the economy, in fashion for most of the Victorian era, was starting to give way to a New Liberalism that championed intervention on the part of the poor and disadvantaged. Around 1900, theorists began developing urban planning models to mitigate the consequences of the industrial age, by providing citizens, especially factory workers, with healthier environments. The following century would therefore be globally dominated by a central planning approach to urban planning, not necessarily representing an increment in the overall quality of the urban realm.

At the beginning of the 20th century, urban planning began to be recognized as a separate profession. The Town and Country Planning Association was founded in 1899 and the first academic course in Great Britain on urban planning was offered by the University of

Liverpool in 1909. In the 1920s, the ideas of modernism and uniformity began to surface in urban planning, and lasted until the 1970s. In 1933, Le Corbusier presented the Radiant City, a city that grows up in the form of towers, as a solution to the problem of pollution and over-crowding. But many planners started to believe that the ideas of modernism in urban planning led to higher crime rates and social problems. The Decline of Detroit is an example of the impacts of social planning on a large urban area.

In the second half of the 20th century, urban planners gradually shifted their focus to individualism and diversity in urban centers.

1.2 21st century practices

Urban planners studying the effects of increasing congestion in urban areas began to address the externalities, the negative impacts caused by induced demand from larger highway systems in western countries such as in the United States. The United Nations Department of Economic and Social Affairs predicted in 2018 that around 2.5 billion more people occupy urban areas by 2050 according to population elements of global migration. New planning theories have adopted non-traditional concepts such as Blue Zones and Innovation Districts to incorporate geographic areas within the city that allow for novel business development and the prioritization of infrastructure that would assist with improving the quality of life of citizens by extending their potential lifespan.

Planning practices have incorporated policy changes to help address anthropocentric global climate change. London began to charge a congestion charge for cars trying to access already crowded places in the city. Cities are also prioritising public transit and cycling by adopting such policies.

1.3 Theories: Street Hierarchy and Accessibility

Planning theory is the body of scientific concepts, definitions, behavioral relationships, and assumptions that define the body of knowledge of urban planning. There are eight procedural theories of planning that remain the principal theories of planning procedure today: the rational-comprehensive approach, the incremental approach, the transactive approach, the communicative approach, the advocacy approach, the equity approach, the radical approach, and the humanist or phenomenological approach.[18] Some other conceptual planning theories include Ebenezer Howard's The Three Magents theory that he envisioned for the future of British settlement, also his Garden Cities, the Concentric Model Zone also called the Burgess Model by sociologist Ernest Burgess, the Radburn Superblock that encourages pedestrian movement, the Sector Model and the Multiple Nuclei Model among others.

1.4 Technical aspects: Technical aspects of urban planning

Technical aspects of urban planning involve the applying scientific, technical processes, considerations and features that are involved in planning for land use, urban design, natural resources, transportation, and infrastructure. Urban planning includes techniques such as: predicting population growth, zoning, geographic mapping and analysis, analyzing park space, surveying the water supply, identifying transportation patterns, recognizing food supply demands, allocating healthcare and social services, and analyzing the impact of land use.

In order to predict how cities will develop and estimate the effects of their interventions, planners use various models. These models can be used to indicate relationships and patterns in demographic, geographic, and economic data. They might deal with short-term issues such as how people move through cities, or long-term issues such as land use and growth. One such model is the Geographic Information System (GIS) that is used to create a model of the existing planning and then to project future impacts on the society, economy and environment.

Building codes and other regulations dovetail with urban planning by governing how cities are constructed and used from the individual level. Enforcement methodologies include governmental zoning, planning permissions, and building codes, as well as private easements and restrictive covenants.[22]

1.5 Urban planners

An urban planner is a professional who works in the field of urban planning for the purpose of optimizing the effectiveness of a community's land use and infrastructure. They formulate plans for the development and management of urban and suburban areas, typically analyzing land use compatibility as well as economic, environmental and social trends. In developing any plan for a community (whether commercial, residential, agricultural, natural or recreational), urban planners must consider a wide array of issues including sustainability, existing and potential pollution, transport including potential congestion, crime, land values, economic development, social equity, zoning codes, and other legislation.

The importance of the urban planner is increasing in the 21st century, as modern society begins to face issues of increased population growth, climate change and unsustainable development. An urban planner could be considered a green collar professional.[23]

Some researchers suggest that urban planners around the world work in different "planning cultures", adapted to their local cities and cultures.[24] However, professionals have

identified skills, abilities and basic knowledge sets that are common to urban planners across national and regional boundaries.

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CHAPTER 23

PUBLIC DISTRIBUTION SYSTEM IN INDIA: AN INITIATIVE FOR SUSTAINING LIFE

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1.0 INTRODUCTION

Public Distribution System and Food Security go hand in hand. Both are justifying their presence on each other. PDS ensures food security in the country. Food security includes two aspects. Firstly, having enough purchasing power or income of beneficiaries to buy food and secondly, is the access to food. The significance of food security has recently gained both global and domestic centre of attention because the idea and its implementation cover strategies going away from food crop production. Food security will only be accessed when the poor, vulnerable and marginal worker, chiefly women, under nourished children and those existing in the marginal areas have safe and sound access to the food they want.

1.1 Public Distribution System- An Overview

The nature has provided sufficient required food for all organisms. But the challenge and reality is wide- spread hunger in many parts of the world. The published data highlights one billion people suffer from hunger and around 800 million malnourished. The Red Cross Society has highlighted the data for children dying under the age of 5 due to malnutrition were 6 million worldwide Bhattacharya et al. (1991). After independence since 1947, the food security was shifted from individual households to state and central government Ahluwalia (1993). World Development Report (1986) defined food security as “access by all the people at all times to enough food for an active, healthy life”. Food and Agriculture Organization FAO (1983) defined food security as “ensuring that all people at all times have both physical and economic access to basic food they need”.

Basically Food security is built upon three pillars namely, Food availability, Food accessibility and Food Affordability. Food use is also an important aspect of food security that is consumption of food based on basic knowledge of required nutrition and care followed with adequate water and sanitation. Majority of population in developing countries like India has limited access to food entitlements and supply especially in food deficit areas. The main factor to back up this point is limited purchasing power of BPL families. The Global Food Security index (GFSI), 2018 considered four core issues of food security across 113 countries; affordability, availability, quality and safety and natural resources and resilience. India ranked 76 out of 113 countries with overall food security score of 50.1 out of 100 and ranked number 1 in nutritional standards GOI (2018-19). According to National Family Health survey (1998-99) and National Sample survey (1999-2000), large proportion of BPL and food insecure population suffers from malnutrition and calorie deprivation. Reason behind this suffering is error of exclusion (Mane, 2006). The increase in price of rice had a negative impact on child nutrition (Tarozzi, 2005).

Hence, Public Distribution System (PDS) is the most important medium through which central and state governments ensures food security. PDS comprises of distribution of essential commodities to the public at large through vast network of Fair Price Shops (FPSs). The essential commodities comprises of wheat, rice, sugar and kerosene oil (Swaminathan and Mishra, 2001). PDS of India falls under the Ministry of Consumer Affairs and Public Distribution and managed jointly with state governments for providing subsidized food to BPL families. The Public Distribution System (PDS) is a direct state intervention in national distribution system of goods (Bhandari, 2002). According to Ruddar Dutt, "Public Distribution System helps in ensuring supply of essential consumer goods of mass consumption to people at reasonable prices particular to weaker section of society." Moreover, public distribution system has a permanent feature to protect the vulnerable sections of the society by controlling prices and distribution of essential commodities (Suryanarayana, 1993).

The backbone of the PDS is the public procurement of major food grains at the national level which is under the control of Food Corporation of India (FCI). FCI was specifically created by the Act of parliament in the year 1965. The basic function of FCI is to procure food grains to fulfill the objective of food security in India with the active support of state agencies which has been created by the state governments over the period of time. Though Government of India has recently enacted National Food Security Act, 2013 through which government is bound to provide minimum requirements of food grains mainly wheat,

Rice sugar and pulses to the people with low income; however this has been in practice after independence through FPSs under TPDS at the state level. So present chapter has been planned to present the overview of the procurement process in India Vis-a-Vis the states. There is close relationship between the public procurement, the storage capacity of the central and state agencies, transportation system on which the shifting of food grains largely depends i.e. railway networking, the expansion of Fair price shop prices and the deterioration in the income of the lower segment of the society.

The Central Government is responsible for the procurement of food grains, storing and transporting the PDS ration items and making them available to State Governments. Food Corporation of India (FCI) is the custodian of all the stocks and procures food grains like, wheat, levy sugar, rice, soft coke, imported edible oil and kerosene under Minimum Support Price (MSP) operations. The Central Government maintains buffer stock and allocates food grains to States and Union territories according to NFSA, 2013. The allocation is based upon Central Issue Price (CIP) which is determined by Central Government and involves food subsidies which are borne by the central Government. PDS is based on the principle of distributive social justice in which food grains are distributed on the basis of identified BPL families and who possess ration cards. Ration card is a document which is issued by the state governments to the identified BPL families for the purchase of essential commodities from Fair Price Shops. State Governments issue distinctive Ration Cards to Below Poverty Line (BPL), *Antyodaya Anna Yojna* (AAY) families and Above Poverty Line (APL) families (*www.epds.nic.in*).

1.2 Evolution of Public Distribution System

India being an agricultural country faces a lot of famines and droughts resulting in scarcity of food for BPL families. To overcome this condition government started taking measures to help the victims through food security system (Tyagi, 1990). During Second World War 1939 under British regime for the first time food grains were distributed among poor. The 6th Price Control Conference laid down the basic principle of PDS which was held in September, 1942.

Similarly, in December, 1942 Food department was set up to dealt with the issues like procurement, inspection, storage and PDS. The basic objective was stabilization of food prices. Then, in 1943, the Food Grains Committee recommended the introduction of rationing system in the urban areas with a population of more than 1, 00,000. After the partition India lost its most fertile land and cereal production. However, in December, 1947, policy of decontrol was announced under the influence of Mahatma Gandhi. In September, 1948 with

the reintroduction of controls policies kept on changing and further shift to decontrol during 1952-54.

During the year 1958-66 imports of food grains were high which induced USA to withhold grains in the last minute. In 1966, the imports reached to 14.00 per cent of the food grain availability which led to abundant supply and resulted in major crisis in domestic production of food grains. The Food Corporation of India (FCI) was established to support food grain management system in India. FCI performed the functions like procurement, storage, transport, distribution and sale of food grains. The study team on FPSs under the chairmanship of V.M. Dandekar, observed that imports of food grains were inadequate to fulfill the increased demand of food grains through FPSs. The team recommended that pricing of food grains should be market oriented. Policy of maintaining buffer stocks was also initiated under the guidelines of Food Grain Policy Committee (1966).

Essential Supplies Program was introduced in 1982, which further intend to expand PDS through induction of more FPSs including Mobile FPSs. The number of FPSs increased from 2.30 lakh in the year January, 1980 to 3.02 lakh in January, 1984. Ministry of Food and Civil supplies were created by Government of India in 1984. Two departments namely- Department of Food and Department of Civil Supplies were functioning under Ministry of Food and Civil supplies; the latter being of PDS. Further, Consumer Advisory Committees were constituted at block/ tehsil/district levels.

1.2.1 Revamped Public Distribution System (RPDS)

The RPDS – was launched in June 1992 with a view to improve its reach in remote, hilly, inaccessible and far flung areas where substantial section of the poor live. The economically and socially backward identified under RPDS covered 1752 blocks. In which, 1072 under Integrated Tribal Development Projects (ITDP), 602 under Drought Prone Areas (DPA), 69 Designated Hill Area (DHA) and 143 Desert Development Programme (DDP). Essential Commodities covered under RPDS were – wheat, sugar, rice, imported edible oil and kerosene. Ration items were supplied in the RPDS blocks at subsidized prices. Food grains under RPDS were issued at 50 paisa below the Central issue Price. Food grains were to be provided at Rs.20 per kg. Additional commodities such as pulses, tea, soap and salt were to be distributed at FPSs.

1.2.1.1 Features of RPDS

- Cancellation of bogus ration cards by the state government.
- For the door step delivery of ration items under more FPS's were to be opened so that access of beneficiaries be improved.

- To set up Vigilance committee, in which local people will be elected with substantial representation of women for each FPS at higher and village level.
- Improvement in supply chain by constructing or hiring small intermediary godowns.
- To introduce additional commodities through FPS's in these areas.

1.2.1.2 Evaluation of working of RPDS

Gaps and constraints were found in the implementation of RPDS such as limited door to door ration delivery services to FPS's, gaps in opening timings of FPSs, no regularity in the distribution of ration items, limited communication at the time of distribution of ration items, inadequate storage capacity at FCI's godowns and lastly vigilance committees failed to perform its duties in prescribed manner.

1.2.2 Targeted Public Distribution System (TPDS)

The Ministry of Consumer Affairs, Food & Public Distribution in 1997, issued guidelines for the implementation of Targeted Public distribution System (TPDS). Under TPDS potential beneficiaries were divided into families, namely, Below Poverty Line (BPL) and Above Poverty Line (APL). APL families were entitled to get subsidized food at economic cost whereas BPL families to get subsidized 10 kg of food grains per month at a price equal to half of economic cost of FCI. Special BPL cards were to be issued by the state government in order to streamline PDS with better monitoring of the PDS delivery system.

