Environmental Issues:
Problems and Solutions

Environmental Issues:
Problems and Solutions

Edited By

Dr. Deepika Saini

Assistant Professor
Dept. of Zoology
Chamanlal Mahavidyalaya,
Landhaura, Haridwar
Uttarakhand

Dr. Adarsh Pandey

Assistant Professor
Dept. of Botany
S.S College, Shahjahapur
Uttarpradesh

Education is Most Powerful Weapon

ABS BOOKS

Delhi-110086

ISBN : 978-93-91002-19-0

Copyright : Edited

Edition : 2022

Published by

ABS Books

Publisher and Exporter

B-21, Ved and Shiv Colony, Budh Vihar
Phase-2, Delhi - 110086

✆ : +919999868875, +919999862475

✉ : absbooksindia@gmail.com

Website : www.absbooksindia.com

PRINTED AT

Trident Enterprise, Noida (UP)

International Branches

ABS Books

Publisher and Exporter

Yucai Garden, Yuhua Yuxiu Community, Chenggong District, Kunming City, Yunnan Province -650500 China

ABS Books

Publisher and Exporter

Microregion Alamedin-1
59-10 Bishek, Kyrgyz Republic- 720083
Kyrgyzstan

Environmental Issues: Problems and Solutions

By : Dr. Deepika Saini
Dr. Adarsh Pandey

प्रो. अखिलेश कुमार पाण्डेय

कुलपति

Prof. Akhilesh Kumar Pandey

Vice Chancellor

विक्रम विश्वविद्यालय

नैक द्वारा 'द' ग्रेड प्रदत्त

उज्जैन (म.प्र.) 456010 भारत

दूरभाष : 0734-2514270 (कार्यालय)

: 0734-2511673 (निवास)

फेक्स : 0734-2514276

VIKRAM UNIVERSITY

Accredited 'A' Grade by NAAC

Ujjain - 456010 (M.P.) India

Phone: 0734-2514270 (off.)

: 0734-2511673 (Res.)

Fax : 0734-2514276

Email : vcvikramujn@gmail.com

Website : www.vikramuniv.ac.in

FOREWORD

"LETS NURTURE TIIBNATURE, S01HATWE
CANHAVEABETIERFUTIJRE"

It gives me immense pleasure to write a foreword letter for such an outstanding and hard work of Dr. Deepika Saini, Assistant Professor, Department of Zoology, Chamanlal Mahavidyalaya, Landhaura, Haridwar, Uttarakhand and Dr. Adarsh Pandey, Assistant Professor, Department of Botany. S.S College, Shahjahapur, U.P.

The endeavor undertaken by Dr. Saini and Dr. Pandey in shaping the burning environment topics in the form of an edited book entitled: ENVIRONMENTAL ISSUES: PROBLEMS AND SOLUTIONS is highly commendable and for sure will be fruitful for the students, academicians, . faculties and society as well.

This volume contains articles /papers on the topics which really need to be discussed in today's scenario when whole whorls is facing global crisis in terms of pollution, climate change, global warming etc.

I whole heartedly congratulate Dr. Saini and Dr. Pandey for considering and choosing such a burning topic of Environmental issues and giving it a shape of an edited volume.

In addition, it gives me pleasure to congratulate the participation ofresearch scholars as well as professor's for sharing their valuable views in spreading environment awareness among the upcoming generations.

I enjoyed reading the book and wish the editors all the success.

27/6/21

(Prof. Akhilesh Kumar Pandey)

Prof. Sardul Singh Sandhu
M.Sc., M.Phil., Ph.D., D.Sc. & F.B.S.

Director: Design Innovation Center (MHRD)

PDF: Monash University Australia ; Sau Paulo University, Brazil; University of Campinas, Brazil;

Fellowships to visit abroad:

UNESCO France, TWAS/ CNPq Brazil, DBT and UGC New Delhi.

LAB: Fungal Biotechnology & Invertebrate Pathology, Department of Biological Sciences,
Rani Durgavati University Jabalpur – 482001 (M.P.) INDIA

FOREWORD

"LETS NURTURE THE NATURE, SO THAT WE CAN HAVE A BETTER FUTURE"

It gives me immense pleasure to write a foreword letter for such an outstanding and hard work of Dr. Deepika Saini, Assistant Professor, Department of Zoology, Chamanlal Mahavidyalaya, Landhaura, Haridwar, Uttarakhand and Dr. Adarsh Pan- dey, Assistant Professor, Department of Botany. S.S College, Shahjahapur, U.P.

The endeavor undertaken by Dr. Saini and Dr. Pandey in shaping the burning environment topics in the form of an edited book entitled: ENVIRONMENTAL ISSUES: PROBLEMS AND SOLUTIONS is highly commendable and for sure will be fruitful for the students, academicians, faculties and society as well.

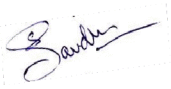
This volume contains articles /papers on the topics which really need to be dis- cussed in today's scenario when whole whorls is facing global crisis in terms of pol- lution, climate change, global warming etc.

I whole heartedly congratulate Dr. Saini and Dr. Pandey for considering and choosing such a burning topic of Environmental issues and giving it a shape of an edited volume.

In addition, it gives me pleasure to congratulate the participation of research scholars as well as professor's for sharing their valuable views in spreading environment awareness among the upcoming generations.

I enjoyed reading the book and wish the editors all the success.

Wishes,



Prof S S Sandhu

Res.: # B-96, Priyadarshini Housing Society, Dumna Road, Near Hitkarni Engineering College, Jabalpur, India. Jabalpur, M.P. (482001) , India.

Mobile-1: +91-9424395270,
Mobile-2: +91-8770961476
Telefax : +91-2608704 (O)

Emails: ssandhu@rediffmail.com, sardulsinghsandhu@gmail.com

ACKNOWLEDGEMENT

On the successful completion of the book, we are thankful to the almighty, the divine power for giving us strength for completing the task undertaken.

We record our heartfelt thankfulness and indebtedness to Dr. **K.K. Dube,** Retd. Prof, Govt. Auto. Science College, Jabalpur (M.P), His holiness **Swami Chinmayanand Saraswati Ji maharaj** (Former Home-Minister for State).

We convey our sincere thanks to respected **Manager Shri Ram Kumar Sharma,** Chamanlal Mahavidyalaya Landhaura Haridwar Uttarakhand; Hon'ble **Principal Shri Sushil Upadhyay** for their co-operativeness to get an excellent work environment and respected **Dr. A.K Mishra**, Secretary, S.S College, Shahjahanpur, U.P.

Our loving gratitude and thanks to our beloved family members for their constant support and encouragement.

We extend our sincere and heartfelt gratitude to ABS Publication for assisting us in all directions for making our book more responsive to the immediate concerns of researchers and the teaching fraternity.

We have deep credence to our readers and authors who would surely not hesitate in expressing their critical opinion for the betterment of the present book and our future endeavors.

We extend our enumerable thanks to all the well-wishers, who directly or indirectly lent their helping hand in the successful completion of this task.

Dr. Deepika Saini
Dr. Adarsh Pandey

PREFACE

To all the people of the world, who are concerned, aware, and willing to create or find a solution to the environmental degradation and other various issues that nature is going through; we owe all our motivation and inspiration to you.

Global environmental issues are intensified along with the advancement of the modern world since the last century. The human race has been at stake in front of the appalling effect of global warming, climate change, and pollution in diverse areas of our ecosystem. In recent years, environmental pollution has received considerable attention from regulators, environmentalists, and economists who have integrated their concepts and left no stone unturned to mitigate its hazards. This book discusses the environmental implications of climatic, technological, ecological, waste, and many other factors, including the impact of Information and Communication Technologies on the environment. The impact of various energies on our environment has been studied and its issues have been solved. This book contains several contributions that illustrate the state of the art of academic research and knowledge in the field of climate change, ecological change, green renewable energy, solid waste management, and pollution. The layout of this book is not only to capture the environmental dimensions of the problem but also its ecological and substantial dimension and its solutions. The research also covers the technology and engineering of today's environmental issues and the development on this.

Dr. Deepika Saini
Dr. Adarsh Pandey

CONTENTS

1.

Climate Change and Sustainability

Komal Verma*

Dr. Deepika Saini**

Introduction

Climate change is the most significant challenge to achieving sustainable development, and it threatens to drag millions of people into grinding poverty.

At the same time, we have never had better know-how and solutions available to avert the crisis and create opportunities for a better life for people all over the world.

Climate change is not just a long-term issue. It is happening today, and it entails uncertainties for policy makers trying to shape the future.

At the World Bank Group we are committed to working where it matters most:

By 2050 two-thirds of the world's population will be living in cities. Helping developing country cities access private financing and achieve low-carbon, climate-resilient growth and avoid locking in carbon intensive infrastructure is one of the smartest investments we can make. Every dollar invested

***Research Scholar, Mahatma Jyoti Rao University, Jaipur Rajasthan**

****Assistant Professor, Department of Zoology, CLM, Haridwar, Uttarakhand.**

in building creditworthiness of a developing country city will mobilize $100 dollars in private financing for low-carbon and climate-resilient infrastructure.

To feed 9 billion people nutritiously by 2050 we need to make agriculture resilient, more productive in changing landscapes, and aggressively reduce food waste. Making agriculture work for the people and the environment is one of the most pressing tasks at hand. We need climate-smart agriculture that increases yields and incomes, builds resilience, and reduces emissions while potentially capturing carbon.

The World Bank Group supports the Sustainable Energy for All goals of doubling both the rate of improvement of energy efficiency and the share of renewable energy in the global energy mix from 18 percent to 36 percent by 2030. Reaching these goals is key to low-carbon growth.

Conclusion

Global warming could not be solve easily if people are not very well practice in lowering carbon emission, law and regulation's implementation and effective forests and agriculture management. The solutions for this issue will be more effective when individuals change their lifestyles. Individuals can contribute to reduce the changes in the global climate through changing their habits. we must try our best to solve the problem and strive as much as possible to reinstate our earth for sake of future generation.

References

1. His Excellency Maumoon Abdul, Gayoom, President of the Republic of the Maldives. Address to the United Nations General Assembly on the issues of environment and development. New York, USA, 19 October 1987.
2. Watson, R. et al. Protecting our planet securing our future: linkages among global environmental issues and human needs. UNEP, NASA, World Bank, 1998.
3. McMichael, A.J. Human frontiers, environments and disease: past patterns, uncertain futures. Cambridge, UK, Cambridge University Press, 2001.
4. Corvalán, C.F. et al. Health, environment and sustainable development: identifying links and indicators to promote action. Epidemiology 10: 656–660 (1999).
5. McMichael, A.J. Population, environment, disease, and survival: past patterns, uncertain futures. Lancet 359: 1145–1148 (2002).
6. United Nations (UN). Report of the UN conference on the human environment. New York, USA, United Nations, 1973.

7. McMichael, A.J. et al. The sustainability transition: a new challenge. (Editorial). Bulletin of the World Health Organization 78: 1067 (2000).
8. United Nations (UN). Agenda 21: the United Nations programme of action from Rio. New York, USA, United Nations, 1993.
9. Hill, A.B. The environment and disease: association or causation.

◆ ◆ ◆

2.