1.2.2.1 Features of TPDS

- BPL families were entitled to get 10 kg of food grains at subsidized prices which half of economic cost of FCI. This entitlement was revised to 20 kg from April 2000 onwards.
- Transitory allocation i.e. quantity in excess of BPL entitlements would benefit the APL families at a price equal to economic cost of FCI.
- In order to plug the leakages all possible steps must be taken and to ensure that the essential commodities do reach the BPL families.
- Food Coupons were to be provided to the beneficiaries under Employment Assurance Scheme (EAS) and Jawahar Rozgar Yojna (JRY), which they can exchange at FPSs to get subsidized food grains. These beneficiaries were entitled to subsidized food grains at the rate of 1 kg per person per day.
- The BPL population is to be identified according to the estimates reached by the planning commission for the year 1993-94. For micro identification and selection of BPL families Gram *Panchayats* and Gram Sabha's should be involved and doubtful

cases should be verified. Ration card would be issued to the identified families and its holder will be entitled to get subsidized food grains at subsidized price from specified FPS. Photo of head of the family was to be pasted on ration card for identification. Bogus cards in circulation were to be cancelled therefore; fresh ration cards were to be issued with proper stamp.

- The central government tried to ensure availability of ration items at FPSs and affordability and acceptability to states. The states should ensure accessibility of ration items to the BPL families through the network of FPSs. Emphasis on creating infrastructure like provisions of godowns and mobile vans would be emphasized.
- Monitoring of FPSs was to be introduced and the beneficiary present at the FPS during inspection should be consulted and if any violation found then remedial actions should be taken. The collector and secretary in charge should make weekly reviews once in a month to check BPL off-take from FPSs.
- It was mandatory on the part of states to send monthly reports to government of India regarding actual issue of food grains through FPSs.
- Transparency measures were to be adopted by the FPSs namely, total number of ration cards attached to the FPS both APL & BPL, monthly allocation made to the FPS, issue price, scale of issue and authority to report in case of violation of rules by FPS dealers.
- Vigilance committees were to be formed at District, State and *Taluk* levels. The committee may consist of beneficiaries, consumer activist and the elected president of *Panchayat* at FPS level. District committee was to be formed with district supply officers as a convener and *Taluka* committees with *Taluka* Supply officer as convener.
- Orientation programs were to be organized by the states with the assistance of Department of Consumer Affairs & Public Distribution for the efficient implementation of PDS.

1.2.2.2 Evaluation of Working of TPDS

The total number of BPL families under TPDS has increased to 652.03 lakh in the year 2000, as against 596.23L in June 1997. Flexibilities to states/UTs were given to fix the retail issue prices. Leakages and diversion of subsidized food grains raised the cost of delivery. Therefore, it was found that TPDS has neither been able to benefit the food insecure families nor it led to reduction of budgetary food subsidy. Basic reasons of food security in

India lie not in supply failure but in declining income and employment in the unorganized sector. Further exclusion errors leaves hundreds of vulnerable out of the purview of PDS. So far as policy of introducing the TPDS was concerned, it may be said that the policy was not unsound but the real problem lies in the way it was implemented Basu (2011).

1.2.3 Antyodaya Anna Yojna (AAY)

AAY was launched in December 2000 for the poorest of the poor families. It was a step ahead in reducing hunger among the poorest of poor segments of the BPL population. Under AAY scheme food grains were to be distributed at a highly subsidized rate of wheat at Rs 2 per kg and rice for Rs 3 per kg. Transportation cost and margin to FPS dealers were to be borne by states and UTs. Under this scheme the entire food subsidy was to be passed on the beneficiaries. The scale of issue was increased from 25 kg to 35 kg per family per month with effect from April 1, 2002.

In the year 2003-04, AAY scheme was expanded by adding households headed by widows or person above the age of 60 with no source of income or disabled person or terminally ill person. Therefore, adding another 50 lakh BPL households. Secondly, the AAY scheme was further expanded to cover tribal households and adding another 50 Lakh BPL families. AAY was further expanded in the year 2005-06 to cover more 50 Lakh BPL households. As on 30.04.2009, 242.75 lakh AAY families had been covered by the states/UTs. The duty was assigned to the concerned State government and UTs to identify eligible families under AAY and allocation of Food grains and to issue distinctive Ration Card to AAY families.

1.2.4 Food Security Act, 2013

The enactment of National Food Security Act, 2013 marks a shift in approach to food security from welfare to right to food. National Food Security Act is more efficient and desirable way to secure food security for all because this offers universal targeting without using below poverty line targeting Sen (2011). According to the act 75.00 per cent of rural and 50.00 per cent of urban population under AAY and PHH are to receive subsidized food grains under TPDS. AAY families are entitled to 35kg of food grains per family per month and PHH are entitled to 5 kg per person per month. Two third of population is covered under the Act. States are responsible for determining eligibility. Emphasizing on women empowerment, this act provides the eldest women in the household, age 18 years or above, is to be the head of the family for the purpose of issuing of ration card to the family. The act has been implemented in all states/ UT's, on all India Basis with effect from November, 2016.

National Food Security Act covered 80 crore BPL population out of total 81.34 crore. These beneficiaries are receiving highly subsidized food grains. Pregnant women, lacting mothers and children in the age group of 6 months to 14 years are entitled to receive free hot meals or "take home ration" free of cost through a widespread network of Integrated Child development Service (ICDS) centers also called as *Aganwadi* centers. Pregnant women and lacting mothers are further entitled to receive maternity benefit of not less than Rs. 6000 for six months for compensation of wage loss during pregnancy and to supplement nutrition. If in any case beneficiaries do not get food grain under NFSA, they are entitled to get Food security allowance which is to be paid to every person. These provisions are governed through Food Security Allowance Rules, 2015. There is a provision for state- and district-level redress mechanisms. State Food Commissions were also to be formed for implementation and monitoring of the provisions of the Act.

The Food allocation, in case of AAY families was 185,926.83 Wheat (in MT), 2,30,211.50 Rice (in MT) and 150.491 Coarse Grains under National Food Security Act and in case of PHH 8,92,213.51(MT) of Wheat, 9,93,607.11 (MT) of Rice and 3,294.13 MT of Coarse Grains were allocated under National Food Security Act. Further, as far as use of ePoS devices were concerned , under AAY 2,26,119.00(MT) of wheat, 2,41,287.57 (MT) of rice and 52.00 (MT) of coarse grains and under PHH 3,84,912.97 (MT) of wheat, 4,42,141.83 (MT) of rice and 2,283.17(MT) of coarse grains were distributed under National Food Security Act to beneficiaries without using ePoS devices (annavitran.nic.in/stateunautomted). Further, at central level, wheat is the major item which is allocated and distributed as compared to rice and coarse grains. 64.23per cent of wheat (11, 29,493.03), 60.43per cent of Rice (11, 08,436.59) and only 30.73per cent of Coarse grains (4,100.41) were distributed to the card holders from the total allocated (36, 06,139.19) food grains. These figures indicate that entire allocated stock was not distributed (annavitran.nic.in). There were 5.33 lakh FPSs and 23 crore ration card holders in the country as on March, 2019 GOI (2018-19). Table 1.1 depicts the comparison of TPDS provision before and after the implementation of NFSA.

Table 1: Comparison of TPDS before and after National Food Security Act, 2013

Provisions of PDS	**Pre- National Food Security Act**	**Post- National Food Security Act**
Population Coverage (by Central	BPL Population (29.5 per cent in 2011-12)	813.4 million (75.00 percent in Rural and 50.00 per cent in Urban areas)

Government)		
Criteria of Selection	BPL Survey- Rural (2002) Urban (2007)	Determined by the State Government
Quantity of Ration Items	APL- 15 kg	APL- Excluded
	BPL- 35 kg	BPL- 5 kg per member
	AAY- 35 kg	AAY- 35 kg
Price of Ration Items	APL-Rice-Rs. 8.30 Wheat- Rs.6.10	APL- Excluded
	BPL- Rice-Rs. 5.65 Wheat- Rs 4.15 Coarse Grains – Rs. 3	BPL- Rice-Rs.3 Wheat- Rs 2 Coarse Grains – Rs. 1
	AAY- Rice-Rs.3 Wheat- Rs.2	

Source: Department of Food and Public Distribution (https://dfpd.gov.in)

1.2.5 Sale of Non- PDS items at FPSs

Clause 9(9) of the TPDS (C) Order, 2015 requires the State Government to allow sale of commodities other than the food grains distributed under the TPDS at the fair price shop to improve the viability of the fair price shop operations. Therefore, in order to make operations of FPS economically viable, the State/UT Governments have been advised to allow FPS dealers to enlarge basket of commodities by allowing the sale of non-PDS items of daily use as per local requirements. Therefore, many State/UT Governments have allowed sale of non-PDS items such as pulses, soaps, edible oil, milk powder etc through FPSs. Over past decade, many states/ UTs have introduced subsidized pulses in PDS with the aim of providing a rich source of protein. NFSA does not make any provision for distribution of pulses; however, it does urge states to diversify commodities available through PDS. As the prices of pulses reaching very high levels over the past years, it would be beneficial for BPL families as they could purchase these at subsidized rates. Table 2 depicts the type, quantities and prices of subsidized pulses for the states.

Table 2: Distribution of Subsidized Pulses under PDS

State	Type of Pulses	CIP(Rs./kg)	Quantity (kg)
Andhra Pradesh	Red Gram	50	1
Chhattisgarh	Dal	10	2
	Kala Chana	5	2
Himachal Pradesh	Chana	25	1
	Urad	35	1
	Whole Moong	50	1

Haryana	Masur/Chana Dal	20	2.5
Punjab	Dal	20	0.5 (per member/ max2.5 kg/family)
Tamil Nadu	Tur	30	1
	Urad	30	1
Telengana	Red Gram	50	1

Source: Department of Food and Public Distribution (https://dfpd.gov.in)

1.3 Government Initiatives to Strengthen the PDS

The government of India has taken different initiatives at times for the transparent and efficient functioning of PDS and to make PDS more focused and targeted to the most vulnerable section of the society. These initiatives are discussed below:

1.3.1 Essential Commodities Act, 1955

In the year 1955, the Government of India enacted "The Essential Commodities Act". This act governs the production, price control, procurement, and distribution of food grains and other essential commodities. Section 2(a) of the Essential Commodities Act lists the commodities which are considered as essential commodities. Section 3 of the Act confers powers of the Central Government to control the production, procurement, storage, supply and distribution of essential commodities. Public Distribution System (Control) Order 2001 (Order) has been issued by the Central Government and thereafter amended in the year 2004. The essential commodities act also contains the provisions regarding offences and penalties for any violation of Control Order.

1.3.2 Citizen's Charter

The Citizens Charter was issued in November, 1997. The Citizens Charter is an important efforts of the Government of India for ensuring the efficient functioning of PDS in a more transparent, effective and accountable manner. The Charter is a model for the State Governments. It contains important information like procedure for issuance of ration cards, entitlements to BPL families, information about FPSs, quality of food grains, right to information, inspection and checking, public participation and vigilance committees. The Citizens Charter has been revised in the year 2007 and Revised Charter has been circulated to all States and UTs.

1.3.3 The Public Distribution System (Control) Order, 2001

The powers conferred by Section 3 of the Essential Commodities Act, 1955 the government of India issued "The Public Distribution System (Control) Order, 2001". This

order ensures supplies and secures the availability and distribution of essential commodities (as defined under Sec2 (a) of the Essential Commodities Act) under the Public Distribution System. The PDS (Control) Order was amended in 2004. The Order contains provisions regarding ration cards, consumer issue price, distribution of food grains and identification of the BPL and AAY families and the scale of entitlements. The state governments should get these lists revised for the inclusion of families who are eligible under either BPL or AAY families. It further explains the responsibility of state governments to cancel bogus cards in circulation.

1.3.4 Vigilance Committee

Vigilance committees were constituted to monitor the functioning of public distribution system in order to make this system more transparent and accountable. Vigilance Committees should be constituted by the states at districts and State levels. The vigilance committees consist of beneficiaries as its members and members of the *Panchayati Raj* Institutes. The basic functions of Vigilance Committee are to ensure efficient and smooth functioning of PDS and effective redressal of problems related to PDS.

1.3.5 Involvement of Panchayati Raj Institutions

The Ministry of Consumer Affairs, Food and Public Distribution on January 13, 2000, addressed a letter to all the Chief Ministers of States and Administrators of UTs, for active participation by Panchayati Raj Institutions in Public Distribution System. The main objective behind involvement of Panchayati Raj was to revamp and strengthening the PDS so that the intended benefit should reach the BPL families. Department of Food and Public Distribution issued detailed guidelines for social audit. FPS committees should be established. The provisions of PRIs includes, display of stock of food grains and list of BPL and AAY beneficiaries at FPS on a prominent place, FPS committee are to be formed so that FPS records could be inspected, to continuously monitor functioning of FPSs, to check the ration cards occasionally for its genuineness, right to information and redressal of grievances.

1.3.6 Area Officers' Scheme

The Government of India introduced the Area Officers Scheme on 21st February, 2000 in order to provide a mechanism to coordinate with State Governments and Union territories for efficient and regular monitoring and review of Public Distribution System (PDS). The senior Officers from the Department of Public Distribution were nominated as Area Officers. The broad features of the Scheme are as under:

- The Area Officer was required to visit allotted districts once in a quarter and review the functioning of TPDS as per the guidelines;

- The Area Officers were also required to submit their reports within 10 days, clearly explaining important issues, findings and recommendations on actions.

1.4 Socio-Economic Indicators of Punjab

As the present study is confined to the state of Punjab, therefore an attempt has been made to present important socio- economic indicators of Punjab in the following discussion. The state is bordered by the Pakistani province of Punjab to its west, Jammu & Kashmir in the north, Himachal Pradesh in the northeast, Haryana in the south and southeast, and Rajasthan in the southwest. The most commonly spoken language of the state is Punjabi. Hindi and English are the other widely used languages. Amritsar, Ludhiana, Jalandhar, Bhatinda, Mohali, Pathankot Hoshiarpur and Patiala are some of the major cities in the state. The state has three major seasons – summer (April-June), rainy season (July-September) and winter (October-March). Due to the presence of large rivers, most of the state is a fertile plain.

Table 3 presents the overall scenario of the Punjab state. The state has three major rivers flowing through it: Ravi, Beas and Satluj. Chandigarh is the capital of Punjab having Geographical area 50,362 (lakh sq. km).

Rural and Urban area in Punjab is 48265 sq.km (96.00per cent of total) and 2097 sq.km (4.00 per cent of total) respectively. Total districts of the state are 22, population density is 551(persons per sq. km). Total population was 277.43 million which consists of 146.39 lakh male which is 52.8 per cent of total population and 131.04 lakh female population which comprises of 47.02 per cent of total population. Rural population was 173.44 lakh (62.52per cent of total) whereas urban population was 103.99 lakh (37.48per cent of total population). District with less population was Barnala, with 5.96 lakh population (2.2per cent of total) and highest population was in Ludhiana district with 34.99 lakh (12.6per cent of total). Gender ratio was 895 females per 1,000 males and Literacy rate was recorded as 76.70 per cent. As per the Socio Economic caste census 2011, Punjab has highest concentration of SC population in rural areas. According to the survey, 36.74 per cent households belong to SC in Punjab. Major share of this population has limited access to basic facilities. 97.37per cent of SC population have their own houses yet 41.90 per cent population is still living in *Kucha* houses.

Table 3: Socio - Economic Indicators of Punjab

Parameters	Punjab
Capital	Chandigarh

Geographical area (lakh sq. km)	50,362
Rural Area (sq. km)	48,265(96% of Total)
Urban Area (sq. km.)	2097(4% of Total)
Administrative districts (No)	22
Population density (persons per sq. km)	551
Total population (lakh)	277.43
Male population (lakh)	146.39(52.8% of Total)
Female population	131.04 (47.02% of Total
District with less Population	Barnala 5.96 lakh (2.2% of Total)
District with highest Population	Ludhiana 34.99 Lakh (12.6%)
Urban Population (lakh)	103.99(37.48%)
Rural population (lakh)	173.44 (62.52%)
Gender Ratio (females per 1,000 males)	895
Literacy rate (%)	76.7

Source: Government of Punjab, Census 2011, Statistical Abstract of Punjab

1.4.1 Population of Punjab

Table 1.4 reveals that population of Punjab has consistently increased from 1951 to 2011. In 1951 population of Punjab was 9161 which increased by 11135, 13551, 16789, 20282, 24359 and 27743 in 1961, 1971, 1981, 1991, 2001 and 2011 respectively.

Table 4: Population of Punjab (1951-2011) (in thousands)

	1951	**1961**	**1971**	**1981**	**1991**	**2001**	**2011**
Punjab	9161	11135	13551	16789	20282	24359	27743
All India	361088	439235	548160	683329	846421	1028737	1210855

Source: Statistical Abstract of Punjab

Table 5: Population of Punjab according to Rural and Urban population

	Rural		**Urban**	
Year	**2001**	**2011**	**2001**	**2011**
India	74,24,90,639	83,30,87,662	28,61,19,689	37,71,05,760
Punjab	1,60,96,488	1,73,16,800	8262511	1,03,87,436

Source: Economic Survey of Punjab 2017-18

1.4.2 Gross State Domestic Product (GSDP), Net State Domestic Product NSDP) and Per Capita Income at Current and Constant (2011-12) prices

The changes in GSDP, NSDP and per capita income at current and constant prices help us to understand the changes in socio economic contribution of the people over the period of time. Table 6 reveals that GSDP at current prices was 297733.82 crore in the year 2012-13 with growth rate of 11.6 per cent whereas in the year 2018-19(A) it is recorded as 518291.12 crore with growth rate of 8.99per cent. GSDP at constant prices (2011-12) in the year 2012-13 was 280822.85 crore with growth rate of 5.32 per cent whereas in the year 2018-19(A) it is recorded at 398169.67 crore with (5.93 per cent) growth rate. In case of NSDP at current prices it was recorded as 251812.58 crore with 5.32per cent growth rate in the year 2012-13 whereas in the year 2018-19(A) it is recorded as468671.62 crore with growth rate of (9.55per cent).NSDP at constant prices (2011-12) in the year 2012-13 was 251812.58 crore with 5.26 per cent growth rate whereas in the year 2018-19(A) it was recorded as 356154.00 crore with the growth rate of (6.14per cent). The per capita income at current prices was 88915 crore in the year 2012-13 with growth rate of 10.21per cent and in the year 2018-19 it is recorded as 153061 crore with growth rate of (8.13per cent). Per capita income at constant prices (2011-12 prices) in the year 2012-13, was 88915 crore with growth rate of 23.9per cent where as in the year 2018-19 it is recorded as 116315 crore with growth rate of (4.77per cent).

Table 6: Gross State Domestic product (GSDP), Net State Domestic Product (NSDP) and Per Capita Income at Current and Constant (2011-12) prices

Year	GSDP(Rs. Crore)		NSDP(Rs. Crore)		Per Capita income	
	At Current price with Growth Rate	At 2011-12 prices with Growth Rate	At Current price with Growth Rate	At 2011-12 prices with Growth Rate	At Current price with Growth Rate	At 2011-12 prices with Growth Rate
2011-12	266628.29	266628.29	239226.95	239226.95	85577	85577
2012-13	297733.82 (11.6%)	280822.85 (5.32%)	267116.49 (11.6%)	251812.58 (5.26%)	94318 (10.21%)	88915 (23.9%)
2013-14	332146.94 (11.56%)	299449.73 (6.63%)	297908.02 (11.53%)	267515.21 (6.24%)	103831 (10.09%)	93238 (4.86%)
2014-15	355101.82 (6.91%)	312125.33 (4.23%)	316745.41 (6.32%)	278484.60 (4.1%)	108970 (4.95%)	95807 (2.755%)
2015-16(R)	390087.44 (9.85%)	330051.93 (5.74%)	350010.82 (10.5%)	294894.86 (5.89%)	118858 (9.07%)	100141 (4.521%)

2016-17(P)	429665.89 (10.15%)	353697.23 (7.16%)	385809.76 (10.23%)	315918.19 (7.13%)	129321 (8.80%)	105894 (5.74%)
2017-18(Q)	475554.27 (10.68%)	375889.96 (6.27%)	427827.53 (10.9%)	335546.41 (6.21%)	141552 (9.46%)	111019 (4.84%)
2018-19(A)	518291.12 (8.99%)	398169.67 (5.93%)	468671.62 (9.55%)	356154.00 (6.14%)	153061 (8.13%)	116315 (4.77%)

Source: Economic Survey 2018-19

1.4.3 Production of Principal Crops

Punjab is the highest producer of principal crops among all the states in India. Table 7 reveals that during 1999-2000, production of wheat, rice and pulses was 15910 MT, 8716 (MT) and 45.4(MT) respectively. In the year 2018-19 the production of Rice and wheat increased to 12815 MT and 17160 MT respectively but in case of pulses the production has marginally increased to 46 MT.

Table 7: Production of Principal Crops (Production in '000 MTs)

Year	Wheat	Rice	Pulses	Total
1999-00	15910	8716	45.4	24671.4
2000-01	15551	9154	44.4	24749.4
2001-02	15499	8816	36.0	24351.0
2002-03	14175	8880	33.9	15096.9
2003-04	14489	9656	39.4	24184.4
2004-05	14698	10437	31.7	25166.7
2005-06	14493	10193	20.2	24706.2
2006-07	14596	10138	27.1	24761.1
2007-08	15720	10489	23.0	26232.0
2008-09	15733	11000	21.7	26754.7
2009-10	15169	11236	18.0	26423.0
2010-11	16472	10837	19.3	27328.3
2011-12	17280	10542	15.0	27837.0
2012-13	16591	11374	53.0	28018.0
2013-14	17620	11267	39.6	28926.6
2014-15	15783	11107	7.9	26897.9
2015-16	16077	11823	43.5	27943.5

2016-17	16440	11586	33.0	28059.0
2017-18	17850	13382	27.7	31259.7
2018-19	17160	12815	46.0	30021.0

Source: www.agricoop.com

1.4.4 Market Arrival of Wheat and Paddy

Table 8 presents the data about market arrival of wheat and paddy. The market arrival has increased significantly. During the year 2017-18, 17972 thousand tones of paddy and 11834 thousand tonnes of wheat arrived in the market. This reveals that Punjab is an agricultural state and increase in the production of major crops resulted into maximum arrival of wheat and paddy.

Table 8: Market Arrivals (Figures in 1000 tonne)

Year	Wheat	Paddy	Total
1999-00	7939	10977	18916
2000-01	9668	11057	20725
2001-02	10579	11066	21645
2002-03	9903	12715	22618
2003-04	9063	13438	22501
2004-05	9500	14004	23504
2005-06	9255	13794	23049
2006-07	8119	12577	20696
2007-08	7911	12802	20713
2008-09	10584	13234	23818
2009-10	10994	14237	25231
2010-11	10278	13136	23414
2011-12	11094	11926	23020
2012-13	12934	13395	26329
2013-14	11097	13192	24289
2014-15	11932	11841	23773
2015-16	10506	14333	24839
2016-17	11834	17915	29749
2017-18	11834	17972	29806

Source: Statistical Abstract, Punjab (Various Issues)

1.5 Public Distribution System in Punjab

Public Distribution System is implemented by the Government of India to protect the poor families from rising prices of essential commodities in view of their limited purchasing power and resources. Punjab played very important role and is contributing maximum towards the central pool reserves of food grain since independence. Public Distribution System (PDS) is operating under the joint responsibility of the Central and the State Governments. Central government is responsible for procurement, storage and allocation of food grains whereas state government holds the responsibility for distributing the food grains through the established network of Fair Price Shops.

The State and Union Territory Governments are responsible for identification of BPL and AAY families, Issuance of ration cards, supervision and monitoring the functioning of FPSs. The Department of Food, civil Supplies & Consumer Affairs was established in 1942 and since then it mechanizes the PDS within the state. During the year 2018, 17072 FPS were currently functional under PDS and covering 1, 14,398 card holders under AAY and 34, 18,927 card holders under PHH under NFSA, 2013. The license for opening a fair price shop shall be granted for a minimum number of 350 ration cards in urban areas, while in rural areas, village shall be minimum number of 300 ration cards or 1500 units. However if the number exceeds the count of 700, then another FPS can be allowed to open. Total BPL households within the state was 5.23 lakh which includes 1.79 lakh from urban area and 3.44 lakh from rural area. Checking of leakages/ ghost cards and regulation of licensing and supervision of the fair price shops (FPS) etc comes under the purview of state government. PUNSUP is another agency which is playing an important role in providing essential commodities in the state. Punjab is among the leading states where National Food Security Act was implemented in December, 2013.

1.5.1 Targeted Public Distribution System in Punjab

TPDS was introduced in the year 1997 all across the nation by the Government of India. It became operative from 1 October 1997 in Punjab state. In the year 2011-2012, 2, 88,600 BPL families were benefitted and allotted wheat under TPDS at the scale of 35 kg per month to each family at the rate of Rs. 4.54 per kg. Under AAY, 179400 families were benefitted. Beneficiaries received 35 kg wheat per month per family at the rate of Rs. 2.00 per kg and under APL criteria 35kg per month at the rate of Rs.6.23 per kg wheat was distributed by the Department of Food & Civil Supplies and Consumer Affairs Punjab. During the year 2013-14 (up to November, 2013), 2,88,600 BPL families were provided 10,098 MT of wheat per month at the scale of 35kg per family at the rate of Rs.4.57 per kg ,

whereas 59,65,266 APL families were provided 52620 MT of wheat at the scale 9kg wheat per family per month at the rate Rs8.06. The distribution of wheat to BPL and APL categories under TPDS has been stopped w.e.f. December 2013 but distribution of kerosene oil was continued. Since May, 2013 levy sugar allocation has not been received from government of India and same was not distributed since then (Economic Survey of Punjab-2015-16).

1.5.2 Atta Dal Scheme (ADS)

Punjab state has emerged as a leading state in the country by launching Atta Dal Scheme which became effective on 15th August 2007. Estimated budget of this scheme was 250 Crore. 12.95 lakh families were benefitted under this scheme. This scheme was brought under the ambit of National Food Security Act, 2013. Under this scheme wheat to be provided @ 4 Rs. Per kg and dal @ Rs. 20.00 per kg to approximately 15.40 lakh families whose annual income was less than Rs. 30,000. These identified families were issued with special Blue Ration Cards.