Types of Pollution and Green-House Gases Effect

Dr. Aniruddha Ram*

Mrs. Sarbha Bhaskar**

Dr. Deepika Saini***

Introduction

The environmental of the globe is a great blessing for every living being. Human life is fully dependent upon a balanced environment and essential for him for existence. Healthy environment is sine quo non for healthy body. In particular and for all living creature in general. It is a gift given by nature to the men for their development and survival. It includes all which is around, above and below us. At present the civilisation is facing with the burning problem of pollution. In the name of development, the man is busy in his destructive activities. In this context, it is oft-quoted that the man is the most destructive enemy of himself. Various programmes to conquest the nature and technologic process initiated by the forms of earth quakes, droughts, floods,

***Associate Professor, Dean College of Law. IIMT University O Pocket Ganga Nagar Mawana road Meerut, Uttar Pradesh.**

****Research Scholar, Jaipur School of Law, Maharaj Vinayak Global University, Jaipur Rajasthan.**

*****Assistant Professor Dept. of Zoology , Chamanlal Mahavidyalaya, Haridwar.**

cyclones, famines and epidemics are causing great sufferings to the living beings. Pollution can be considered to be more dangerous than nuclear weapons, bombs and virulent germs. Environment comprehends the totality of physical, economic, cultural, aesthetic and social circumstances and factors which also affect the quality of peoples, lives. It includes the surrounding conditions, influence on forces which influences or modify. A disbalance in environment and eco-system may render the human survival impossible.[1]

There are many factors that threaten the healthy environment, Population explosion, growth of industrialisation, unregulated exploitation of natural resources cause loss to healthy environment. The recent issue of science reveals the outcome of a new study that urban and industrial air pollution and acidic rain and snow fall because the pollution particles prevent cloud water from condensing into raindrops and snowflakes.

The classification of environmental pollution is a difficult task because the pollution and the media through which the pollutants are transported are all inter-connected and inter-related. However, pollution may be classified from the point of view of object which is polluted. From this angle pollution may be classified as elaborated below:

(A) Air Pollution;
(B) Water Pollution;
(C) Land Pollution;
(D) Food Pollution;
(E) Radio-active Pollution and
(F) Noise Pollution;

(A) Air Pollution

Air pollution is generally accomplished through air pollutants. The definition of air pollutant is given under Section 2 (9) of the Air Pollution Act, 1981. Section 2 of the Air Pollution Act defines air pollutant as follows:

"Air Pollutant means any solid, liquid or gaseous substance including noise present in the atmosphere in such concentration as may be or tend to be injurious to human beings or living creatures or plants or property or environment."

Section 2 (b) of the Air Act defines air pollution in the following words:

"Air Pollution means the presence in the atmosphere of any air pollutant."

For understanding air pollution, it is desirable to understand the composition of air.

Air is the mixture of gases forming the earth's atmosphere. In the air are found several gases. Mainly, nitrogen, oxygen, argan and carbon dioxide. Besides, other trace that gases like neon, krypton, helium, hydrogen, xenon are also present. Air is very important for all types of life in the biosphere. Human life is not possible without air because man can live for a few days without water or for a few weeks without food but cannot survive for a few minutes without air. The typical ingredients of the air are nowhere completely absent from the atmosphere.

Atmosphere is roughly divided into five zones. They are following:

(i) Troposphere
(ii) Stratosphere
(iii) Mesosphere
(iv) Ionosphere
(v) Exosphere

(B) Water Pollution

Water is the most significant element in the biosphere because on one hand it is vital for the survival of all forms of life and on the other hand it helps in the movement, circulation and cycling of nutrients in the biosphere. It supports life system and its shortage has been serious concern of human being's. It covers about one-third of earth's surface in the world.

In natural water is found in three main forms—(i) Atmospheric moisture, (ii) Precipitation and (iii) Soil water. As regard these forms, precipitation is the dominant source. Atmospheric moisture is present as vapour which is invisible is known as fog or cloud.

(C) Land Pollution

Land is in fact the very heart of life layer (biosphere) because it represents a zone wherein plant nutrients produced,

held, maintained and are made available to plants through their roots and to the micro-organisms which live in the land. Further land is very important environment attribute for human society because (i) it is the basic medium for food and timber production; (ii) it provides foundation for buildings and roads; (iii) it is very important exhaustible nature resource because it cannot be replaced if it is destroyed of lost through excessive soil erosion caused by anthropogenic activities and it is the base for the development of human civilization. The quality of land depends upon the nutrients, both organic and inorganic, humous content, moisture, temperature etc, present in the soils.

Decrease in the quality of land either due to anthropogenic sources or natural sources or by both is called land pollution. Decrease in the quality of land is caused due to accelerated rate of soil erosion, decrease in plant nutrients, decrease in soil micro-organisms, excess of deficit of moisture, lack of humous content and input and concertation of various types of pollutants.

(D) Food Pollution

Food is one of the most essential resources of human survival. Adequate food is an absolute requirement for human existence. Without sufficient food, human physical and mental development is dramatically impeded. Every living being requires food to get energy through which he carries on his activities. If the food taken by the people is polluted and adulterated it has injurious effect on them. Food is polluted from its source to its use. Every living being has natural sense to judge whether the food is suitable for consumption of not. Men inspect mice snit and elephants taste food before eating it. In addition to this innate sense men have developed certain other tests to judge the quality of food. Such tests are intended to:[2]

(a) Make the food palatable and attractive in the local frame of value;

(b) Keep the nutrient value as high as possible;

(c) Handle it in storage to reduce loss;

(d) Achieve abundance;

(e) Keep it free of filth and objectionable additions;

(f) Keep it free of poisons, by rejecting natural foods, removing poisonous parts, and processing inactive poisons and avoid knowingly adding materials in quantities which cause poisoning;

(g) Keep it free of pathogenic biological agents.

The pollution of food begins when in order to protect seeds in soil from termites and pests' chemicals are used; then chemicals are used to protect plant growth, then where plant starts flowing and fruits starts coming then again chemicals are used. These chemicals directly or indirectly affect the quality of food and when polluted or adulterated food is consumed, it affects the health or consumer.[3]

(E) Radio-Active Pollution

Radio-active pollution arise from radio-activity. It is, therefore, necessary to know what is radio-activity. There are certain elements like radium, uranium, etc. which emit invisible effects known as radiations. The emission of these invisible radiations is called radio activity and such substances are known as radioactive substances.

The expression 'radio-activity is defined in the following words:

"Property exhibited by unstable isotopes of elements which decay, emitting radiations, principally alpha, beta and gamma particle is known as radioactivity."

Such radiations are biologically harmful as they are emitted from the nucleus of radioactive substances. Radioactive substances emit three kinds of rays (i) alpha rays, (ii) beta rays and (iii) gamma rays. Alpha rays are positively charged whereas beta rays are negatively charged but gamma rays are high energy electromagnetic waves. It is, however, notable that out of the three ray's gamma rays are most dangerous for living beings.

(F) Noise Pollution

Noise pollution may be defined as the state of discomfort and restlessness to humans by unwanted intensity sound known as noise. In this way noise is the main pollution of

noise pollution. Noise is sound which is unwanted or undesired and unpleasant. It is of very high intensity. It has bad effect on health. The well-known effect on health is loss of hearing capacity and fatigue. It causes sleep interruptions. It can affect digestive system and produce blood pressure. Property damage by actual vibration or boom destruction is also known. Apart from horns of vehicles, noise is also produced by domestic appliances viz. radio, television, tape recorder, loud speaker, fridge, cooler, grinder and air conditioners etc.

Mankind's capacity to create noise has increased dramatically. Noise surrounds us through the roar of the vehicular traffic, the bustle of crowds, rapid industrialisation and the passage of trains and aeroplane. The home can also be invaded by noise. The amplified music and dogs also become causes of noise. It is hard to find, even in rural areas, any place where the only sounds are those produced by nature. For detailed discussion on noise pollution, the chapter on 'Noise Pollution Control' may be seen.

Greenhouse Gases Effect

Greenhouse gases effect refers to the gradual warming of the earth's atmosphere due to the presence of greenhouse gases, such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFC's) all of which have warming effect on the world climate. Human being is increasing global concentration of greenhouse gases by carrying on various activities such as burning coal, oil, natural gas etc.

A greenhouse is meant for plants mainly in the cold countries where total insolation at least during winter season is not sufficient enough to support plant growth. The glasses of green house are such that these allow the visible sunlight to enter but prevent the long wave infrared rays to go out. A greenhouse effect also does not have any provision for artificial heating. According to Oxford Dictionary- The Greenhouse Effect means 'progressive worming up of earth's surface due to the blanketing effect of man-made carbon dioxide in the atmosphere.' In nut shell it may be stated that a greenhouse is the body which allows the short wave incoming solar radiation to come in but does not allow the longwave outgoing terrestrial infrared radiation to escape. Carbon dioxide and vapour act

as a green house in that these allow visible light of the sun to reach the surface of the earth but absorbs and reflect back the longwave outgoing terrestrial radiation mainly infrared rays and these help in keeping the earth's surface warmer. The gases with the properties of greenhouse are called greenhouse gases such as carbon dioxide, methane, nitrous oxide, chlortoluron, carbons and so on. As a result of carrying on various activities such as burning coal, oil, natural gas, people are producing carbon dioxide and greenhouse gases as by-products more than 6000 million metric tons annually. Similar is the position as a result of deforestation and land cleaning also releasing significant quantities of such gas another 1 to 2,000 million tons per year. The effect of all this is that greenhouse gases have been releases in the atmosphere much faster than natural processes can remove them. According to an estimate the position is that since 1860 the concentration of carbon dioxide in the atmosphere has come to rise 30% from 280 part per million (ppm) to 365 ppm.

The position at present is that industrially advanced countries are the highest producer of greenhouse gases. In comparison to the developing countries their contribution is over 10% whereas that of developing countries it is limited to 30%. It is expected that by 2015 China will be the largest overall omitted of greenhouse gases. In this way both developing and developed countries are competing with each other in producing greenhouses gases.

In this respect the Inter-Governmental Panel on Climate Change (IPCC) has estimated the effect of green gases on climate change in the following words.

(1) Concertation of greenhouse gases could exceed 700 ppm by 2100 under "business as usual-levels not seen on the panel for 50 million years. The projected temperature increases of 1 to 3.6 degrees centigrade over the next 100 years could exceed the rate change for the last 10,100 years.

(2) Increased temperatures are expected to speed up the global water cycle. Faster evaporation will lead to a drying of soils and in some areas increased drought overall, however, due to the faster global cycling of water, there will be an increase in precipitation.

(3) Sea, levels are expected to rise between 15 and 94 centimetres over the next century. A 50-centimetre sea level rise could double the global population at risk from storm causes from roughly 45 million to over 90 million, even coastal populations do not increase. Low lying areas are particularly vulnerable.

(4) Human health is likely to be affected. Wormer temperature will increase the chances of heat waves and exacerbate air quality and can lead to an increase allergic disorder. Diseases that thrive warmer climates such as dengue fever, malaria, yellow fever, encephalitis and cholera are likely to spread due to the expansion of the range of disease carrying organisms. By 2100 there could be an additional 50-50 million cases of malaria each year."

Kyoto Protocol-Greenhouse Gases

A summit to reduce global warming on account of greenhouse gases was held from December 1 to 10, 1997 in Kyoto city of Japan and an agreement to this effect was also signed. This summit was attended by the representative of 149 countries. This agreement is properly known as *Kyoto Protocol* or Kyoto Thermal Treaty. The following are central points of this historic agreement: -

(i) A proposal of 30 per cent cut in the emission of carbon dioxide by 2008-12 A.D. was presented by the island nations on the feat that the temperature is estimated to rise 2 C to 3.5 C at the present rate global warming but the proposal was strongly opposed by the developed and industrialised countries. Finally an agreement on 5.2 per cent cut from 1990 level of carbon emission could be signed. This cut in carbon emission would be implemented by 11 industrialized countries. It is notable that the U.S.A., European Community and Japan agreed to curtail 7 per cent, 6 per cent emission of carbon dioxide respectively. However, the developing countries did not agree for any cut in carbon emission.

(ii) According to this agreement industrial countries can have mutual transfer of fixed quota of cut in the emission of greenhouse gases.