1.5.3 New Atta Dal Scheme

New Atta Dal Scheme has been launched with effect from December, 2013 and distribution started from June, 2014. For New Atta Dal Scheme the limit of annual income has been increased from Rs. 30,000 to Rs. 60,000, therefore, after identification the number of identified families has increased from 15.40 lakh to 28.63 lakh. Families who are linked with New Atta Dal scheme are entitled to get Health Insurance of Rs 50,000 annually and accidental death insurance of Rs. 5, 00,000. Beneficiaries are supplied with wheat and pulses at an affordable price of Rs. 2 and Rs.30 per kg respectively. Wheat is distributed at an average scale of 5 Kg per member per month and maximum of 25 Kg can be allotted to a family. Whereas, the maximum limit assigned for pulses distribution for each family is 2.5 Kg or each person within a family owns a right to obtain at least 0.5 Kg pulses. The identified beneficiaries are entitled to get entitlements under bi- annual distribution system. State government has started bi- annual system of distribution with the permission of government of India.

1.5.4 Smart Ration Card Scheme

The state Government has introduced “Smart Ration Card Scheme” from 1st April 2018. Under this Scheme beneficiaries are entitled to get ration through bio metric system. Beneficiaries have to submit bio metric details to get entitlements. Bi- annual distribution model has been implemented with approval of Government of India. Under this bi- annual model beneficiaries get 30 kg sealed gunny bags of wheat at the rate of Rs. 2 per kg. PHH and AAY families get 5 kg and 35 kg wheat per month respectively.

Under Smart ration Card Scheme the wheat is distributed to the eligible beneficiaries through *Adhaar* enabled system (ePoS). Department procured 1417 ePoS machines for the distribution of food grains. Central government has stopped the allocation of Kerosene oil to Punjab State from March, 2017. Dal (Pulses) was distributed up to the year 2016-17. The State government is yet to take decision about inclusion of *Dal* (Pulses), Sugar and Tea. A three TIER grievance redressal machinery, namely, Internal, External and through State food commission for redressal of grievances of the consumers has been established. Additional deputy Commissioner level officers have been designated as District Grievances Redressal Officers. Food grains are to be distributed in the presence of government functionaries, Panchayat members/ Councilors and members of local Vigilance committee (Economic Survey of Punjab, 2017-18). To ensure the transparency and efficiency in PDS operations under NFSA the following measures are being undertaken:

- End to End computerization of TPDS
- Automation of FPS
- Supply Chain Management

1.5.5 Growth of Public Distribution System in Punjab

The number of beneficiary families and number of units (family members) has increased in 2016-17 as compared to 2006-07 and families and units were attached with their *Adhaar* Cards. Portal has also been established for making system more transparent. Prices were reduced from Rs. 4.58 per Kg to Rs. 2 per Kg in a standard packing before sending to godown was made and then provided under bi-annual system to beneficiaries. State government directly sends the wheat to village and ward so that beneficiaries can get the ration in time and sacks were given to the beneficiaries free of cost. Furthermore, a new scheme named *Bhagat Puran Singh* Health Insurance was introduced for those beneficiary families who were attached with *Atta Dal Scheme,* were entitled to get 50,000 health Insurance annually and Accidental Death Benefit of 5, 00,000.

UID based Bar Coded different Ration cards were made available free of cost, therefore, there was no need to carry photograph at the time of distribution of ration from FPS. A State Level Food Commission was established for the redressal of complaints regarding Distribution of food grains. In addition to it, Supervision Committees were also established in every Ward/village and Block in order to protect the interest of beneficiaries. Beneficiaries at the District level were the members of these committees, and in order to promote women empowerment, one woman should be the member of supervision committee.

Further Department has started the Toll Free Helpline Number 180030061313 and beneficiaries can contact any time from 9 AM to 5 PM on every working Day. So the system of distribution has been made more transparent.

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CHAPTER 24

GREEN MARKETING:
A STEP TO PROTECT THE ENVIRONMENT

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ABSTRACT

Green marketing may be a phenomenon which has developed particular important within the modern market. This concept has enabled for the re-marketing and packaging of existing products which already adhere to such guidelines. Additionally, the event of green marketing has opened the door of opportunity for companies to co-brand their products into separate line, lauding the green-friendliness of some while ignoring that of others. Such marketing techniques are going to be explained as immediate results of movement in the minds of the buyer market. As a result of this businesses have increased their rate of targeting consumers who are concerned about the environment. These same consumers through their concern have an interest in integrating environmental issues into their purchasing decisions through their incorporation into the method and content of the marketing strategy for whatever product could also be required. This paper discusses how businesses have increased their rate of targeting green consumers, those that are concerned about the environment and permit it to affect their purchasing decisions. The paper identifies the three particular segments of green consumers and explores the challenges and opportunities businesses have with green marketing. The paper also examines the present trends of green marketing in India and describes the rationale why companies are adopting it and way forward for green marketing and concludes that green marketing is something that will continuously grow in both practice and demand.

Keywords: Environment, companies, demand, marketing, consumers, ecology

1.0 INTRODUCTION

According to the American Marketing Association, green marketing is that the marketing of products that are presumed to be environmentally safe. Thus green marketing incorporates abroad range of activities, including product modification, changes to the

assembly process, packaging changes, as well as modifying advertising. Yet defining green marketing is not an easy task where several meanings intersect and contradict each other; an example of this may be the existence of varying social, environmental and retail definitions attached to the present term. Other similar terms used are Environmental Marketing and Ecological Marketing. Thus “Green Marketing" refers to holistic marketing concept wherein the assembly, marketing consumption and disposal of products and services happen during a manner that's less detrimental to the environment with growing awareness about the implications of worldwide warming, non-biodegradable solid waste, harmful impact of pollutants etc., both marketers and consumers are becoming increasingly sensitive to the need for switch in to green products and services. While the shift to "green" may appear to be expensive within the short term, it will definitely convince be indispensable and advantageous, cost-wise too, in the long run. Green marketing, also alternatively known as environmental marketing and sustainable marketing, refers to an organization's efforts at designing, promoting, pricing and distributing products which can not harm the environment

1.1 Why Green Marketing

It is really scary to read these pieces of data as reported within the Times recently: "Air pollution damage to people, crops and wildlife in US. Total tens of billions of dollars each year". "More than 12 other studies in the US, Brazil Europe, Mexico, South Korea and Taiwan have established links between air pollutants and low birth weight premature birth still birth and infant death". As resources are limited and human wants are unlimited, it is important for the marketers to utilize the resources efficiently without waste also on achieve the organization's objective. So green marketing is inevitable. There is growing interest among the consumers all over the world regarding protection of environment. Worldwide evidence indicates people are concerned about the environment and are changing their behavior. As a results of this, green marketing has emerged which speaks for growing marketplace for sustainable and socially responsible products and services. Thus the growing awareness among the consumers everywhere the planet regarding protection of the environment during which they live, People does want to bequeath a clean earth to their offspring. Various studies by environmentalists indicate that people are concerned about the environment and are changing their behavior pattern so on be less hostile towards it. Now we see that the majority of the consumers, both individual and industrial, are getting more concerned about environment friendly products. According to Peattie (2001), the evolution of green marketing has three phases. First phase was termed as "Ecological" green marketing, and thru this era all marketing activities were concerned to help environment and provide

remedies for environmental problems. Second phase was "Environmental" green marketing and the focus shifted on clean technology that involved designing of innovative new products, which lookout of pollution and waste issues. Third phase was "Sustainable" green marketing. It came in to prominence in the late 1990s and early 2000.

1.2 Green Products and Its Characteristics

The products those are manufactured through green technology which caused no environmental hazards are called green products. Promotion of green technology and green products is important for conservation of natural resources and sustainable development. We can define green products by following measures:

- Products those are originally grown,
- Products those are recyclable, reusable and biodegradable,
- Products with natural ingredients,
- Products containing recycled contents, non-toxic chemical,
- Products contents under approved chemical,
- Products that don't harm or pollute the environment,
- Products which will not be tested on animals,
- Products that have eco-friendly packaging i.e. reusable, refillable containers etc.

2.0 Need of green marketing

An Anthropological View Issues like heating and depletion of ozone umbrella are the most for the healthy survival. Every person rich or poor would have an interest in quality life filled with health and vigor than would the company class. Gain and economic profit is the main aim of any corporate business. But harm to environment cost by sustain business across the globe is realized now though off late. This sense is building corporate citizenship in the business class. So green marketing by the business class remains within the selfish anthological perspective of future sustainable business and to please the buyer and acquire the license by the governing body. Industries in Asian countries are catching the need of green marketing from the developed countries but still there may be a wide gap between their understanding and implementation.

3.0 Challenges in green marketing

i. Need for Standardization

It is found that only 5% of the marketing messages from “Green” campaigns are entirely true and there is a lack of standardization to authenticate these claims. There is no standardization to authenticate these claims. There is no standardization currently in situ to

certify a product as organic. Unless some regulatory bodies are involved in providing the certifications there'll not be any verifiable means. A standard quality control board needs to be in place for such labeling and licensing.

ii. New Concept

Indian literate and concrete consumer is getting more aware about the merits of Green products. But it is still a new concept for the masses. The consumer must be educated and made conscious of the environmental threats. The new green movements got to reach the masses which will take tons of time and energy. By India's ayurvedic heritage, Indian consumers do appreciate the importance of using natural and herbal beauty products. Indian consumer is exposed to healthy living lifestyles like yoga and natural food consumption. In those aspects the buyer is already aware and is going to be inclined to simply accept the green products.

iii. Patience and Perseverance

The investors and company got to view the environment as a major long-term investment opportunity, the marketers need to check out the long-term benefits from this new green movement. It will require a lot of patience and no immediate results. Since it's a replacement concept and idea, it'll have its own acceptance period.

iv. Avoiding Green Myopia

The first rule of green marketing is that specialize in customer benefits i.e. the primary reason why consumers buy certain products in the first place. Do this right, and motivate consumers to modify brands or maybe pay a premium for the greener alternative. It is not getting to help if a product is developed which is completely green in various aspects but does not pass the customer satisfaction criteria. This will lead to green myopia. Also if the green products are priced very high but it'll lose its market acceptability.

4.0 GOLDEN RULES OF GREEN MARKETING

i. Know you're Customer: confirm that the buyer is aware of and anxious about the problems that your product attempts to deal with, (Whirlpool learned the hard way that consumers wouldn't pay a premium for a CFC-free refrigerator because consumers dint know what CFCs were.).

ii. Educating your customers: is not just a matter of letting people know you're doing whatever you're doing to guard the environment, but also a matter of letting them know why it matters. Otherwise, for a significant portion of your target market, it is a case of "So what?" and your green marketing campaign goes nowhere.

iii. Being Genuine & Transparent: means that a) you are actually doing what you claim to be doing in your green marketing campaign and b) the remainder of your business policies are according to whatever you are doing that's environmentally friendly. Both these conditions need to be met for your business to establish the type of environmental credentials which will allow a green marketing campaign to succeed.

iv. Reassure the Buyer: Consumers must be made to believe that the product performs the job it's supposed to do-they won't forego product quality in the name of the environment.

v. Consider Your Pricing: If you're charging a premium for your product-and many environmentally preferable products cost more thanks to economies of scale and use of higher-quality ingredients-make sure those consumers can afford the premium and feel it's worthwhile.

vi. Giving your customers a chance to participate: means personalizing the advantages of your environmentally friendly actions, normally through letting the customer participate in positive environmental action.

vii. Thus leading brands should recognize that consumer expectations have changed: it's not enough for a corporation to green its products; consumers expect the products that they purchase pocket friendly and also to assist reduce the environmental impact in their own lives too.

5.0 THE FUTURE OF GREEN MARKETING

There are many lessons to be learned to avoid green marketing myopia, the short version of all this is often that effective green marketing requires applying good marketing principles to form green products desirable for consumers. The question that is still, however, is, what's green marketing's future? Business scholars have viewed it as a “fringe” topic, as long as environmentalism's acceptance of limits and conservation does not mesh well with marketing’s traditional axioms of “give customer what they want” and “sell the maximum amount as you can”. Evidence indicates that successful green products have avoided green marketing myopia by following three important principles:

5.1 Consumer Value Positioning

i. Design environmental products to perform also as (or better than) alternatives.

ii. Promote and deliver the buyer desired value of environmental products and target relevant consumer market segments

iii. Broaden mainstream appeal by bundling consumer desired value into environmental products.

5.2 Calibration of Consumer Knowledge

i. Educate consumers with marketing messages that connect environmental attributes with desired consumer value.

ii. Frame environmental product attributes as "solutions "for consumer needs.

iii. Create engaging and academic websites about environmental products desired consumer value.

3.3 Credibility of Product Claim

i. Employ environmental product and consumer benefit claims that are specific and meaningful.

ii. Procure product endorsements or eco-certifications from trustworthy third parties and educate consumers about the meaning behind those endorsements and eco-certifications.

iii. Encourage consumer evangelism via consumers social and internet communication network with compelling, interesting and entertaining information about environmental products.