Clean Development Mechanism

CDM- Article 12: this is an important feature of Kyoto Protocol based on U.S Proposal for "joint implementation for credit" in developing countries. This mechanism will allow companies in developed countries to enter into co-operative projects to reduce emission on the developing countries- such as construction o high-tech, environmentally sound power plants- for the benefit of both parties. The companies will be able to reduce emission at lower costs than they could at home while developing countries will be able to receive the kind of technology that can allow them to grow more sustainably. This scheme also allows developing countries to bring projects forward in circumstances where there in no immediate developed country partner.

The scheme enables the companies to choose to make investments in projects or to buy emissions reduction. Moreover, parties will ensure that small portion of proceed be used to help particularly vulnerable developing countries, such as island states, adopt to the environmental consequences of climate change.

A Clean Development Fund. - it would be established which would be funded by the fines realized from the countries which flout the protocol.

Overview of Kyoto Protocol- one positive outcome of the Kyoto conference on climate change and Kyoto Protocol is that the developed and developing countries accepted at least in principle that some concert steps should be imitated to check climate change due to rise in global temperature. The developing and poor countries succeeded managing and securing unanimity on the point that reduction in the emission of greenhouse gases from the developing countries such as China, India, Brazil etc. would also increase substantially in near future. It is to be noted that at the time of Kyoto Protocol (1997) the per capita emission of greenhouse gases from the developing countries was 2.4 tonnes per annum against annual per capita emission of 11.9 tonnes from developed countries, thus, the developing countries should also be prepared for future cut in the emission of greenhouse gases.

(1) Developing Countries- The Kyoto Protocol lays down

separately with respect to developing countries. It makes provision for participation of developing countries on down payment in effort to reduce greenhouse gas emission.

(a) Developing countries are required to be engaged through the Clean Development Mechanism.

(b) Ail parties are required to implement Article 41 of Commitments under 1992 Frame Work Convention on climate change help at Rio. This convention identifies various areas such as energy, industry, agriculture, forestry and waste management in which actions should be considered in developing. National programmes to combat climate change and provide for more specific reporting on actions taken.

(2) Military Emissions- with the view to protect Military interest especiall U.S Military Operation the following proposals were made:

(a) Emissions from bunker fuels for international maritime of aviation use are exempted from emission limits.

(b) Emission from multilateral operations pursuance to U.N Charter are exempt from emission limits.

(c) Countries may decide among themselves how to account for emissions relating to multilateral operations for example, U.S. training in another NATO Country.

However, the position is that Kyoto Conference could not be so effective as expected because of rigid attitude adopted by developed countries and futile efforts to blame each other for global warming. It is true that the purpose of the provisions of Kyoto Protocol is to suitable place for the living beings but its effectivity is doubtful of reservation made by each and every nation.

Conclusion

Thus, development is not antithetical to environment. Judicial approach has tried to reconcile the both. Indian Constitution has also safeguarded the environment interests. International commitments are also kept with. So, the need of the hour is that every citizen should realize his duties in protecting and improving environment. From child to an elderly person,

a house wife to a busy corporate, every person can contribute in keeping the environment safe. The community as a whole should pledge not to spread garbage on the roads, sanitation facilities should be maintained well and such arrangements be made so that smoke and other effluents does not pollute the air and water then only we can say that we are worth living on this beautiful planet. The protection of environment is a global issue and it is not an isolated problem of any area or nation. The problem of environmental pollution in an increasingly small world concerns all countries irrespective of their size. Level of development or ideology. Notwithstanding political division of the world into national units. The oceanic world is interconnected whole: and winds that blow over the countries are also one[4]. If the nuclear test is carried out in one part of the world, the fall out irresponsible disposal of radioactive waste from a remote energy plant in one country may turn out to have greater adverse effect on the neighbouring countries than the danger of full-fledged war.[5]

Reference

1. Jaswal and Jaswal, Environmental Law, 1991, p.1
2. Emil T. Chanlet, Environmental Protection (1973) p. 359.
3. Ibid. p. 400.
4. M.C Mehta v. Union of India (1991) 2 SCC 353 at 354.
5. Due to the agricultural chemicals. Solvents and mercury. Which flowed into the Rhine River during a warehouse fire in Switzerland. Millions of fish were killed and the drinking water in the Federal Republic of Germany and the Netherlands was threatened.

◆ ◆ ◆

3.

Agriculture and Environmental Sustainability by the Application of Biofertilizers

Mumtaz Husain*

Keshav Shukla**

Dr. Adarsh Pandey**

Introduction

In India, there is a constant pressure on crop production from limited available land in order to fulfill the ever-increasing demand of food production for feeding the constantly exploding population. In order to reap maximum benefit, sometimes farmers used chemical fertilizers injudiciously expecting a high yield and greater profit. However, wrong and unbalanced application of chemical fertilizers disturbs the nutrients balance of the soil and ultimately adversely affecting its yield capacity. Biofertilizers, on the other hand are helpful in mobilizing and augmenting the availability of soil nutrients. They do so by fixing atmospheric nitrogen and by solubilization and mineralization of phosphorus and potassium. Though the use of chemical fertilizers is the quickest way of increasing crop production but at the same time these fertilizers are

***Department of Botany, SS College Shahjahanpur.**

****Department of Biotechnology, Invertis University, Bareilly.**

*****Assistant Professor, Dept. of Botany, S.S College, Shahjahapur, Utter Pradesh.**

very costly and their production is based on raw materials which are non renewable and limited in supply due to high cost.Small and marginal farmers are unable to use chemical fertilizers in the recommended doses or in balanced proportion. The imbalance and disproportionate use of chemical fertilizers under modern intensive farming deteriorate soil's physical conditions also lead to environmental pollution (Sharma and Gupta, 2005). There use at a high rate also causes problems like soil health deterioration, ground water pollution and atmospheric pollution, etc. The problems like leaching, volatilization, denitrification of nitrogen and deposition of non-available Phosphorus in soil are also the resultants of heavy use of chemicals fertilizers (Maurya and Beniwal, 2003). The use of synthetic fertilizers like DAP, urea etc. often leave residnes with levels above maximum tolerance limits (MTL) in food products leading to health problems including sterility among human beings.

Therefore, the immediate need of the hour is to use to alternative fertilizer sources in place of chemical fertilizers. Biofertilizers may fulfill this need and may replace the use of chemical fertilizers. Biofertilizers are biologically active products or microbial inoculants of bacteria, algae and fungi either separately or in combination which can contribute nutrients, especially nitrogen, to plant through microbial activity. Biofertilizers are micro organisms which mobilize nutritive elements in the soil from non usable form to usable form through biological process. They are cost effective and do not require non – renewable source of energy and also help in sustainable crop production by maintaining soil productivity. They are also helpful in controlling many plant pathogens and harmful microorganisms. Therefore, the use of biofertilizers is both economical and environment friendly. The Government of India has launched the "National project on Development and use of Biofertilizers" during the sixth five year plan. Therefore, use of biofertilizers is getting impetus to minimize the chemical fertilizers in crop cultivation.

Recently, it has been found that, the use of biofertilizers is a cheap means for supplying plants with nitrogen and phosphorus during the growth and could partially substitute the expensive

applied chemical fertilizers, thus leading to significant decrease in the production costs. In addition, pollution rate in the soil, water and the product could be lowered as a result of this practice. Biofertilizers could be used as supplements to chemical fertilizers (El-Assiouty and Abo-Sedera, 2005).

In general biofertilizers from nitrogen fixing bacteria could be used especially for cash crops such as vegetables, fruits, flowers and medicinal or herbal crops. These bacteria once associated with roots of some vegetable plants can enhance their root development, growth and yields. (Shaheen, ***et. al.,*** 2007).

Biofertilizers, in the recent past have become an integral part of oriented organically vegetables production and integrated plant nutrient supply system for sustainable vegetable production. Keeping in view, the widespread advantages of biofertilizeres in enhancing the growth and productivity of the crops on one hand and reducing the cost of production of crops on the other hand, two symbiotic nitrogen fixing bacteria namely ***Azotobacter*** and ***Azospirillum*** inoculants have been selected in the present study.

Azotobacter is free living bacteria which grow well on a nitrogen free medium. It is gram negative, polymorphic i.e. it is of different sizes and shapes. Its size ranges from 2-10 x 1-2.5 μm. The cyst germinates under favourable conditions to give vegetative cells. Is also produces poly-saccharides. ***Azotobacter*** species are sensitive to acidic pH, high salts and temperature above 35^0C. There are four species of ***Azotobacter*** namely ***A. chroococcum***, ***A. agilis***, ***A. paspali*** and ***A. vinelandii*** of which ***A. chroococcum*** is most commonly found in our soils.

Azotobacter fixes atmospheric nitrogen in the rhizosphere. Some strains have higher nitrogen fixing ability than others. It uses carbon for it metabolism from simple or compound carbonaceous substances in nature. Besides carbon, ***Azotobacter*** also requires calcium for nitrogen fixation. Similarly a medium used for growth of ***Azotobacter*** is required to have presence of organic nitrogen, micro- nutrients and salts in order to enhance the nitrogen fixing ability of ***Azotobacter*** (Anonymous, 2008). The species of ***Azotobacter*** are known to fix atmospheric nitrogen on an average 10 mg of N/g of sugar in

pure culture on a nitrogen free medium. A maximum of 30 mg N fixed per gram of sugar was reported by lopatina. However, ***Azotobacter*** is a poor competitor for nutrients in soil. Most efficient strains of ***Azotobacter*** would need to oxidize about 1000 kg of organic matter for fixing 30 Kg of N/ha. ***Azotobacter*** also produces some substances which check the plant pathogens such as ***Alternaria, Fusarium*** and ***Helminthosporium***. Hence, ***Azotobacter*** also acts as biological control agent. It is used in a large number of crops like rice, sugarcane, cotton, sunflower, mustard, maize, wheat, sorghum, turmeric, tobacco and all types of vegetables, fruits, horticulture crops etc.

Azospirillum is a free living diazotroph that was isolated from the rhizosphere and from the roots of grasses. ***Azospirillum*** species are ubiquitous and are found in many parts of the world consisting of tropical, subtropical and temperate climatic conditions. These bacteria are gram negative, aerobes, curved rod shaped with a polar flagellum and contaglobules of poly–betahyodroxy butyrate. They have a DNA base composition of 66-71 mole G+C. (Elmerich, ***et. al.,*** 1987).

Five species of ***Azospirillum*** have been reported which are ***A. lipoferum***, ***A. brasilense***, ***A. amazonemse***, ***A. halopraeferens***, ***A. irakense***. Organic acids, such as malate and succinate are the preferred carbon sources for ***Azospirillum*** (Govindrajan and Thangaraju, 2001).

The occurrence of nitrogen fixing ***Azospirillum*** from the roots of rice, sorghum, maize, cotton, ragi, guinea grass, hariyali has been reported by (Purushothaman ***et. al.,*** 1980). Subba Rao (1983) have also reported occurrence of fixing ***Azospirillum*** from roots of the plantation crops and orchard crops.

It is evident from the above that both ***Azotobacter*** and ***Azospirillum*** are ecofriendly, non-toxic to both plants and animals, improve and germination, fix 20-30 % nitrogen, thrive best even in alkaline soil and fix nitrogen by producing growth promoting substances. Therefore, in the present study an attempt ha

Biofertilizers are natural, organic, non-pollutant, cheap products that are required in a small dose. Residual effect of legumes on succeeding crop can result in a additional reserve

of 20-60 Kg N/ha.

Biofertilizers are latent or living cells of effective microorganism (bacteria, fungi) which mobilize and augment the availability of plant nutrients such as by encouraging fixing of atmospheric nitrogen, solubilization and mineralization of potassium and phosphorus which can act as a renewable supplement to chemical fertilizers and organic manures. No doubt, all chemical fertilizers support the plant growth and development, that results higher production, hence are beneficial if used judiciously, but it is also very true that their constant and unbalanced application in long run deteriorate the quality if soil by polluting it on the other hand that the biofertilizers are totally safe.

Types of Nitrogen Fixing Biofertilizers:

1. Rhizobium
2. Azolla
3. Acetobacter
4. Azotobacter
5. Azospirillum
6. Blue Green algae (BGA)
7. Hebaspirillum

In this article we have described two biofertilizers i.e. ***Azotobacter*** and ***Azospirillum***.

Azotobacter

It belongs to family Azotobacteriaceae. These are non-symbiotic free-living aerobic bacteria possessing highest respiratory rate and can fix nitrogen up to 25 Kg/ha under optimum conditions and increase yield up to 50 percent. They improve seed germination and plant growth by producing B-vitamins, naphthalene acetic acid (NAA), gibberellic acid (GA) and other chemicals that are inhibitory to certain root pathogens. Additionally, plant biomass and nitrogen content increased that induces drought tolerance in plants, improves root growth and enhances uptake of plant nutrients. ***Azotobacter*** has been used in various vegetables, sunflower, mustard, cotton, maize, pearlmillet, paddy etc.

Azospirillum

These associative symbiotive micro-organism are beneficial namely to cereal crops because these effective free living bacteria are capable of colonizing the root zone, thereby fixing 20-40 Kg N/ha, resulting in an increase of crop yield by 10-15 percent. In legumes ***Azospirillum*** induces plant roots to secrete mucilage which creates low oxygen atmosphere and helps in fixation of atmospheric nitrogen. They also promote production of the growth promoting substances and thereby enhance uptake of minerals and water and plants have better root development, greater photosynthetic activity, luxurious vegetative growth and tolerance to high soil temperature.

Conclusion

Biofertilizers play a multiple role in modern agriculture and can prove beneficial in a variety of ways. First, they are cheaper and help to reduce the cost of production of crops and provide nitrogen directly to the plants by fixing atmospheric nitrogen and thereby avoiding the use of costly chemical fertilizers. Secondly, biofertilizers enhance plant growth due to release of hormones, vitamins and auxins. Thirdly, they improve soil properties and sustain soil fertility. Lastly, biofertilizers help in mineralization of plant nutrients and their availability to plants.

References

1. Anonymous, (2008). Azotobacter http://www.indiaagronet.com/indiaagronet/ manures_fertilizers/azotob.
2. El-Assiouty, F.M.M. and Abo-Sedera, S.A. (2005). Effect of bio and chemical fertilizers on seed production and quality of spinach (Spinacia oleracea L.) Int. J. Agri. and Bio. 7 : 947-952
3. Elmerich, C.; Bozouklian, H.; Vieille, C.; Fogher, C.; Perround, B.; Perrin, A. and Anderleyden, J.V. (1987). Azospirillum : genetics of nitrogen fixation and interaction with plants. Phil. Trans. R. Soc. Lond. B. 317 : 183-192.
4. Govindarajan, K. and Thangaraju, M. (2001). Azospirillum a potential inoculant for horticultural crops. South Indian Hort. 49 : 233-235.
5. Maurya, R.P. and Beniwal, V.S. (2003). Use of biofertilizers in horticulture crops. Agrobios News letter. 1 : 12-13.
6. Purushothaman, D.S.; Gunasekaran, and oblisami, G. (1980). Nitrogen fixation by Azospirillum in some tropical plants. Proc. Ind. Natl. Sci. Acad. 46 : 713-717.
7. Shaheen, A.M.; Fatma, A. Z; Omiama, M.S. and Ghoname., A.A. (2007). The integrated use of bio-inoculants and chemical nitrogen fertilizer on

growth, yield and nutritive value of two okra (Abelmoschus esculentus L.) cultivars. Aust J. Basic and Appl. Sci. 1 : 307-312.

8. Sharma., H.O. and Gupta, S.C. (2005). Pace of growth and prospects of biofertilizer consumption in different agroclimatic regions of Madhya Pradesh. Ind. J. Applied and Pure Bio. 20 : 197-204.
9. Subbarao, N. S. (1983). Nitrogen fixing bacteria associated with plantation and orchard plants. Can. J. Microbiol. 29 : 863-866.

◆ ◆ ◆

4.

Avian Biodiversity of Uppalapadu Lake, Andhra Pradesh, India

Ravi Babu Birudu*

Suma Saggurthi**

Raju Dirisenapu***

Introduction

The Uppalapadu Bird Sanctuary is located near Guntur City in Uppalapadu, India. The village water tanks are used by painted storks, spot-billed pelicans, and other migrating birds from Siberia and Australia to lay their eggs. Previously, there were over 12,000 birds in these tanks, but now only about 7000 birds sleep in this dwindling environment throughout the year. Certain initiatives, such as the planting of artificial trees, boosting neighbourhood awareness, and giving appropriate water to the ponds, have been taken. thousands of pelicans could be present at the uppalapadu lake. Aside from the six pintail ducks, there were several cormorants, five red crested pochards (rhodonesa rufina), common coots, common teals, black-headed ibises, and two stilts.

***,**Depatment of Zoology& Aquaculture, Acharya Nagarjuna University, Guntur, Andhra Pradesh, India.**

***Department of Chemistry,Vikas PG College, Vissannapet, Andhra Pradsh, India.**

Wetlands are significant aquatic ecosystems that provide services such as water for diverse human needs, groundwater recharge, aquatic biodiversity support, and are the site of a variety of recreational activities (R. Brouwer *et al.,* 1999, R. T. Woodward *et al.,* 2001, IWMI, 2006). These wetlands are important nesting grounds for a variety of bird species both in India and abroad(A. Bhatt). Many migratory birds use water features (lakes, ponds, etc.) to lay eggs and rear their young, then return to their original territory once the young chicks can fly. During their breeding season, the birds' essential needs are a suitable location in which to lay their eggs (usually trees or shrubs) and a food source. Birds require minimum human disturbance and no other human hazards in order to mate successfully (W. J. Sydeman, 1991 AND S. Y. Kim, 2005).

The deterioration of food and water quality has an impact on migrating birds, which is especially damaging during the nesting season. Local humans frequently endanger these migratory birds with their activities, preventing them from returning to the wetlands (J. R. Liebezeit *et al.,* 2009, E. Mellink, 2009, H. M. Conesa, 2007 and R. T. Kingsford, 2004)

Study Area: Uppalapadu is a small hamlet in the Andhra Pradesh state of India, located two kilometres from Guntur. After the settlement, the lake is named Uppalapadu Cheruvu (Cheruvu means lake). The lake is located in Pedakakani mandal.

This lake is surrounded by three other ponds, constituting a complex. This lake is surrounded by three more ponds, constituting a 30-acre water body complex. The research lake covers nine acres, seven of which are constantly flooded and two of which are wet. The lake is encircled by a fence. A diversity of bird species, including uncommon and endemic species, can be found around the lake. Many experts have studied the lake's species diversity and bird fauna biodiversity, proving its ecological significance. The present study mainly focused on the avian biodiversity of the lakes present in uppalapadu.

Materials and Methods: Data from literature surveys and on-the-ground observations were used in this study. A preliminary field inventory was conducted to characterise the lake's environment, which included bird fauna. Recorded the all the pictures of the avian fauna of the lake and identified

the bird names books published by the forest department of Andhra Pradesh.

Results and Discussion: there are several birds are present in uppalapadu lake. The birds mainly migrated from Saiberia and Australia for beeding. A few studies compared the bird species found in Uppalapadu Lake to those found in other surrounding local lakes (N. V. Nanda Kumar). In and around Uppalapadu Lake, the Salim Ali Centre for Ornithology and Natural History documented 1,583 birds belonging to 40 wetlands and 20 land species, with the prominent species being the spot-billed pelican, painted stork, and night heron (SACON). Other species were counted, and information on their nesting sites was provided by SACON. At Garapadu Lake, they discovered a breeding colony of spot-billed pelicans, painted storks, and ibis (Rama Chandra Palem). This suggests that despite previous anthropogenic disturbances, the birds attempted to return to their previous habitat. NandaKumar et al. identified six major bird species that inhabit Uppalapadu Lake in their investigation.

Over a three-year period (2006–2010), they studied the population features of these prominent birds. The pelican population was the most prolific, with 6,700 individuals observed over three years, followed by white ibis (2,600), painted storks (2,000), open bill stork (1,820), glossy ibis (550), darter (11), and six other species (250). Painted storks were also found solely in Uppalapadu, according to Nanda Kumar et al.

Birds Present in Uppalapadu Lake

Grey Pelican (Pelecanus Philippensis): The grey pelican (Pelecanus philippensis), often known as the spot-billed pelican, belongs to the pelican family. It breeds from Pakistan to India and east to Indonesia in southern Asia. It is an interior and coastal bird that favours vast inland and coastal bodies of water, especially large lakes. Despite their smaller size, they are difficult to recognise from other pelicans in the area from a distance; nevertheless, up close, the dots on the upper jaw, the lack of brilliant colours, and the greyer plumage separate them. In some areas, these birds reproduce in large colonies near human populations.

Grey pelican (Pelecanus philippensis)

The Painted Stork (Mycteria Leucocephala): It is a large wader of the stork family. It can be found in the marshes of tropical Asia's plains south of the Himalayas, as well as Southeast Asia. The adults' distinctive pink tertial feathers give them their name. They feed in flocks in shallow water in rivers and lakes. They dip their half-open beaks into the water and sweep them from side to side, grabbing small fish that they detect with their fingers. They wade ahead, swirling the water with their feet in the hopes of flushing out any lurking fish. They often enlist the help of other water birds to build their nests in trees in colonies (Chavan *et al.*,2018).

Painted stork (Mycteria leucocephala)

The Asian Openbill Stork: (Anastomus oscitans) belongs to the Ciconiidae family of storks and is a large wading bird. This peculiar stork can be found throughout the Indian subcontinent and Southeast Asia. Adults are greyish or white with glossy black wings and tail, with a gap between the arched upper jaw and the recurved lower mandible. This gap is not present in young birds, which is thought to be an adaptation to assist them deal with their main prey, snails. They migrate long distances in response to weather and food availability, despite the fact that they live within their range (Sawangproh et al., 2021)

Asian openbill stork (Anastomus oscitans)

American white ibis : The Threskiornithidae family includes the American white ibis (Eudocimus albus). It can be found from Virginia to the Gulf Coast of the United States in much of the coastal New World tropics. This ibis has white plumage, a beautiful red-orange down-curved bill, long legs, and black wing tips that are visible only when flying. Males are larger and have longer bills than females. The breeding range includes the Gulf and Atlantic coasts, as well as the coasts of Mexico and Central America. This species' range extends further inland in North America, as well as into the Caribbean, outside of the mating season (Rodriguez *et al.,* 2011)

White ibis (Eudocimus albus)

The glossy ibis (Plegadis falcinellus) is a wading bird that belongs to the ibis family Threskiornithidae. The scientific name is derived from the Ancient Greek plegados and the Latin falcis, both of which refer to the bill's distinctive shape and signify "sickle." Glossy ibises are migratory and move about a lot after they reproduce. The inhabitants in the north are entirely migratory, moving in huge groups over the Sahara Desert, for example. Tropical populations reproduce during the rainy season, while temperate populations breed during the local spring. Nesting is typically done in mixed-species colonies (Nefla *et al.,* 2019).