6.0 CONCLUSION

Now this is often the proper time to pick "Green Marketing "globally. It will come with drastic change in the world of business if all nations will make strict roles because green marketing is important to save lots of world from pollution. From the business point of view because an ingenious marketer is one who not only convinces the consumer, but also involves the consumer in marketing his product. Green marketing should not be considered as just one more approach to marketing, but has to be pursued with much greater vigor, because it has an environmental and social dimension to it. With the threat of global warming looming large, it's extremely important that green marketing becomes the norm instead of an exception or just a fad. Recycling of paper, metals, plastics, etc., in a safe and environmentally harmless manner should become much more systematized and universal. It has to become the general norm to use energy-efficient lamps and other electrical goods. Marketers even have the responsibility to form the consumers understand the necessity for and benefits of green products as compared to non-Green ones. In green marketing, consumers are willing to pay more to take care of a cleaner and greener environment. Finally, consumers, industrial buyers and suppliers got to pressurize effects on minimize the negative effects on the environment-friendly. Green marketing assumes even more importance and relevance in developing countries like India.

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CHAPTER 25

PURPLE AND GREEN ECONOMY

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1.0 INTRODUCTION: PURPLE ECONOMY

The purple economy is that part of the economy which contributes to sustainable development by promoting the cultural potential of goods and services.

"The purple economy refers to taking account of cultural aspects in economics. It designates an economy that adapts to the human diversity in globalization and that relies on the cultural dimension to give value to goods and services."

These two trends, one vertical and one horizontal, feed one another. In fact the growth in the cultural component attached to products is linked to each territory's cultural vitality.

Examples of purple professions

These are purple jobs, capable of contributing to the advent of a culturalized economy. These include, for example: humanities and social sciences teachers and re- searchers, developers and town planners, and tourism professions.

1.1 Territorial economics

The international appeal, "Towards a cultural renaissance of the economy", signed by architects, chefs, Nobel laureates in Economics and leaders of international organizations, defines the purple economy as a form of territorial economics, in which "territories that successfully preserve and promote the different aspects of their original identities will enjoy a real competitive advantage. This cultural revitalization of local environment does not however signify a disinterest in more distant societies. The appetite for other cultures and need to understand them better cannot help but expand in the world of tomorrow." From this perspective, the purple economy is universal by nature:

"All territories, including those less economically and technologically well-endowed, have a cultural message to share. It is a matter of giving each of them the chance to

showcase what makes them unique, in a world where homogenization is a sign of devitalization."

1.2 Surge in culture

The context of the purple economy is that of the growing importance of culture in contemporary society. The factors involved in this include in particular: a global economic and political readjustment in favour of emerging countries, a return to local environments (once again perceived as centres for stability), new forms of claims (following on from the collapse of the great ideologies), growing social demand for quality based on cultural consumption patterns (which go hand in hand with the logic of popularization, individualization and longer life expectancies), innovative approaches (that presuppose a cultural state of mind and interdisciplinarity conducive to serendipity), and so on.

1.3 Scope

The purple economy is multidisciplinary, in that it enriches all goods and services by capitalizing on the cultural dimension inherent to every sector. The sensory, experiential economy is one application of this.

It differs from the cultural economy, which is sector-based. In June 2013, the conclusions of a first inter-institutional working group on the purple economy formed of experts from UNESCO, the OECD, the International Organisation of the Francophonie, French ministries, various companies and civil society. That document underscored the impact of the phenomenon of culturalization, which now affects the entire economy, with follow-on effects on employment and training. The report differentiates between purple jobs and purplifying professions: the former are directly linked to the cultural environment by their very purpose (like town planners and developers), while the latter are merely caused to transform under the effect of culturalization (such as positions in human resources or in marketing and communications). Another reference document published in June 2017 mentioned various aspects of the human environment in which economics are likely to produce cultural benefits: architecture, art, colours, enjoyment, ethics, heritage, imagination, learning, social skills, singularity, etc.

1.4 Origin

The term first appeared in 2011, in France, in a manifest published on Le Monde.fr. The signatories included the board members of the association Diversum, which organized the first International Purple Economy Forum under the patronage of UNESCO, the European

Parliament and the European Commission. The concept was invented by Jerome Gouadain, who later put it into theory via the association Diversum and then in the Prix Versailles Connection to sustainable development.

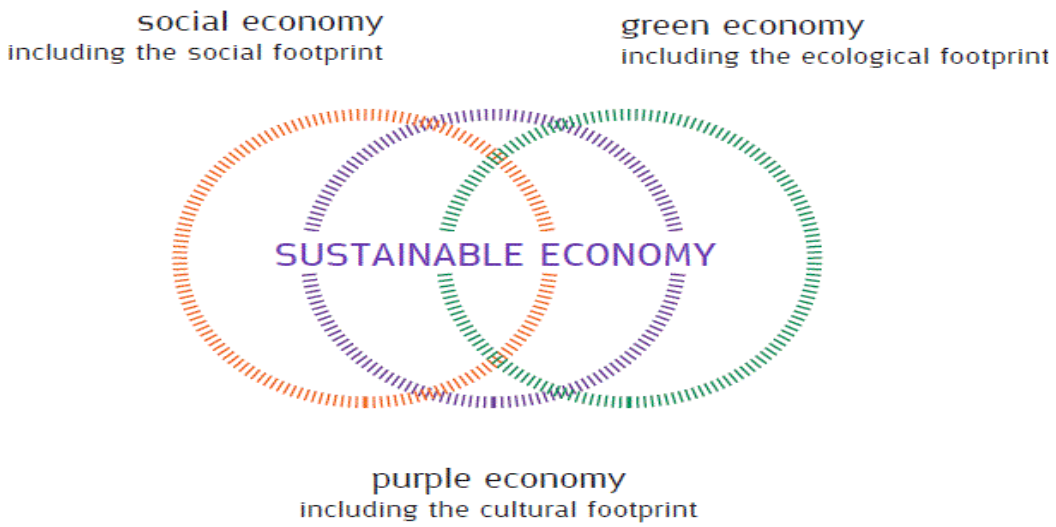

Figure 1: ***The three components of a sustainable economy***

2.0 GREEN ECONOMY

A green economy is defined as low carbon, resource efficient and socially inclusive. UN Environment promotes a development path that understands natural capital as a critical economic asset and a source of public benefits, especially for poor people whose livelihoods depend on natural resources.

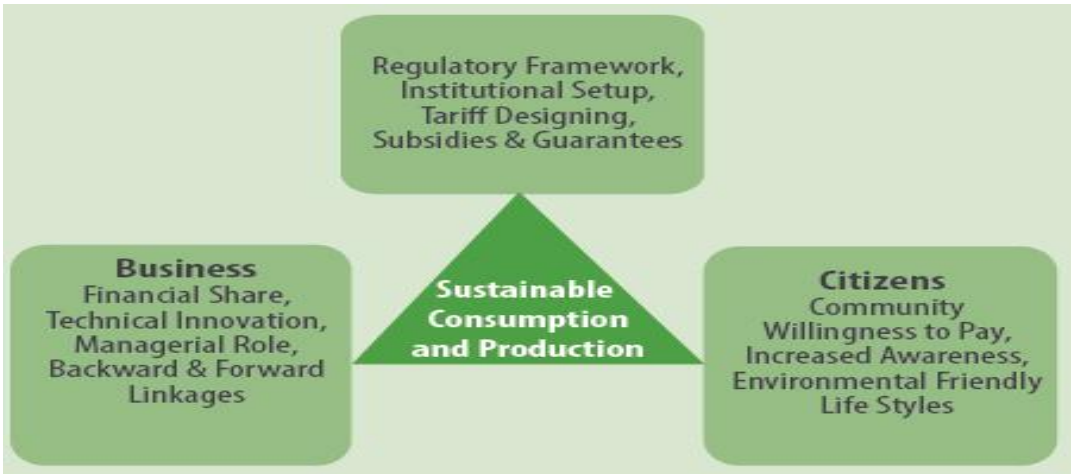

Figure 2: Green Economy

Source: https://images.app.goo.gl/e5xHnYS2NYf7xtJu6

Green growth is a term to describe a path of economic growth that uses natural resources in a sustainable manner. It is used globally to provide an alternative concept to typical industrial economic growth. This path would lead to what is known as a green economy.

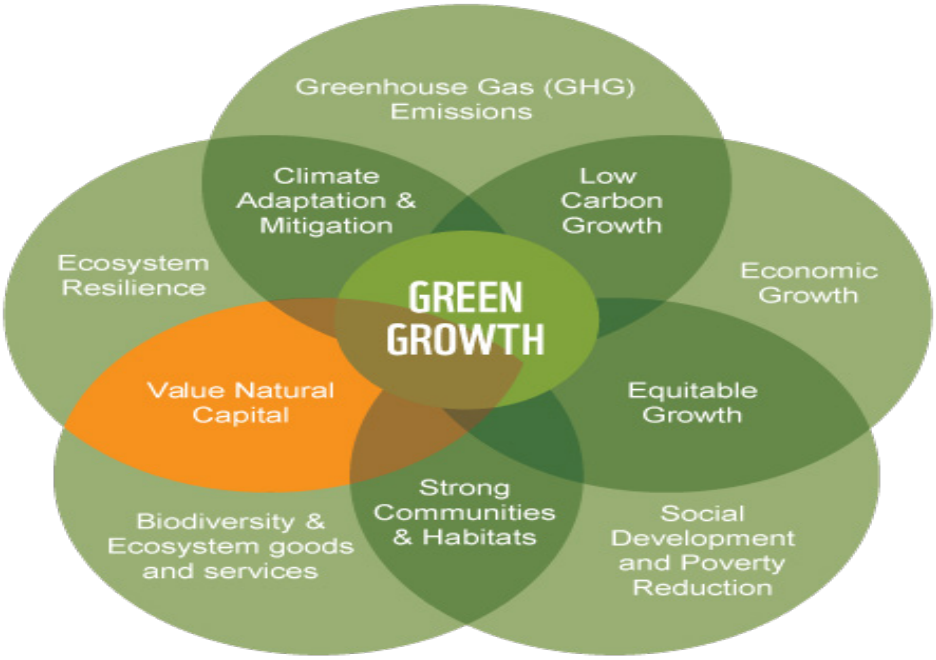

Figure3: Economic Growth

3.0 CONCLUSION

The purple economy emphasizes the presence of externalities: the cultural environment from which agents draw and on which, in return, they leave their own footprints is a common good. As a result, the purple economy sees culture as an axis for sustainable development.

In fact, culture has been a whole sub-section of sustainability since the beginning. Corporate social responsibility can even be said to have originated in the International Covenant on Economic, Social and Cultural Rights adopted by the United Nations in 1966.

This issue is just one of the different components of sustainable development, alongside concerns relating to the natural environment (green economy) and to the social environment (social economy). The complementary nature of these aspects of the sustainable economy was reaffirmed in a call published by Le Monde Economies in 2015, leading up to the 21st United Nations Conference on Climate Change.

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CHAPTER 26

ALCOHOL: NECESSARY EVIL OR POSITIVE GOOD

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ABSTRACT

Ethyl alcohol, or ethanol, is an intoxicating ingredient found in beer, wine, and liquor. Alcohol is produced by the fermentation of sugars and starches by yeasts. Historically and internationally, cultural visions of alcohol and its effect vary in terms of how positive or negative they are and the likely consequences that they attach to alcohol consumption. The dominant contemporary vision of alcohol in the united states is that alcohol(a) is primarily negative and has exclusively hazardous consequences, (b) leads frequently to uncontrollable behavior, and (c) is something that young people should be warned against. The consumption of alcohol plays an important social role in many cultures. Excessive use of alcohol can lead to the development of chronic diseases and some other serious problems like high blood pressure, heart disease, stroke, liver disease, digestive problems and cancer of the breast, mouth, throat, esophagus, liver, and colon.

Keywords: Alcohol, alcoholism, health, drink, economy, consumption

1.0 INTRODUCTION

Alcohol is a central nervous system depressant that is rapidly absorbed from the stomach and small intestine into the bloodstream. Alcohol is metabolized in the liver by enzymes. However, the liver can only metabolize a small amount of alcohol at a time, leaving the excess alcohol to circulate throughout the body. The intensity of the effect of alcohol on the body is directly related to the amount consumed. The consequences of this vision are that when children do drink (which teenagers regularly do), they know of no alternative but exclusive, intense consumption patterns, leading them frequently to drink to intoxication.

Here we explore alternative models of drinking and channels for conveying them which emphasize healthy versus unhealthy consumption patterns as well as the individual's

responsibility to manage his or her drinking. The ultimate goal is for people to see alcohol as accompaniment to overall healthy and pleasurable lifestyle, an image they enact as moderate, sensible drinking patterns.

2.0 MODELS OF ALCOHOL'S EFFECTS

Selden Bacon, a founder and longtime director of the Yale (then Rutgers) center of Alcohol studies, remarked on the strange public health approach to alcohol taken in the United States and elsewhere in the Western World:

Current organized knowledge about use can be likened to knowledge about automobiles and their use if the latter were limited to facts and theories about accidents and crashes. The positive functions and positive attitudes about alcohol uses in our as well as in others societies--- If educating youth about drinking is bad--- full of risk for life and property, at best considered as an escape, clearly useless or frequently the precursor of disease, and the subject matter is taught by nondrinkers and ant drinkers, this is a particular indoctrination. Further, if 75-80% of the surrounding peers and elders are or are going to become drinkers, there is – an inconsistency between the message and the reality. The coronary and mortality benefits of alcohol were only beginning to be established, while the psychological and social benefits of drinking had not been systematically assessing. But, now today that the life – prolonging effects of alcohol are on a firm footing and the conference on which this volume is based has begun the discussion of the ways in which alcohol enhances quality of life. In other word, if science indicates that alcohol conveys significant life advantage, why does alcohol policy act as thought alcohol was evil?