Glossy ibis

The Uppalapadu bird sanctuary

Project fellow at Uppalapadu lake

Conclusion

The current investigation of the avifauna of Uppalapadu Lake reveals a variety of bird species. Migratory birds frequent the Uppalapadu Lake. Breeding migratory birds arrived from Siberia and Australia. These migratory birds can be seen in many parts of Andhra Pradesh. The Kolleru and Pulicat lakes are important migratory bird destinations. After these locations, migrating birds flock to the Uppalapadu water bodies. According to the study and prior data, various varieties of migratory birds can be found at Uppalapadu water bodies. Grey pelican (Pelecanus philippensis),White ibis (Eudocimus albus), Glossy ibis (Plegadis falcinellus), Asian openbill stork

(Anastomus oscitans), Painted stork (Mycteria leucocephala) are among the notable and main migratory birds. The government is implementing excellent conservation strategies to maintain the biodiversity of Uppalapdu Lake, but local populations must pay special attention to migratory bird protection.

References

- A.Bhatt,"Migratorybirds:ourcelestialguests,"2012, http://www.greaterkashmir.com/news/2012/Jan/17/migratory-birds-our-celestial-guests-18.asp.View at: Google Scholar
- Chavan, S. P., Kulkarni, A. N., & Jadhav, P. L. (2018). Bird and their conservation status at Nandur Madhameshwar bird Sanctuary near Nashik, India. International Journal of Fauna and Biological Studies, (5), 109-119.
- E. Mellink and M. Riojas-López, "Waterbirds and human-related threats to their conservation in Laguna Cuyutlán, Colima, México," Revista de Biologia Tropical, vol. 57, no. 1-2, pp. 1–12, 2009.View at: Google Scholar
- H. M. Conesa and F. J. Jiménez-Cárceles, "The Mar Menor lagoon (SE Spain): a singular natural ecosystem threatened by human activities," Marine Pollution Bulletin, vol. 54, no. 7, pp. 839–849, 2007.View at: Publisher Site | Google Scholar
- IWMI, "Working wetlands: a new approach to balancing agricultural development with environmentprotection,"2006, http://www.iwmi.cgiar.org/Publications/Water_Policy_Briefs/PDF/WPB21.pdf.View at: Google Scholar
- J. R. Liebezeit, S. J. Kendall, S. Brown et al., "Influence of human development and predators on nest survival of tundra birds, Arctic Coastal Plain, Alaska," Ecological Applications, vol. 19, no. 6, pp. 1628–1644, 2009. View at: Publisher Site | Google Scholar
- N. V. Nanda Kumar, K. Sailaja, and A. Nagarjuna, "Avian biodiversity indices and comparative chronobiology of uppalapadu and nelapattu bird protected areas of Andhra Pradesh,India," European Journal of Applied Sciences, vol. 3, no. 2, pp.62–66, 2011.
- Nefla, Aymen, Ridha Ouni, and Saïd Nouira. "Past and present: the Glossy Ibis Plegadis falcinellus in Tunisia." SIS Conservation 1 (2019): 16-20.
- R. Brouwer, I. H. Langford, I. J. Bateman, T. C. Crowards, and R. K. Turner, "A meta—analysis of wetland contingent valuation studies," Regional Environmental Change, vol. 1, pp. 47–57, 1999.View at: Google Scholar
- R. T. Kingsford and R. F. Thomas, "Destruction of wetlands and waterbird populations by dams and irrigation on the Murrumbidgee River in Arid Australia," Environmental Management, vol. 34, no. 3, pp. 383–396, 2004. View at: Publisher Site | Google Scholar
- R. T. Woodward and Y. S. Wui, "The economic value of wetland services: a meta-analysis," Ecological Economics, vol. 37, no. 2, pp. 257–270, 2001. View at: Publisher Site | Google Scholar
- Rodriguez, Tommy. Visions of the Everglades: History Ecology Preservation. AuthorHouse, 2011.

- S. Y. Kim and P. Monaghan, "Interacting effects of nest shelter and breeder quality on behaviour and breeding performance of herring gulls," Animal Behaviour, vol. 69, no. 2, pp. 301–306, 2005.View at: Publisher Site | Google Scholar
- SACON Annual Report (2006-2007)," Ecology and Conservation of the Spot-billed Pelican in Andhra Pradesh, http://moef.nic.in/divisions/csurv/annual report E 2007.pdf.
- Sawangproh, Weerachon. "Notes on the foraging and feeding behaviours of the Asian Openbill Stork (Anastomus oscitans)." Ornithology Research 29, no. 1 (2021): 42-45.
- W. J. Sydeman, J. F. Penniman, T. M. Penniman, P. Pyle, and D. G. Ainley, "Breeding performance in the western gull: effects of parental age, timing of breeding and year in relation to food availability," Journal of Animal Ecology, vol. 60, no. 1, pp. 135–149, 1991.View at: Google Scholar

◆ ◆ ◆

5.

Intensive Use of Pesticides in Agriculture and Livestock in India and their Impacts on Environment

Sachin Kumar*

Aquil Mohmad**

Abhijet Nandi***

Introduction

The production of pesticides started in India in 1952 with the establishment of a plant for the production of BHC near Calcutta, and India is now the second largest manufacturer of pesticides in Asia after China and ranks twelfth globally for the consumption (Mathur, 1999). There has been a steady growth in the production of technical grade pesticides in India, from 5,000 metric tonnes in 1958 to 102,240 metric tonnes in 1998. In 1996-97 the demand for pesticides in terms of value was estimated to be around Rs. 22 billion (USD 0.5 billion), which is about 2% of the total world market. The pesticides cover a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others. Among these, organochlorine (OC) insecticides, using

,**,Division of Parasitology, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, India.**

successfully in controlling a number of diseases, such as malaria and typhus, were banned or restricted after the 1960s in most of the technologically advanced countries. The introduction of other synthetic insecticides – organophosphate (OP) insecticides in the 1960s, carbamates in 1970s and pyrethroids in 1980s and the introduction of herbicides and fungicides in the 1970s–1980s contributed greatly to pest control and agricultural output. The pesticide market of India in the world is with US$ 0.6 billion per annum, which is 1.6% of the global market (Hundal and Randeep Singh Ananda, 2006). Although the pesticide consumption in India is still very low, there has been a widespread contamination of food commodities with pesticide residues basically due to these indiscriminate and non-judicious application. Despite a ban imposed by the World Health Organization (WHO) on use of certain organochlorine compounds, some of these chemicals are intensively used in limited quantity in many developing countries including India for agricultural, livestock and public health programmes.

Since pesticides are designed to kill or adversely affect living organisms, by their very nature, they pose risk to humans, non-target plants and animals. They not only contaminate the ecosystem but also bio-accumulate in the food chain and can be traced in plant and animal tissues causing serious health hazards (Johan et. al, 2001). Animal husbandry is one of the most important areas of foreign exchange. To compete in the international markets, it is necessary that Indian products should be meant for exports of international standards. Therefore, it is necessary to strengthen quality competitive aspects of animal products. Feed and fodder offered to animals are often contaminated with pesticide residues (Sandhu, 1980), (Raikwar and Nag, 2003) and after feeding, these residues pass through the body systems (Prasad and Chhabra, 2001). Pesticide poisoning in human has been extensively studied (Hamilton et. al, 2004) and frequently reported in forensic medicine (Below and Lignitz, 2003). As per World Health Organization estimates pesticides lead to one million pesticide poisoning cases and 20,000 deaths every year globally. Therefore, there is a need of discussion on causes of environmental contamination, pesticide residues in milk, meat and other dairy products, health hazards associated with dietary exposure of successful

in meeting the goals of self-sufficiency in pesticides as well as prevention and control strategies for occurrence of pesticides in animal products in Indian scenario.

Types of Chemical Pesticides

A. **Organophosphate Pesticides:** These pesticides affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. Most organophosphates are insecticides. They were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. Some of the OP compounds are diazinon, malathion, coumaphos.

B. **Carbamate Pesticides:** These pesticides affect the nervous system by disrupting an enzyme that regulates acetylcholine, a neurotransmitter. The enzyme effects are usually reversible. There are several subgroups within the carbamates. Aldicarb, carbofuran, carbaryl, carbosulfan are the example of carbomates.

C. **Organochlorine Insecticides:** These were commonly used in the past, but many have been removed from the market due to their health and environmental effects and their persistence. DDT, chlordane, aldrin, dieldrin, heptachlor are the common OC compounds.

D. **Pyrethroid Pesticides:** These were developed as a synthetic version of the naturally occurring pesticide pyrethrin, which is found in chrysanthemums. They have been modified to increase their stability in the environment. Some synthetic pyrethroids are toxic to the nervous system. Deltamethrin, cypermethrin, permethrin and fenvelarate are some of the commonly used Pyrethroid.

Pesticide Use in Agriculture

In the process of development of agriculture, pesticides have become an important tool as a plant protection agent to boost up food security as these chemicals play a significant role by keeping many dreadful diseases. A vast majority of the population in India (56.7%) is engaged in agriculture and is therefore exposed to the pesticides used in agriculture (Gupta, 2004), (Planing Commission of India, 2002-2007). Although Indian average consumption of pesticide is far lower than

many other developed countries, the problem of pesticide residue is very high in India. Generally, pesticides are used in three sectors viz. agriculture, public health and consumer use. The consumption of pesticide in India is about 600 gms. / hectare, whereas that of developed countries is touching 3000 gms. / hectare. Pesticides are found as common contaminants in soil, air, water and on non-target organisms in our urban landscapes. Once there, they can harm plants and animals ranging from beneficial soil microorganisms and insects, non-target plants, fish, birds, and other wildlife (USGS, 1995). Repeated and excessive use of pesticides in agriculture to the development of resistance in many insects/ pests. **Residues in food** for humans and feed for livestock can be a consequence of direct application of a chemical to the food source, by the presence of pollutants in the environment or by transfer and bio-magnification of the chemical along a food chain.

As it is clear from the (Fig.1), the consumption of chemical pesticides in India is gradually decreasing from 1994-2006. However, the Punjab and Haryana were the two states using the largest quantity of chemical pesticides during 1999-01 (Fig. 2).

The pattern of pesticide usage in India is different from that for the world in general. As can be seen in (Fig.3), in India 76% of the pesticide used is insecticide, as against 44% globally (Mathur, 1999). The use of herbicides and fungicides is correspondingly less heavy. The main use of pesticides in India is for cotton crops (45%), followed by paddy and wheat. Consumption of pesticides in Haryana in agriculture during 1999–2000 was 5,030 MT. This followed Uttar Pradesh (7,400 MT), Punjab (7,100 MT) and Andhra Pradesh (7,000 MT). However, the g/ha consumption in Haryana was 8,481 as compared to the average consumption of 288 g/ha in the country (Agnihotri, 2000).

Impacts On Non Target Organisms

Pesticides are found as common contaminants in soil, air, water and on non-target organisms in our urban landscapes. These chemicals can harm plants and animals ranging from beneficial soil microorganisms and insects, non-target plants, fish, birds, and other wildlife. Pesticides can kill birds in several

ways, including direct effects of acute poisoning by ingestion of granules, baits, treated seeds, and direct exposure to sprays. Indirect death of birds may result from consumption of treated crops, contaminated water, or feeding on contaminated prey. Wildlife poisoning depends on a pesticide's toxicity and other properties (eg. water-soluble pesticides may pollute surface waters), the quantity applied, frequency, timing and method of spraying (eg. fine spray is prone to drift), weather, vegetation structure, and soil type. Insecticides, rodenticides, fungicides (for seed treatment) and the more toxic herbicides threaten exposed wildlife.

Impacts on Environment

Pesticides present the only group of chemicals that are purposely applied to the environment with aim to suppress plant and animal pests and to protect agricultural and industrial products. Pesticides can contaminate soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish and beneficial insects. However, the majority of pesticides are not specifically targeting the pest only and during their application they also affect non-target plants and animals. Repeated application leads to loss of biodiversity. Many pesticides are not easily degradable, they persist in soil, leach to groundwater and surface water and contaminate wide environment. Depending on their chemical properties they can enter the organism, bio-accumulate in food chains and consequently influence the environment.