Table No.1: Key features of Alcohol showing bad and good effects

Key Points	**Alcohol is Good**	**Alcohol is Bad**
Model of alcohol use	Temperance / proscriptive	No temperance
Key ingredient	Abstinence; formal control	Excessive drinking, No control
Consequences	Optimal drinking	No optimal health

Two different typologies of social attitudes towards alcohol are employed. One is the distinction between temperance and no temperance Western societies. In the former, major efforts have been mounted to ban alcoholic beverages. Less alcohol is consumed in temperance societies, with more outward signs of problematic use. In no temperance societies, by contrast, alcohol, and few behavioral and other alcohol-related problem are

noted. An alternate typology has been used by sociologists to characterize norms and attitudes towards alcohol in subgroups, within larger society. Four such types of group are:

i. Groups with proscriptive norms against the use of alcohol;
ii. Prescriptive groups that accept and welcome drinking but establish clear norms for its consumption.
iii. Groups with ambivalent norms that invite drinking but also fear and resent it; and
iv. Groups with permissive norms that not only tolerate and invite drinking but do not set limits on consumption or on behavior while drinking.

3.0 VISIONS OF ALCOHOL

3.1 Alcohol is bad

The idea of alcohol as evil took root 150 to 200 years ago. Although this idea has varied in its intensity since then, anti-alcohol feeling has resurfaced and consumption has declined since the late 1970s in much of the Western World, led by the United States (Heath, 1989). The idea that alcohol is bad takes a number of forms. Of course, in the 19th and 20th centuries, the temperance movement held that alcohol is a negative force that must be eliminated from society because of the following characteristics of alcohol:

- Alcohol is an addictive substance whose use inevitably leads to increased, compulsive, and uncontrollable use.
- Alcoholism underlies most, indeed practically all, modern social problems (Unemployment, wife and child abuse, emotional disorders, prostitution, and so on).
- Alcohol conveys no discernible social benefits.

Harmful use of alcohol was the cause for 5.9% of all deaths and 5.1% of the global burden of disease and injury. India is the largest market for alcoholic beverages in the world with estimated 6.25 million alcohol user in 2005. The objective of this study was to know the prevalence of alcohol consumption, pattern of drinking, and its effect on people's health and social consequences.

3.2 METHODS

This cross -sectional study was conducted in 850 Alcoholic beverages, known since Vedic period, are used for worship purposes, medicinal preparations, and widely consumed as a relaxant. Alcohol consumption, at present is ubiquitous and has been consistently increasing throughout the World. Globally, harmful use of alcohol causes approximately 3.3 million deaths every year (5.9% of all deaths) and 5.1% of the global burden of disease is

attributable to alcohol consumption. It causes more than 60 different disorders and is the third most important risk factor for the global burden of disease.

3.3 Alcoholism as a disease: the inbred alcoholic

The essential attributes of alcoholism as a disease were part of the temperance movement's view of alcohol. These were consolidated and reintegrated into the modern disease theory of alcoholism both through the development of Alcoholic Anonymous (AA) beginning in 1935, and in a modern medical approach beginning in the 1970s and espoused currently by the directorship of the NATIONAL INSTITUTE ON ALCOHOL ABUSE AND ALCOHOLISM (NIAAA). AA popularized the idea that a small subgroup of the individuals has a deeply ingrained form of alcoholism that prevents its members from drinking moderately. In the modern medical view, this has taken the form of the idea of a heavy genetic loading for alcoholism.

AA actually wished to coexist with alcohol in the post prohibition era because the signs were inescapable that the nation would no longer support national prohibition. If only certain individuals are stricken with alcoholism, then only they have to fear the evils that lurk in the beverage. For this limited group, however, the evils of alcohols are the unlimited. They progressively lead the alcoholic (the drunkard or inebriate in temperance terms) to a total collapse of ordinary values and life structure and the ultimate depredations of death, the insane asylum, or prison.

3.4 Alcohol dependence and the public health model

The modern medical viewpoint, despite its allegiance to genetic causality of alcoholism, is less committed than AA to the idea that alcoholism is in -born. For example, an NIAAA general population study assessed the risk of developing alcoholism to be much higher for youthful drinkers (a risk that was multiplied if alcoholism was present in the family). The model underlying this view of alcoholism's development is alcohol dependence, which holds that individuals drinking at a high rate for substantial period develop a psychological and physiological reliance on alcohol should be noted that the study did not distinguish between those who first drank at home and those who drank peers outside "not counting small tastes or sips of alcohol", which more likely indicates first drinking other than within the family or at home.

In addition to the disease and dependence views of alcohol's negative action, the modern public health view of alcohol is a drinking – problems model, which holds that only a minority of alcohol problems (Violence, accidents, disease) are associated with alcoholic or dependent drinkers. Rather, it holds, drinking problems are spread across the population and

can appear either because of acute intoxication even in occasional drinkers, cumulative effects from lower levels of nondependent drinking, or heavy drinking by a relatively small percentage of problem drinkers.

In any case, according to the most popular public health viewpoint, alcohol problems are multiplied by higher levels of drinking society – wide. The public health model sees not only alcohol dependence but all alcohol consumption as inherently problematic, in that greater consumption leads to greater social problems. The role of public health advocates in this view is to diminish alcohol consumption through whatever means possible.

3.5 Alcohol is good

The view of alcohol as beneficent is ancient, as old at least as the idea that alcohol produces harm. The Old Testament describes alcoholic excess, but it also values alcohol. Both the Hebrew and Christian religions include wine in their sacraments. Hebrew prayer bestows a blessing on wine. Even earlier, the Greeks considered wine a boon and worshipped a god of wine. From the ancients to the present, many have valued wine and other beverage alcohol for either their ritualistic benefits or their celebratory and even licentious aspects. The value of alcohol certainly was appreciated in colonial America, which drank freely and gladly, and where minister increases Mather termed alcohol the "good creature of God".

Before prohibition in the United States and from the 1940s through the 1960s, drinking alcohol was accepted and valued as was perhaps even excessive drinking. We can see the view of drinking and even alcohol intoxication as pleasurable, including also the work of such mainstream and morally upright.

4.0 THE STORY OF ETHANOL: THE DRINKING ALCOHOL

Ethanol occurs in nature as a product of fermented sugars. Humans have been drinking fermented juices and grains since they were living in caves. Elephants in Africa and other mammals also eat fermented fruit.

Ancient people of Greece and Arabia learned how to distill wine and grain drinks into stronger alcohol drinks such as brandy, cognac and vodka types beverages. Ethanol has also been used for industrial purposes. The distillation process became more advanced, so that the pure ethanol could be extracted from fermented liquids as used as fuel and a solvent. In the early days of space technology, ethanol was used as rocket fuel. Some people distill ethanol from fermented corn to create a biofuel for their automobiles.

Before the French revolution, Antoine Lavoisier discovered the ethanol was made out of carbon, hydrogen and oxygen. Unfortunately, he was executed a few years later at the guillotine by revolution leaders.

Alcohol use is quite common in India both in rural and urban areas with prevalence rates as per various studies varying from 23% to 74% in males in general and although it's not that common in females but it has been found to be prevalent at the rate 24% to 48% in females in certain sections and communities.

Although developed countries have succeeded in marginally reducing alcohol consumption, yet their average consumption is still higher than those of developing countries. Southeast Asia and the western pacific regions are still showing increasing alcohol consumption trend. In Southeast Asia region, per capital pure alcohol consumption has increased by over 50% between 1980 and 2000. Similarly, In India also per capital alcohol consumption has increased alarmingly by 106.7% between 1970-1972 and 1994 – 1996. Estimated number of alcohol users in India, in 2005, was 62.5 million, 17% them being dependent users accounting for 20%-30%of hospital admission due to alcohol – related problems. The National Household survey 2004 has reported alcohol use in 21% of adult males and less than 5% among females. State was prevalence rate is highly variable being the lowest (7%) in western part of Gujarat and the highest (75.0%) in Arunachal Pradesh.

In southern India, the prevalence of current alcohol use has varied between 33% and 50%

In view of easy availability of alcohol at a subsidized rate in Pondicherry, this study was conducted in rural areas to estimate the prevalence of alcohol consumption, pattern of drinking, and its impact on the health of the people and the social consequences.

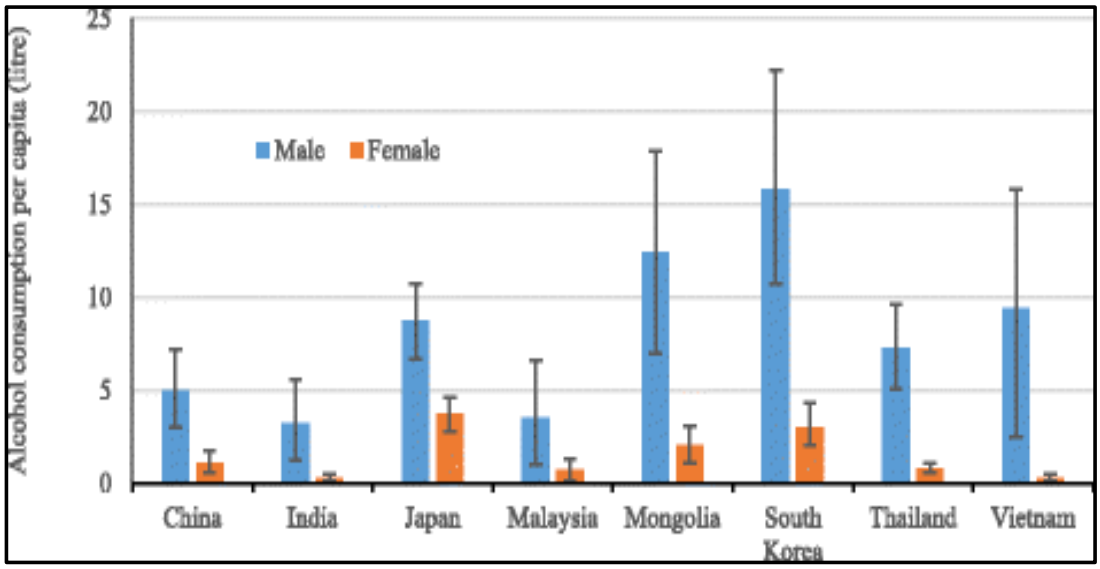


Figure 1: Pictorial presentation of Alcohol consumption per Capital in litre (Jiang et al., 2018)

Table 2: Column showing drinking status of Alcohol for distinct years

(Jiang et al., 2018)

Drinking status	1991	1993	1995	1998	2001	2004	2007
			(per cent)				
Daily	10.2	8.5	8.8	8.5	8.3	8.9	8.1 #
Weekly	41.0	39.9	35.2	40.1	39.5	41.2	41.3
Less than weekly	30.4	29.5	34.3	31.9	34.6	33.5	33.5
Ex-drinker[(a)]	12.0	9.0	9.5	10.0	8.0	7.1	7.0
Never a full serve of alcohol	6.5	13.0	12.2	9.4	9.6	9.3	10.1 #

(a) Has consumed at least a full serve of alcohol, but not in the previous 12 months.

Difference between 2004 result and 2007 result is statistically significantly (2-tailed α = 0.05).

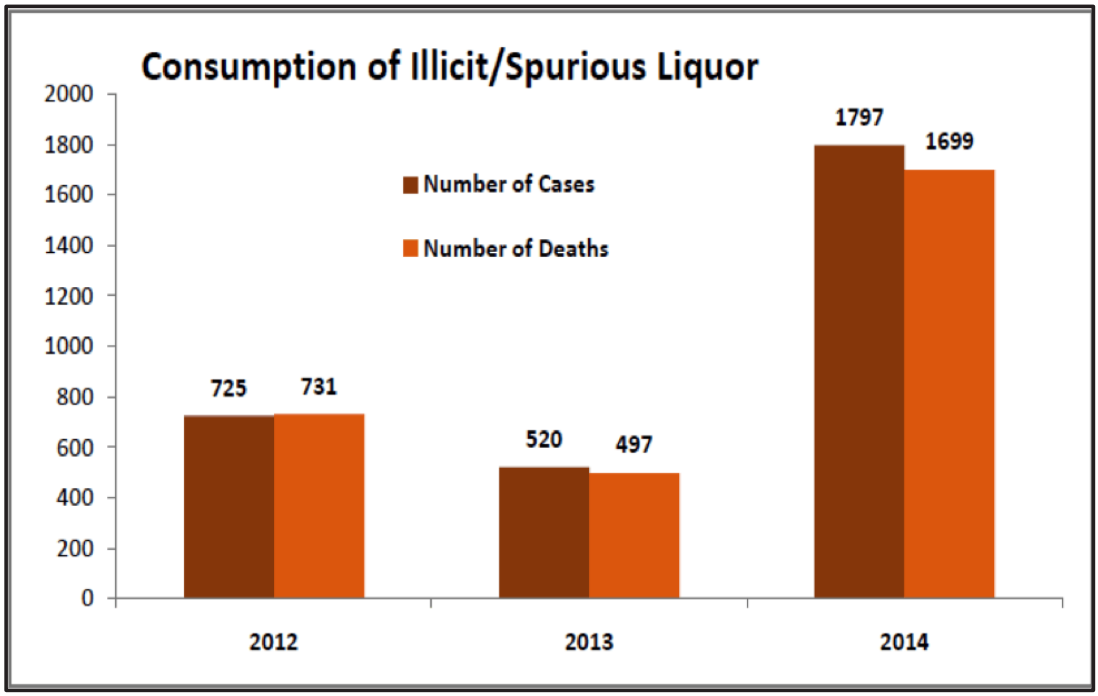


Figure 2: A pie chart representing Number of cases and deaths due to Consumption of Liquor (Dubbudu, 2015)

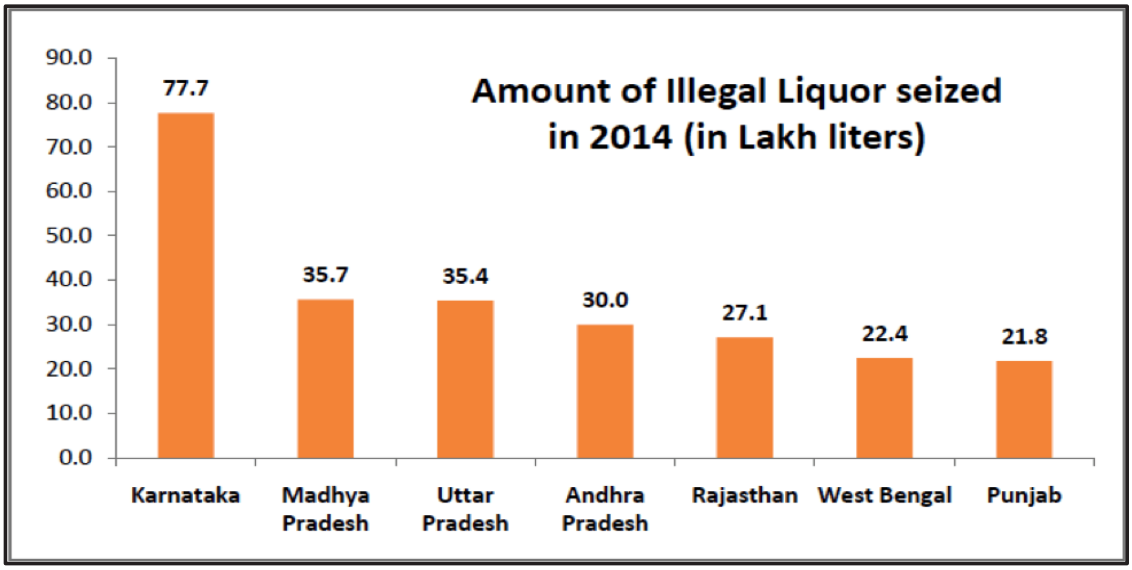


Figure 3: Bar diagram indicating Amount of illegal Liquor seized in selective states in 2014 (Dubbudu, 2015)

4.1 Alcoholism

Alcoholism is a chronic illness marked by dependence on alcohol consumption that interferes with physical or mental health, and social, family or job responsibilities. This addiction can lead to liver, circulatory and neurological problems.

There are approximately 79,000 deaths attributable to excessive alcohol use each year in the US.

This makes excessive alcohol use the 3rd leading lifestyle – related cause of death for the nation. In the single year 2005, there were more than 1.6 million hospitalizations and more than 40 million emergency room visits for alcohol – related conditions.

4.2 Definition of Patterns of Drinking Alcohol

- **Binge Drinking**

- For women, 4 or more drinks during a single occasion.
- For men, 5 or more drinks during a single occasion.

- **Heavy Drinking**

- For women, more than 1 drink per day on average.
- For men, more than 2 drinks per day on average.

4.3 Short Term Effect of Alcohol

- **Brain**

Alcohol can reach the brain in a short amount of time and the brain's ability to control the body is greatly affected. Fine motor skills, speech and vision may be affected.

- **Heart**

Alcohol causes the heart rate to increase and the blood vessels to expand. Due to the expanded blood vessels, blood is circulated closer to the outermost layer of skin, allowing the body's heat to escape easier.

- **Liver**

The liver is the organ that processes the alcohol in the body and turns it back into water and carbon dioxide. When more alcohol is consumed faster than the liver can handle, the alcohol continues to circulate the blood stream cause intoxication.

- **Respiratory System**

The lungs release carbon – dioxide from the body while a person is breathing. The water passes out of the body in the form of urine, perspiration, and breath vapor.

- **Stomach**

Some of the alcohol consumed by a person will pass through the lining of their stomach to reach the bloodstream. Ingesting too much alcohol in a short amount of time may cause the stomach to reject the poison and vomiting may occur.

Alcohol can affect a person's judgment and may interfere with a person's ability to control decisions, behavior and emotions.

The chances of contracting sexually transmitted diseases, unplanned pregnancies and violence are greatly increased when a person is under the influence of alcohol.

➢ **Drinking and Driving**

- Alcohol reduces a person's ability to judge distances, speeds and turns makes a person reflexes.
- The deadliest short term effect of alcohol is driving under the influence of alcohol (DUI)
- Legal limit in Michigan Blood alcohol content over 21 = 0.08 under 21 years = zero tolerance
- Driving under the influence of alcohol is the leading cause of death among teenagers. On average 11 teenagers are killed and 350 injured every day in the US due to drink driving.

4.4 Long – Term Effects of Alcohol

- Long -term excessive use of alcohol can lead to severe brain damage.
- Moderate drinking can result in the loss of brain cells.

- Loss of brain cells can cause impairment of intellectual abilities like memory and problem solving.
- If you choose to continue to use alcohol while you are pregnant with a baby, many different problems can arise. Whatever a mother consumes the baby also consumes. If a mother is drunk, there is a good chance here unborn baby is also.

Alcohol also interferes with the livers ability to function properly. The liver is unable to break down fats creating a fatty build up within the liver that prohibits it from functioning Longtime heavy use of alcohol can cause a condition called as Liver Cirrhosis. This is a condition in which liver tissue is destroyed and then replaced with scarred tissue.

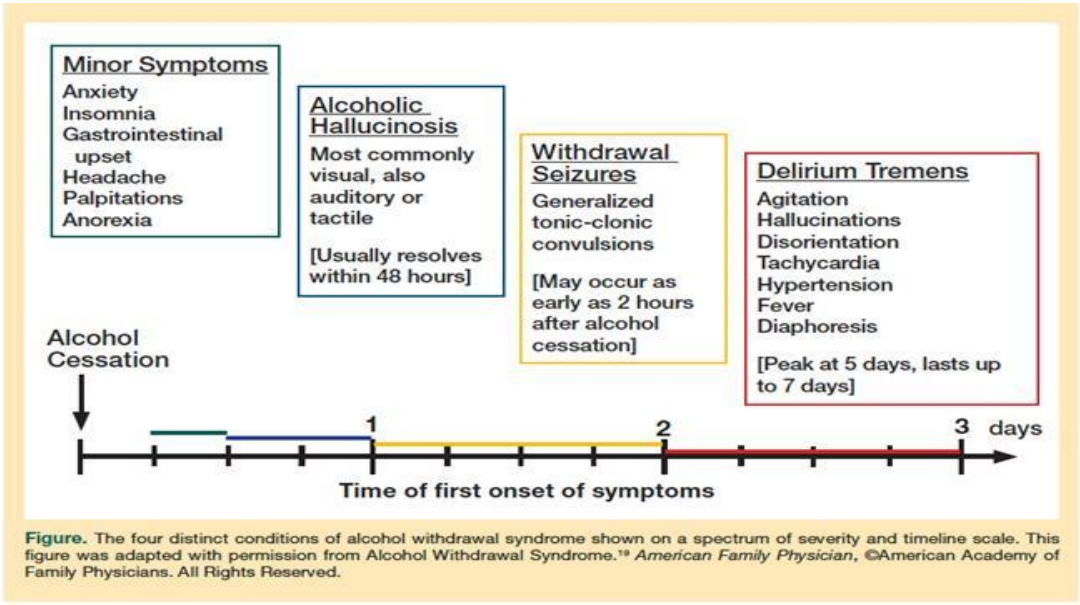


Figure. The four distinct conditions of alcohol withdrawal syndrome shown on a spectrum of severity and timeline scale. This figure was adapted with permission from Alcohol Withdrawal Syndrome.[19] *American Family Physician*, ©American Academy of Family Physicians. All Rights Reserved.

(Source: Case Report on Identification and Management of Alcohol Abuse and Withdrawal in Elders, 2012, Consultant 360)

Figure 4: Diagram presenting 4 distinct conditions of Alcohol withdrawal symptoms

4.5 Impact of Alcohol Use on Economic and Family Finances

The economic impact of alcohol consumption plays a major role in families belonging to lower socio – economic strata. In study done by Bono et al, it was found that there was an empirical association found between the use of alcohol and tobacco and impoverishment through borrowing and selling off assets in distress because of hospitalization. It was found that alcohol-dependent persons spent more money than they earned, they were forced to take loans to spend for their expense related to alcohol consumption, on an average, 12.2 working days were lost to the habit and around 60% of the families were financially supported by the

income from other family members. In a study the persons who consume alcoholic beverages had strained relations with their family members especially their spouse and children.

4.6 Road Traffic Accidents

One of the major problems of alcohol consumption are road traffic accidents which occur due to driving vehicles under the influence of alcoholic beverages. Both developing and developed countries report high rates of road traffic accidents because of alcohol consumption.

In a study conducted by the National Institute of Mental Health and Neurosciences (NIMHANS) 12 Major hospitals of Bangalore city, it was found that nearly 28% of injuries because of road traffic accidents were directly attributable to alcohol. The roadside survey revealed that nearly up to 40% of the drivers were under the influence of alcohol.

According to the latest data released by the NATIONAL CRIME RECORDS BUREAU (2015), TAMIL NADU recorded the highest number of drunk and driving accidents in the country. In a study, high - risk behavior was more common among alcohol – dependent individuals with road traffic accidents being the most frequently observed.

4.7 Legal Problems Because of Alcohol Consumption

Another important area where complications arise because of alcohol abuse is legal problems. Crimes that are committed following alcohol intoxication include sexual/physical assault, rape, and exploitation of women in homicide. According to NATIONAL CRIME RECORDS BUREAU OF INDIA, the different crimes that are related to alcohol consumption fall under four major acts namely, the prohibition Act, Gambling Act, psychotropic substance Act and Excise Act. However, the major reason because of which the public nuisance created because of alcohol abuse goes unnoticed is that those crimes are classified under petty crime and they largely go unrecognized or they may get overlooked.

4.8 Benefits of Alcohol Consumption

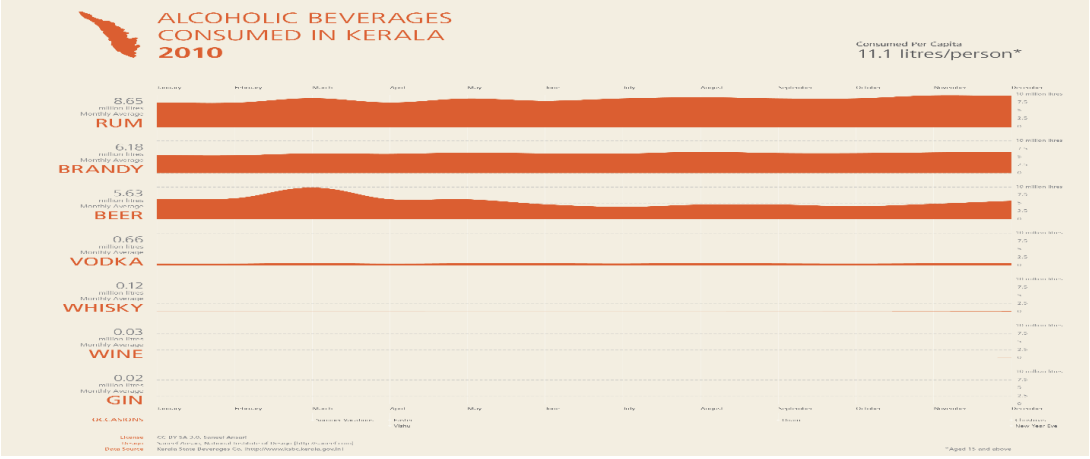
There are many studies that have pointed out that drinking alcohol in moderate amounts is good for the heart as they help in preventing coronary artery disease (CADS). However, individual susceptibility plays a major role in the protective benefits of alcohol consumption. THE AMERICAN HEART ASSOCIATION (AHA) states that it’s not possible to predict in which people alcoholism will become a problem and advice not to consume alcohol for the benefits it may carry.

In a multi – center study done in India, it was found that even light or occasional consumption of alcohol might increase risk of CAD. So, the benefits of alcohol consumption may not be true for Indians at least.