Impacts on Humans

Exposure to pesticides both occupationally and environmentally causes a range of human health problems. It has been observed that the pesticides exposures are increasingly linked to immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer. There is now overwhelming evidence that some of these chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment (Forget, 1993, Igbedioh, 1991, Jeyaratnam, 1985). No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects, though a disproportionate burden is

shouldered by the people of developing countries and by high risk groups in each country (WHO, 1990).

It is estimated that nearly 10,000 deaths annually to use of chemical pesticide worldwide, with about three-fourths of these occurring in developing countries (Horrigan et. al, 2002). Pesticides being used in agricultural tracts are released into the environment and come into human contact directly or indirectly affecting human life (Wadhwani and Lall, 1972, Kasyap and Gupta, 1973). Humans are exposed to pesticides found in environmental media (soil, water, air and food) by different routes of exposure such as inhalation, ingestion and dermal contact. Exposure to pesticides results in acute and chronic health problems (Hollingworth and Kurihara, 1995, Hurley et. al, 1998). The world-wide deaths and chronic diseases due to pesticide poisoning were numbered about 1 million per year (Environment Forum, 1999). Some of these are suicides, but most involve some form of accidental exposure to pesticides, particularly among farmers and spray operators in developing countries, who are careless in handling pesticides or wear insufficient protective clothing and equipment. Moreover, there have been major accidents involving pesticides that have led to the death or illness of many thousands. In India, the first report of pesticide poisoning was documented from Kerala in 1958, where more than 100 people died after consuming wheat flour contaminated with parathion. One instance occurred in Bhopal, where more than 5,000 deaths resulted from exposure to accidental emissions of methyl isocyanate from a pesticide factory.

There are two Types of the Pesticide Effects on Human Health:

A. Chronic Effects of Pesticide Exposure

Chronic health problems linked to pesticides include adverse neurological effects such as a fourfold increased risk of early-onset Parkinson's disease, shortened attention span, memory disorders, and reduced coordination; reproductive problems including miscarriages; reduced infant development; birth defects; depression; and cancer.

B. Acute Effects of Pesticide Exposure

Acute health problems which are sometimes misdiagnosed or not recognized as being associated with pesticide toxicity,

include blurred vision, headaches, salivation, diarrhea, nausea, vomiting, wheezing, eye problems, skin conditions, seizure, coma, and even death. **Mild to moderate pesticide poisoning mimics intrinsic asthma, bronchitis, and gastroenteritis.** Pesticides are **especially harmful to children** because of their developing physiology. And, relative to their size, they are exposed to higher amounts of pesticides.

Surface Water Contamination

Pesticides can reach surface water through runoff from treated plants and soil. Contamination of water by pesticides is widespread. During a survey in India, 58% of drinking water samples drawn from various hand pumps and wells around were found contaminated. Maximum residue levels (or tolerances) have been established for pesticides in foodstuffs and drinking water in most countries to avoid any adverse impact on public health, and to insist on good agricultural practice. Residues of systemic herbicides in soil used in the previous season may influence the growing of succeeding crops. Residues of insecticides in surface water may cause adverse effects on aquatic organisms.

A number of researchers have reported pesticides and heavy metals in drinking and groundwater in different parts of India (Dikshit et. al, 1990, Kumar et. al, 1995, Bansal and Gupta, 2000). HCH and DDT were detected in different sources of water wells, hand pumps and ponds in Bhopal. Water samples of wells in Bhopal showed residues of total HCH (4640 µg/l) and total DDT (5794 µg/l) (Bouwer, 1990). Drinking water samples from Ahmedabad showed total HCH was 23.90-2488.70 nanogram/l and total DDT (p,p-DDE, o,p'-DDT and p,p'-DDT) in the range of 10.90-314.90 nanogram/l respectively (Jani et. al, 1991). Organochlorine and organophosphorus pesticide residues were detected in groundwater samples from irrigation wells, domestic wells and canals used for irrigation and drinking purposes in Aligarh (Ray, 1992). The concentration of aldrin and dieldrin residues in water samples collected from different sites upstream and downstream sections of river Yamuna in Delhi ranged from 0.0005 - 0.05 µg/ml (upstream) and from 0.0001 - 0.1 µg/ml (downstream) respectively (Nair, 1991). Once ground water is polluted with toxic chemicals, it may take

many years for the contamination to dissipate or be cleaned up.

Impacts on Livestok Animals

There is increasing anxiety about the importance of small residues of pesticides, often suspected of being carcinogens or disrupting endocrine activities, in drinking water and food. In spite of stringent regulations by international and national regulatory agencies, reports of pesticide residues in human foods, both imported and home-produced, are numerous. Pesticide residues in livestock generally accumulate by two ways either through direct application on animals or on agricultural crops and fodder (Poppenga, 1999). The livestock reared on pesticides contaminated soils, crops, and fodders may accumulate considerable residues in edible tissues. Furthermore, pesticide residues also accumulate on cropland soil (Jabbar et. al, 1993). Animals can accumulate these substances from contaminated feed and water. Also, due to the lipophilic nature of these pesticides, milk and other fat-rich substances are the key items for their accumulation (John et. al, 2001). Therefore, an indirect source of pesticides accumulation can be represented by animal-derived products.

A little work was carried out in Haryana on OCPs residues in milk (Chouhan et. al, 1982, Kathpal et. al, 1992, Kumari et. al, 1995). However, endosulfan, an organo-chlorinated insecticide, is generally used in agriculture for the control of various pests in crops in India, as a result, it has been reported to be present as residues in different feed concentrates and green fodders up to a concentration of 6 ppm (Dikshit et. al, 1989, Prassad, 1998, Kang et. al, 2002, Imrankhan et. al, 2003, Deka et. al, 2004). It was however reported that unlike the other organochlorinated insecticides, endosulfan apparently does not pass into the milk of cattle when ingested in feed—even at a high concentration for a prolonged period of time.

Animal husbandry constitutes backbone of fish collected in River Yamuna in Delhi, which received discharges from a DDT factory, contained DDT at a mean concentration of 56 mcg/g (Aggarwal, 1986). Similarly, fish from rural ponds that million buffaloes, 185 million cattle, 120 million received agricultural runoff contained DDT and HCH goats, 62.5 million sheep, 14.3 million pigs and 430 at mean concentration of 7 and

6.3 mcg/g, respectively million chickens (FAO, 2006). Among several meat products, greatest contamination was observed in chicken muscle followed by goat and beef collected in Lucknow, India (Kaphalia and Seth, 1981). The increasing incidences of pesticide residues in the meat and milk are of a great concern for ensuring food safety and human health. Higher contents of organo-chlorine pesticide residues have been reported in meat (Nag et. al, 2005). and milk samples collected from different locations of the country (ICMR,1993). Reference (Agnihotri et. al, 1974). reported that most of the milk samples from Delhi market contained DDT in levels higher than MRL fixed by FAO-WHO. Workers (Lakshminarayan and Menon, 1995) made similar observation on milk samples from Hyderabad. Reference (Verma, 1990) found 17 and 12μ of Lindane/kg of buffalo and cow milk, respectively from Indore.

Development of Resistance

This use of pesticides has led to appearance of pesticide resistance in 27 insect pests; 14 of public health importance, 7 of agricultural crops and 6 of stored grains and commodities. Chronologically, in India, the pesticide resistance appeared first in insect vectors of parasitic diseases in 1952, in agricultural pests in 1963 and in insect pests of stored grains and commodities in 1971 (Mehrotra, 1989). Insecticide resistance to representatives of commonly used insecticide groups (pyrethroids-cypermethrin; organophosphates-chlorpyriphos; cyclodienes-endosulfan) was determined in five major insect pests of cotton from the main cotton growing regions of India with emphasis on Andhra Pradesh and Maharashtra (Kranthi et. al, 2002).

In India, about 60% of livestock is reared by small and marginal farmers and use of OP compounds like diazinon and malathion is very common for the control of agricultural pests including livestock and poultry (Sharma, 2004, Ghosh et. al, 2006). Besides their applications against agriculturally important pests, OP compounds are also used for mass eradication of mosquito larvae in the breeding places (ICMR, 2002). Livestock is an integral part of the agricultural production system in India and plays an important role in national economy. However, almost of all dairy and meat animals are suffering

from tick infestation (Ghosh et. al, 2006) and cause significant economic loss. Indiscriminate use of pesticides for the control of these ecto-parasites has resulted into development of large scale of diazinon,coumaphos, amitraz and pyrethroid resistance in *R. microplus* collected from different agro-climatic regions of India (Kumar et. al, 2011 and Sharma et. al, 2012 and 2021).

Conclusion

Pesticides are often considered a quick, easy and inexpensive solution for controlling weeds and insect pests in urban landscapes. Pesticides have contaminated almost every component of our environment. Pesticide residues are found in soil and air, and in surface and ground water across the nation, and urban pesticide uses contribute to the problem. Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms, to insects, plants, fish, and birds. Contrary to common misconceptions, even herbicides can cause harm to the environment.

Depending on the chemical properties of synthetic insecticides they can enter the organism, bio-accumulate in food chains and consequently influence also human health. Overall, intensive pesticide application results in several negative effects in the environment that cannot be ignored. For the general population, diet has become a major exposure route for most known toxic contaminants. The solution lies in promoting practices like Integrated Pest Management (IPM), organic farming, biopesticides and crop diversification. IPM employs control of pests with use of crop rotation, biopesticides and pesticides of plant origin like Neem formulations. Organic farming is also gaining gradual momentum with growing demand of organic food due to increasing awareness of health and environment issues in agriculture. Neem and plant-based formulations like Repline, Neemark and Indene (Dhaliwal et. al, 2000) can be adopted routinely. Agriculture Diversification Infrastructure Development fund has also been set up. With popularization of some of the above practices, it is expected that the use of pesticides in the agriculture sector in the country will reduce and soil, ecosystem and human health will be restored. Farmers are unlikely to change the way they

manage their animals and parasite problems unless they see convincing evidence that a new approach will confer an economic advantage.

Acknowledgement

The authors are grateful to Mewar University, Chittorgarh, Rajasthan and Indian Council of Agricultural Research, New Delhi.

References

1. Mathur, S.C. 1999. "Future of Indian pesticides industry in next millennium," Pesticide Information, XXIV (4), 9-23.
2. Hunda, B.S. and Anada, S. R. 2006. "Pesticide Marketing," The Indian Scenario the ICFAI J. Managerial Econ., 4 (2), 32-37.
3. John, P.J., Bakore, N. and Bhantnagar, P. 2001. "Assessment of organochlorine pesticides residue levels in dairy milk and buffalo milk from Jaipur city, Rajasthan, India," Environment International, 26, 231-236.
4. Sandhu, T.S. 1980. "Pesticide residues in foods," Indian Dairyman, 32, 61–63.
5. Raikwar, M.K. and Nag, S.K. 2003. "Organochlorine pesticide residues in animal feeds," In: Proceedings of 40th Annual Convention of Chemists, Indian Chemical Society, p. D4.
6. Prasad, K.S.N. and Chhabra, A. 2001. "Organochlorine pesticide residues in animal feed and fodders," Indian Journal of Animal Science, 71(12), 1178–1180.
7. Hamilton, D., Ambrus, A., Dieterle, R., Felsot, A., Harris, C., Petersen, B., Racke, K., Wong, S.S., Gonzalez, R., Tanaka, K., Earl, M., Roberts G., and Bhula, R. 2004. "Advisory Committee on Crop Protection Chemistry, Division of Chemistry and the Environment of the International Union of Pure and Applied Chemistry, Pesticide residues in food—acute dietary exposure," Pest. Manage. Sci., 60, 311–339.
8. Below, E. and Lignitz, E. 2003. "Cases of fatal poisoning in post-mortem examinations at the Institute of Forensic Medicine in Greifswald—analysis of five decades of post-mortems," Forensic Sci. Int., 133, 125–131.
9. Gupta, P.K. 2004."Pesticide exposure – Indian scene," Toxicology, 198, 83-90.
10. Planning Commission of India, New Delhi. 2001 " Goverment of India, Tenth five-year plan (2002-2007),"513–566.
11. USGS.1995. "Pesticides in the atmosphere: current understanding of distribution and major influences," Fact Sheet FS- 152-95. http://water.wr.usgs.gov/pnsp/atmos/
12. Agnihotri, N.P. 2000. "Pesticide consumption in agriculture in India –an update," Pesticide Research Journal, 12(1), pp. 150-55.
13. Forget, G. 1993. "Balancing the need for pesticides with the risk to human health. In: Impact of Pesticide Use on Health in Developing Countries, Eds. G. Forget, T. Goodman and A. de Villiers, IDRC, Ottawa, pp. 2.