5.0 ALCOHOL POLICY IN INDIA

Although the prohibition of alcohol use is encouraged in the constitution of India, alcohol policy is a state subject. States are having full control alcohol related legislation, excise rates and the production, distribution and sale of alcohol. Newly independent India, which was born post-independence, retained alcohol prohibition until mid 1960s, and by 1970, only the state of Gujarat, had a complete alcohol prohibition policy. In, Bihar, there is complete prohibition of alcohol use since 4 April 206. However, following a year after the ban, trade of illicit liquor flourished along the borders, as the neighboring states have no prohibition on alcohol. In addition, there seems to be illicit trade of narcotic drugs as people have begun to look for other substances for addiction.

Another controversial 'DRY STATE' is Manipur, Where the prohibition of alcohol consumption is in force since 1991, but scheduled castes (SCs) and scheduled tribes (STs) were allowed to brew their traditional liquor. In 2002, the government lifted the ban of alcohol in some districts in Manipur. Manipur is known popularly called 'WETTEST DRY STATE'. Government is now looking to remove prohibition act, AS illicit liquor use, death because of methanol poisoning and substance abuse are on rise. The major reason states experience fluctuation on the alcohol prohibition at the policy level is that it generates nearly 15% to 20% of their revenue from alcohol taxation, contributing a significant amount to state treasury. States like Gujarat, where complete prohibition is in force, the rich have continued access to alcoholic beverages and the lower class and poor people resort to illegal brewing of alcohol with increase in deaths because of methanol poisoning.



(Source: Saneef, Consumption of Alcoholic Beverages (in Liters) & per capita consumption in Kerala for the year of 2010; (2011), Kerala State Beverages Co.)

Figure 5: Alcohol and Sustainability

6.0 MAJOR OBSTACLE TO DEVELOPMENT

The 2030 Agenda contains 17 sustainable development Goals with 169 targets. The 17 SDGs cover all three aspects of sustainable human development; the social; environmental and economic dimension.

Alcohol is a major obstacle to sustainable human development, adversely affecting all three dimensions of sustainable development. Alcohol kills 3.3 million peoples Worldwide every year. It means: Every 10 seconds a human being dies because of alcohol. This represents 5.9% of all deaths. Globally, alcohol is the 5th leading risk factor for premature death and disability; among people between the ages of 15 and 49, it is the number one risk factor. Through its multiple public health, social and economic impacts, alcohol is a massive obstacle to achieving 13 out of 17 SDGs, and a total of 52 targets. Alcohol is an obstacle to development by jeopardizing human capital and hindering sustainable human development. Alcohol is a specifically mentioned in SDG 3 on death and well – being Target.

"Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol".

7.0 VARIOUS CYCLE OF ALCOHOL & POVERTY

Alcohol has various adverse effects on people's economic status while economic status in turn affects alcohol use in many ways.

Alcohol can push people into poverty and lack them, their families and entire communities there over generations. The direct costs of alcohol harm to the household are often considerable and frequently underestimated – and put a big burden on development.

Latin America: Alcohol has become the leading cause of male death and disability threatening further progress and sustainable development

A study in Sri Lanka found that over 10% of male respondents reported spending as much as or more than their regular income on alcohol.

8.0 CONCLUSION

It can be concluded from the above points that Alcohol is solely responsible for suffering many disorders, syndromes and diseases. Alcohol is the major risk factors for many disorders to occur.

- Alcohol major risk factor for TB, HIV /AIDS
- Alcohol major risk factor for NCDs
- Alcohol and global death, disability
- Alcohol and road traffic injuries, fatalities.

- Bottles over books: alcohol and children's primary education
- Alcohol marketing perpetuates harmful norms
- Alcohol fuels epidemic of violence against women
- Drinking water or producing alcohol?
- Massive economic costs due to alcohol
- Alcohol workplace and lost productivity
- Leaving no youth in NEET behind
- Alcohol and health, social inequalities
- Alcohol's to harm others
- Alcohol outlet density: unsafe public space, neighborhood violence
- Alcohol barrier to inclusive enabling public space for children, adolescent's youth.
- Alcohol production threatens sustainable use of natural resources.
- What could become toxic, addictive, carcinogenic substance?
- Not green after all: Alcohol fuels greenhouse gas emissions, global warming.
- Pervasive alcohol violence
- Youth suffering from violence
- Alcohol taxation: win win measure for financing development
- Big Alcohol: No partner sustainable development

9.0 BIG ALCOHOL & SDGs CONFLICT OF INEREST

The producers of alcohol and other unhealthy commodities are commercial determinants of ill health, economic, harm and under development ".

Alcohol is a major obstacle to achieving the SDGs. To effectively curb the commercial drivers of this obstacle to development, alcohol availability, affordability, and marketing need to regulate.

But this goes contrary to the core business interest of BIG ALCOHOL: to maximize profits by increasing alcohol consumption everywhere.

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CHAPTER 27

CONSUMERISM IN INDIA: AN OVERVIEW

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ABSTRACT

No economy can flourish without the rights of the consumer being protected. A consumer is an indispensable actor of any economy as he is the person who buys or hires goods or services from the seller and in turn boosts employment in the country. Thus, protecting the rights of the consumer is important because in the present times the demands and expectations of the consumer have changed due to globalization and growing awareness. However, the availability of a large number of goods and services sometimes proves to be harmful to the consumer as not all sellers and service providers are genuine. The Consumer Protection Act, 1986 was established to address the grievances of the consumer and to protect their interests. It was a laudable step at that point of time and amended from time to time.

Keywords: Consumer Protection Act

1.0 INTRODUCTION

Consumerism is the idea that increasing consumption of goods and services purchased in the market is always a desirable goal and that a person's well being and happiness depends fundamentally on obtaining consumer goods and material possessions. According to MC Million Dictionary 1985 "consumerism is concerned with protecting consumers from organisations with which there is exchange relationship. It encompasses the set of activities of government, business ,independent organisations and concerned consumers that are designed to protect the rights of consumers".

Consumerism and quality of life come together because people can control both of them. If anyone is able to manage their money and decide on what to spend it they actually controlling their standards of living and their quality of life. A wise consumer must consider

other sales not just focus on one must be able to buy the basic and important needs that you need on a daily life. Anyhow a consumer must check the quality of a product and understand how to manage it as well as to use it.The Act was passed to protect the interest of the consumer because there was some seller who provide the poor quality of goods and charged high prices of goods from consumer. Act was passed to give quality of life to consumer. The Consumer Protection act 1986 as under section 6 give some rights to consumers.

2.0 RIGHTS TO CONSUMER UNDER CPA, 1986

i. **Right to safety-** Consumers have the right to be protected against product and services that are hazardous to health and life

ii. **Right to be informed-** Consumer have the right to be protected against fraudulent draught full and are grossly misleading information advertising labelling or other practices

iii. **Right to choose-** The consumer have the right to be protected against have right to assured access to a variety of products and services at competitive prices coloured brand quantity rates.

iv. **Right to be here-** Address consumer have the right to be assured that consumer interest will receive full and sympathetic consideration in the formulation of government policies and fair and Expectations treatment in ATS Administrative Tribunal

v. **Right to enjoy a clean and healthy environment-** Environmental issues pollution issues

3.0 PROBLEMS FACED BY INDIAN CONSUMER

i. Short supply of many goods and services

ii. Lack of effective or cable competition

iii. Many product in advanced countries are still new to a very large segment of the Indian Consumer

iv. Consumerism in India is not well organised and developed

v. Laws to safeguard the interest of consumed are not effectively implemented Consumer organisations

There are Consumer Protection Agencies which protect the interest of consumers CERC (Consumer Education and Research Centre, Ahmedabad) FEDCOT (Fedration of Consumer Organisation in, Tamil Nadu) Consumer guidance Society of India ,Mumbai CUTS (Consumer Unity of Trust Society, Jaipur)

CONCERT (Centre for Consumer Education and Research ,Teaching ,Training and Testing, Chennai)

4.0 BUREAU OF INDIAN STANDARDS, CHENNAI

Consumers should aware about

- **Underweight and Under Measurement-**The goods being sold in the market are sometimes not measured for weighted correct
- **Top standard quality -**The goods sold are sometimes of substandard quality selling of medicines beyond their expiry date is generally the grievance of consumer
- **High prices** -Very often the traders charge a higher price than the prescribed retail price
- **Duplicate article-** In the name of genuie parts are goods fake or duplicate item are being sold to the consumer
- **Artificial scarcity-** In order to in profit Businessman create artificial scarcity by hoarding they sell it later at a higher price
- **False or incomplete information**- As easily mislead consumer by giving wrong information about the product is price quality reliability life cycle expiry date and durability
- **Under Section 72 (1)-** if any consumer failure to comply with order of district state national commission then imprisonment period of not less than one month extendable up to three years or find not less than rupees 25000 upto rupees 100000 or both
- **Under section 88-** Failure to comply with order of CCPA under sec 20,21. A complaint can be filled by the central Consumer Protection authority or any officer authorised by it in this behalf then imprisonment is which may extend up to six month or fine which may extend upto rupees 20 lakh or both
- **Under section 89-** if any consumer false and misleading advertisement by any manufacturer or service provider a complaint can be filled by the central Consumer Protection authority or any officer authorised by it in this behalf then imprisonment which may extend to two years and find which may extend to rupees 10 lakh subsequent offence imprisonment which may extend to five years and with fine which make stand to rupees 50lakh.
- **Under section 90 (1) (a)-** Manufacture for sale or storing selling or distributing your important product containing an adulterant but does not result in an injury to the

consumer then imprisonment which may extend to 6 month and fine which may extend to rupees 100000

- **Section 90(1) (b)** manufacture for sale or storing selling or distributing or importing product containing an adult and causing injury but not previous hard to the consumer than imprisonment which may extend to one year and find which may extend to rupees 3 lakh
- **Section 90(1) (c)-**Manufacture for sale or storing selling or distributing or important product containing an adult and causing injury resulting in grievance hard to the consumer which may extend to seven years and find which may extend to rupees 500000 such an offence Shelby cognizable and non bailable
- **Section 90(1) (d) -**Manufacturer for sale or storing selling or distributing for importing products containing an adult and results in deatht of consumer then I'm penalty imprisonment not less than 7 year which may extend to life imprisonment and fine not less than rupees 10 lakh such an offence shall be cognizable and non bailable

4.1 Remedies

The farm commissions can order the following relief removal of defect from the goods replacement of the goods refund of the price paid award of compensation for the loss or injury suffered removal of defect or deficiencies in the services discountenance of unfair trade practices and restrictive trade practices and directing not treating them withdrawal of the hazardous food from being offered for sale award for adequate cost to practice.

5.0 PRACTICES TO BE FOLLOWED BY BUSINESS UNDER CONSUMER PROTECTION ACT, 1986

Source: https://www.toppr.com/guides/business-studies/consumer-protection/consumer-protection-act/

- If any defect found the seller should remove the mentioned defects from the whole batch or the goods affected. For example, there have been cases where car manufacturing unit found a defect in parts of the vehicle usually they remove the defect from every unit or they call of the unit.
- They should replace the defective product with a nondefective product and that product should be of similar configuration or should be the same as the product purchased.

5.1 Redressal: Three Tier System under Consumer Act

- **District Forum:** These fora are set by the district of the state concerned in each district wherein it consists of President and two members of which one should be a woman and is appointed by the State Government. In this, the complaining party should not make a complaint more than 20 Lacs and once the complaint is filed the goods are sent for testing and if they found defective the accused party should compensate and if the party is dissatisfied can make an appeal with state commission within 30 days.
- **State Commission:** This is set up by each state It consists of President and two members. Complains should be at least 20 lacs and exceed not more than 1 crore. The goods are sent for testing and if found defective are asked for replacement or compensation. If not satisfied can make an appeal within 30 days in front of the National Commission.
- **National Commission:** Consist of President and 4 members. The complaint must exceed an amount of 1 crore. The goods are sent for testing and if found defective are asked for replacement or compensation

6.0 CONCLUSION

A Consumer can file complaint on a plain paper either handwritten or typed with no legal formalities for filing the complaint to three-tier adjudication system popularly known as "Consumer Courts" under Consumer Protection Act, 1986. Consumer courts may grant many kinds of relief to consumers. The consumer under CPA requires only small fees to pay in form of demand draft. The rigors of court procedures have been dispensed with and replaced with simple procedures as compared to the normal courts. In reality, Consumers have to realize their role and importance. The consumer movements can be winner movements only with the active involvement of consumer by knowing his rights and enforcing them. The consumer is exposed to many hazardous- physical, environmental and exploitation due to unfair trade practices. There is need of strong consumerism in our country on account of the many reasons

e.g. illiteracy, less-education, ignorance and ill-information, poverty, lack of social awareness etc. For safeguarding the consumers, consumer must understand his rights and responsibilities. It is recognized theory of the jurisprudence that rights and duties are correlated and there can be no right without duty and vice versa.

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Environment is defined as the total planetary inheritance and the totality of all resources. It includes all the biotic and abiotic elements that influence each other. All living elements-the birds, animals and plants, forests, fisheries etc. are biotic elements. Abiotic elements of the environment includes non-living elements like air, water, land, rocks and sunlight etc. Whereas Sustainable development refers to the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development promotes the preservation of the environment so that the wonders of the nature can be enjoyed by our future generations. Examples of sustainable development that help to safeguard environment are: solar energy, wind energy, crop rotation. Sustainable development aims at social development, environmental protection and economic development.

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