14. Igbedioh, S.O. 1991. "Effects of agricultural pesticides on humans, animals and higher plants in developing countries," Arch. Environ. Health, 46, 218.
15. Jeyaratnam, J. 1985. "Health problems of pesticide usage in the third world" BMJ, 42, 505.
16. WHO. 1990. "Public Health Impact of Pesticides Used in Agriculture," World Health Organization, Geneva, p. 88.
17. Horrigan, L., Lawrence, R.S. and Walker, P. 2002. "How sustainable agriculture can address the environmental and human heath harms of industrial agriculture," Environ. Health Perspect., 110(5), 445-456.
18. Wadhawani, A.M. and Lall, I.J. 1972. "Harmful effects of pesticides. Report of the special committee of ICAR," Indian Council of Agricultural Research, New Delhi, pp. 44.
19. Kasyap, S.K. and Gupta, S. K. 1973. "Review of pesticide toxicology in India," In: Proceedings of the symposium on, "Progress and problems in pesticide residue analysis". Ludhiana, 18-19 Nov., pp. 1-44.
20. Hollingworth, R. M., Kurihara, N., Miyamoto, J., Otto, S. and Paulson, G.D. 1995. "Detection and significance of active metabolites of agrochemicals and related xenobiotics in animals," Pure Appl. Chem., 67, 1487-1532.
21. Hurley, P.M., Hill, R.N. and Whiting, R.J. 1998. "Mode of carcinogenic action of pesticides inducing thyroid follicular cell tumors in rodents," Environ. Health. Perspect., 106, 437.
22. Environews Forum, Killer environment.1999. Environ. Health Perspect., 107, A62.
23. Dikshit, T.S.S., Raizada, R.B., Kumar, S.N., Srivastava, M.K., Kulshreshta, S.K. and Adbolia, U.N. 1990. "Residues of DDT and HCH in major sources of drinking water in Bhopal, India," Bull. Environ. Contamn. Toxico., 45, 389-393.
24. Kumar, S., Singh, K.P. and Gopal, M. 1995. "Organochorine residues in Rural drinking water sources of northern and north eastern India," J. Environ. Sci. Health, A30, 1211-1222.
25. Bansal, O.P. and Gupta, R. 2000. "Groundwater Quality of Aligarh district of Uttar Pradesh," Pesticide Research Journal, 12 (2), 188-194.
26. H. Bouwer, "Agriculture and Ground water quality," Civil Engg., 59, 60-63, 1989.
27. Jani, J.P., Raiyani, C.V., Mistry, J.S., Patel, J.S., Desai, N.M. and Kashyap, S.K. 1991. "Residues of organochlorine pesticides and polycyclic aromatic hydrocarbons in drinking water of Ahemdabad city," Bull. Environ. Contamn. Toxico., 47, 381-385.
28. Ray, P.K. 1992. "Measurements on Ganga River Quality- heavy metals and pesticides," Project Report Industrial Toxicology Research Center, Lucknow, India.
29. Nair, A., Dureja, P. and Pillai, M.K.K. 1991. "Levels of aldrin and dieldrin in environmental samples from Delhi, Indi," The Science of Total Environment, 108, 255-259.
30. Poppenga, R.H. 1999. "Current environmental threats to animal health and productivity," J. Nat. Toxins., 8(1), 47-5,
31. Jabbar, A., Masud, S.Z., Perveen, Z. and Mubarik, A. 1993. "Pesticides

residue in cropland soils and shallow groundwater in Punjab, Pakistan," Bull. Environ. Contam. Toxicol., 51(2),112-118.

32. Chauhan, R., Singh, Z. and Dahiya, B. 1982. "Organochlorine insecticides as food contaminants," in First International Conference on Food Science and Technology, May 23–26, Bangalore, Abstract. No. 9, Section II, pp. 5.
33. Kathpal, T.S., Singh, G., Yadav, G.S., Dhankar, J.S. and Singh, A. 1992. "Monitoring of milk and milk products for DDT and HCH contamination," Pesticide Research Journal, 4(2), 123–131.
34. Kumari, B. and Kathpal, T.S. 1995. "Level of contamination of milk with HCH and DDT in Haryana," Indian Journal of Animal Sciences, 65(5), 576–582.
35. Dikshit, T.S.S., Kumar, S.N., Raizada, R.B., Srivastava, M.K. 1989. "Organochlorine insecticide residues in cattle feed," Bull. Environ. Contam. Toxicol., 43, 691–696.
36. Prassad, K.S.N. 1998. "Biodegradation of organochlorine pesticide residues in ruminants and measures to minimize their excretion in milk," Ph.D. Thesis, NDRI, Karnal, India.
37. Kang, B.K., Singh, B., Chahal, K.K. and Battu, R.S. 2002. "Contamination of feed concentrates and green fodder with pesticide residues," Pestic. Res. J., 4(2), 308–312.
38. Imrankhan, M., Barman, K. and Atreja, P.P. 2003. "Pesticide residues in food chain: threats and solutions," Indian Dairyman, 61–66.
39. Deka, S.C., Barman N. and Baruah, A.A.L.H. 2004. "Monitoring of pesticide residues in feed, fodder and butter in Assam," Pestic. Res. J., 16(1), 86–89.
40. Aggarwal, H.C. 1986. "DDT Residues in the river Jamuna in Delhi, India," Water Air and Soil Pollution, 28, 89-104.
41. FAO. (2005) FAO statistics on livestock population in India. [Online] Available: http://faostat.fao.org.
42. Kaphalia, B.S. and Seth, T. D. 1981. "DDT and BHC residues in some body tissues of goats, buffalo and chickens from Lucknow, India," Pestic. Monit. J., 15, 103-106.
43. Nag, K.S., Raikwar, M.K., Mahanta, S.K. and Kundu, S.S. 2005. "Pesticide residues in feeds," In: Animal Feed Technology (Eds. S. S. Kundu, S. K. Mahanta, Sultan Singh, P.S. Pathak), Satish Serial Publishing House, Delhi.
44. ICMR. 1993. "Surveillance of food contamination in India," Indian Council of Medical Research, New Delhi, pp 117.
45. Agnihotri, N.P., Dewan, R.S., Jain, H.K. and Pandey, S.Y. 1974. "Residues of insecticides in food commodities from Delhi: II. High fat content food materials," Indian J. Entomol., 36(3), 203 -208.
46. Lakshminarayan, V. and Menon, P.K. 1975. "Screening of Hyderabad market samples of food stuffs for organochlorine insecticide residues," Indian Journal of Plant Protection, 3, 4-19.
47. Verma, D.K. 1990. "BHC residues in milk: A gas chromatographic investigation," International Journal of Environmental Analytical Chemistry, 42, 79-81.
48. Mehrotra, K.N. 1989. "Pesticide resistance in insect-pests Indian Scenario,"

Pesticide Research Journal, 1(2), 95-103.

49. Kranthi, K.R., Jadhav, D.R., Kranthi, S., Wanjari, R.R., Ali, S.S. and Russell, D.A. 2002. "Insecticide resistance in five major insect pests of cotton in India," Crop Protection, 21(2), 449-460.
50. Sharma, B. 2004. "Role of drug residue and drug resistant genes in livestock and their impact on human health and environment," Agric. Environ., 62–66.
51. Ghosh, S., Azhahianambi, P., Fluente, J. de la 2006. "Control of ticks of ruminants with special emphasis on livestock farming system in India—present and future possibilities for integrated control- a review," Exp. Appl. Acarol., 40, 49–66.
52. ICMR Bulletin. 2002. "Chemical insecticides in malaria vector control in India," vol. 32(10).
53. Kumar, S., Paul, S., Sharma, A.K., Kumar, R. Tewari, S.S., Chaudhuri, P. Ray, D.D., Rawat, A.K.S., and Ghosh, S. 2011. "Diazinon resistant status in *Rhipicephalus (Boophilus) microplus* collected from different agro-climatic zones of India," Veterinary Parasitology, 181, 274-281.
54. Sharma, A.K., Kumar, R., Kumar, S., Nagar, G., Singh, N., Rawat, S.S., Dhakad, M.L.,. Rawat, A.K.S., Ray, D.D. and Ghosh,S. 2012 "Deltamethrin and cypermethrin resistance status of *Rhipicephalus (Boophilus) microplus* collected from six agro-climatic regions of India," Veterinary Parasitology 188 (2012) 337– 345.
55. Dhaliwal, G.S., Arora, R.,. Dhawan, A.K and Singh, B. 2000. "Intensive agriculture and pest problems: A case study of Punjab," Indian Journal of Ecology, 27(2), 109-130.

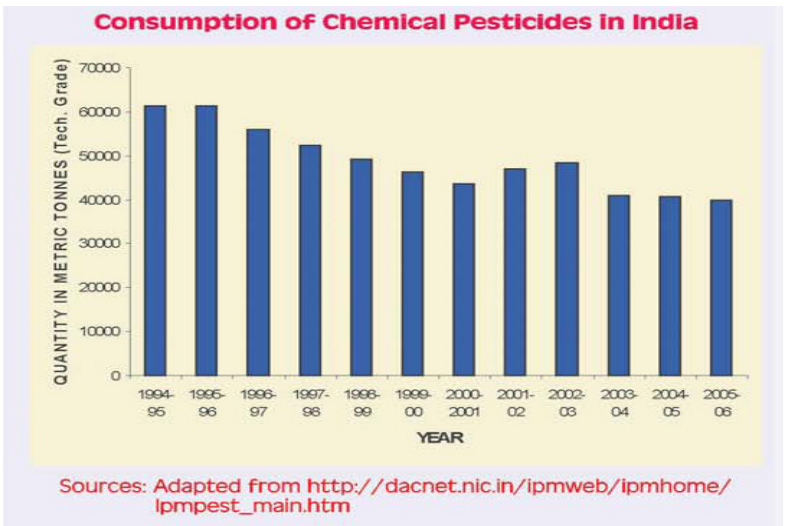


Fig. 1: Consumption of different chemical pesticides in India

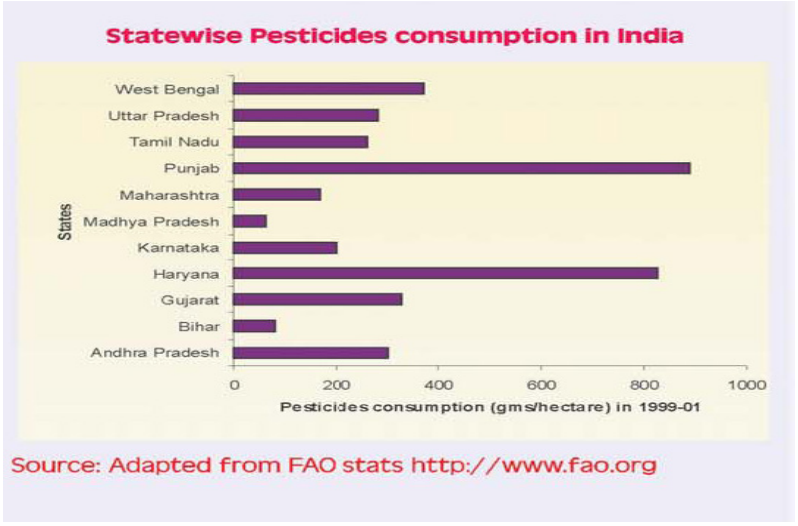


Fig. 2. State-wise pesticides consumption in India

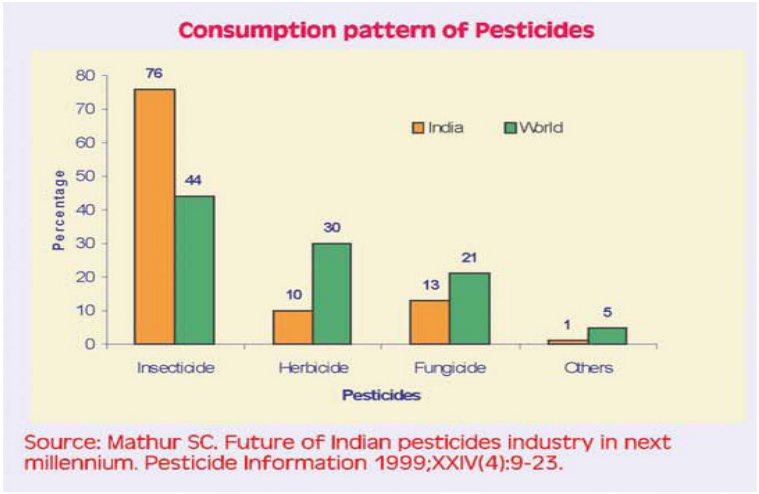


Fig. 3. Consumption pattern of pesticides in India and the world.

◆ ◆ ◆

6.

Impact of Pesticides Used in Tea Plantations on Human Health: A Case Study in Upper Assam, India

Uttam Nath*

Amrit Puzari**

Introduction

Tea (Camellia sinensis) is a perennial crop grown in monoculture practice. India ranked among the top countries in terms of tea production although more than 70 percent of her tea is consumed in the country itself. In India, Assam is among the top tea-producing states. Assam contributes 53% of the total national tea production cultivated in 3.22 lakh hectares area. The tea industry of Assam contributes enormously to the state economy (Laskar and Thappa, 2015). The environment of Assam helps a thick growth of tea. On the other hand, the environmental condition of the region and the monoculture nature of tea plantations provide suitable environment for a variety of pests as well. Because of the high manifestation of pests in the tea gardens, it has become obvious to use pesticides to control the growth

***Research Scholar, Department of Science & Humanities (Chemistry), National Institute of Technology Nagaland, Chumukedima, Dimapur, Nagaland, India.**

****Associate Professor, Department of Science & Humanities (Chemistry), National Institute of Technology Nagaland, Chumukedima, Dimapur, Nagaland, India.**

of the pests and to increase productivity. In a bid to eradicate the pests from the tea gardens, the farmers are relying heavily on pesticides and invariably using them in an injudicious way causing serious threats to the ecosystem including human. While the utilization of certain synthetic chemicals in farming is controlled to some extent, agriculture is one of a handful of areas in which synthetic substances are deliberately released into the environment, and eventually, biological balance is disturbed (FAO, 1990; Warra and Prasad, 2020).

Pesticides are an indispensable part of modern agriculture for controlling pests and increasing crop productivity (Khanal and Singh, 2016; Schreinemachers et al., 2017; Wang et al., 2017). According to Food and Agriculture Organization(FAO) pesticides are any substance or combination of substances expected for forestalling, annihilating or controlling any vermin, including vectors of human and animal sicknesses, undesirable types of plants and creatures causing harm during or in any case meddling with the production, handling, stockpiling, transport or advertising of food, agrarian wares, wood and wood items, and animal feedstuffs, or substances that might be administered to animals for the management of insects, or different irritations in or on their bodies. For last many years, it has become a tradition in the tea industry to apply synthetic pesticides as it always gives a better result. The use of pesticides in pest management has become a common practice around the globe and it has modified the traditional way of pest control to increase the production and quality of agricultural products (Mada and Hussaini, 2014). Though Chemical pesticides show greater success in controlling different pests including weeds, it's beset with a large no of environment-related problems. The released pesticides when entered into the environmental complex may get degraded by temperature or sunlight or micro-organisms or they may last longer in the environment. Persistent pesticides have the ability to build up in the environment which extensively interrupts our ecosystem. These effects are called biomagnifications and bio-concentrations (Tian et al., 2018; Zhen et al., 2019). Exposure to different metal-imbued elements of tea is diverse and it may cause different health issues (Soomro et al., 2007). The origin, habitat, and production of tea leaves determine the absorption

of contaminants from pesticides and other chemicals applied in the tea gardens (Ebadi et al., 2005).

Pesticides such as organochlorine, organophosphate, and synthetic pyrethroid have been more dominantly used in tea gardens because of its sharp results. The modern trend of high dependence on the application of synthetic pesticides in tea gardens of North-East India has led to environmental pollution, pest manifestation, higher pesticide residues in made tea, and harmful impact on the ecosystem and human health (Gurusubramanian et al., 2005; Borthakur et al., 2005; Sarnaik et al., 2006; Bora et al., 2007 a & b). World Health Organization reports that there are three million acute poisoning cases throughout the globe each year in which approximately 2, 20,000 deaths are related to pesticides, and 1% of such incidents are found in highly industrialized countries (Satake et al., 1997).

There is a dearth of scientific work on pesticide residues, pesticide handling in tea gardens, and their health-hazard related work in Assam. Therefore, this study aims to find out the facts related to pesticides present in tea in three districts of Upper Assam namely Sivasagar, Jorhat, and Golaghat, through scientific analysis and field study. In the present work, the pattern of pesticide usage, health hazards of it in agricultural handling, and its presence in tea leaves were recorded.

Methodology

The methodology of the present work highlights the following steps:-

1. Selection of Study sites
2. Field study and collection of data through Questionnaire.
3. Collection and analysis of tea leaves to determine the presence of pesticides.

Description of Study Sites

The investigation site for the present work comprises three districts of Upper Assam to be specific Sivasagar, Jorhat, and Golaghat. Sivasagar district covers 2668 sq. km of the total 78438 sq. km area of Assam. Two sub-divisions namely Sivasagar and Nazira comprise the district. The district present in the range of 26.45°N and 27.15°N latitude and 94.25°E and

95.25°E longitudes (http://cgwb.gov.in/District_Profile/Assam/Sibsagar.pdf). The Brahmaputra river surrounds it in the north whereas southern part is delimited by Nagaland, eastern part by the Charaideo district and west by river Jhanji. The district possesses an area of 2,851 square kilometers (http://cgwb.gov.in/District_Profile/Assam/Jorhat.pdf), arranged at the latitude of 26.7465° N, and longitude of 94.2026° E. Majuli district shares boundary with Jorhat at the north, southern part surrounded by Nagaland, eastern part by Charaideo, and Golaghat on the west. Golaghat district is encircled by the Brahmaputra river toward the north, the territory of Nagaland toward the south, Jorhat toward the east and Karbi Anglong and Nagaon region toward the west. Dhansiri is the major river of the district, which begins from the Laisang pinnacle of Nagaland. Total area of the district is 3502 sq. km (http://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf). Golaghat is located in the latitude of 26.5239˚N, and the longitude is 93.9623° E.

For the study, three tea estates were selected from each district. The selected tea estates were Sepon, Krishna beehari, and Mohkhuti tea estates from Sivasagar district, Borholla, Gorajan & Kolapani tea estates from Jorhat district, and Mokrong , Ghiladhari & Dolajan tea estates from Golaghat district. Samples were collected in the month of April-May, 2019 from the respective tea factories. A sample of 500 gm (tea leaf) was collected from each tea estate. The collected samples were taken for extraction and analysis.

Field Survey and Pesticide-Related Data Collection

The field survey was made in two-phase viz. April-May, 2019 & January-February, 2020. The tea gardens were visited and with the help of the managers of respective gardens processed tea samples (500g) were collected. The data regarding the name and brand of the pesticides were also collected with the help of the tea garden officials. The primary data regarding the handling of pesticides and their impact on the health of the handlers were collected through interviews and questionnaires with the tea garden workers. Most of them were either uneducated or semi-educated. The age structure of the informants was between 23 to 55 years. The information

was collected from the male workers since female workers were not found to deal with pesticides and their applications.

Collection and Analysis of Tea Leaves

500g of processed tea was collected from each tea estate. The collected samples were kept in the fridge till extraction. Then 100g of samples were extracted in methanol by using the Soxhlet apparatus. The samples were extracted for 7 to 10 hours before filtration. The filtered samples were taken into a rotary evaporator which removed the solvent (methanol). After evaporating all the solvents, the extracted samples were analyzed through Thin Layer Chromatography to find out the indication of the presence of different compounds. Then, according to the desirability, the separation of compounds was done through Column Chromatography. The separated compounds were characterized with the help of IR spectroscopy.

Result and Discussion

Pesticides Used in the Tea Gardens of Assam

The commonly used pesticides were recorded from the office of the sample tea estates. These pesticides were used throughout the year depending on the manifestation of pests. Table 1 shows the name of the pesticides, trade name, molecular formula, pesticide category, toxicity status, and their side effects.

Table 1. Name, trade name, molecular formula, pesticide category, toxicity status, and side effects of some pesticides used in tea cultivation.

Name of the pesticides	Trade name	Molecular formula	Pesticide category	Toxicity status	Side effects
Dicofol	Dicofol 18.5% EC	$C_{14}H_9C_{15}O$	Organoc-hlorine	Slightly hazardous	Respiratory disorder, kidney, liver damage, affects central nervous system
Ethion	Ethion 50% EC/ Fosmite	$C_9H_{22}O_4P_2S_4$	Organoph-osphate	Moderately hazardous	Headache, dizziness, nausea, vomiting, diarrhea
Fenaz-aquin	Magister® 10% EC	$C_{20}H_{22}N_2O$	Quinazoline group	Moderately hazardous	Headache, dizziness, nausea, weakness

Fenpyroximate	Fenpyroxymate 5% EC	$C_{24}H_{27}N_3O_4$	Pyrazole group	N/A	Eczema, Itchy bumps, eye irritation
Quinalphos	Quinalphos 25% EC/ Krush EC	$C_{12}H_{15}N_2O_3PS$	Organophosphate	Moderately hazardous	Cardiac dysfunction, Vomiting, Pancreatitis
Hexythiazox	Hexythiazox 5.45% EC	$C_{17}H_{21}C_lN_2O_2S$	Thiazolidine	Moderately hazardous	Possible human carcinogen
Propargite	Mitex, Omite, and Comite(Propergite 57% EC)	$C_{19}H_{26}O_4S$	Sulfite ester	Slightly hazardous	Decreased appetite, weight loss, skin, and eye problem
Spiromesifen	Oberon®	$C_{23}H_{30}O_4$	Titronic acid	No acute hazard at normal use	Not available
Etoxazole	*Etoxazole* 10% SC (Borneo Sumitomo)	$C_{21}H_{23}F_2NO_2$	Diphenyloxazoline	Low toxicity	Respiratory disorder
Thiacloprid	Calypso 70WG	$C_{10}H_9C_lN_4S$	Neonicotinoid	Moderately hazardous	Abdominal pain, headache, vomiting, hypertension, cancer
Azadirachtin	Align, Azatin, and Turplex (1, 2)	$C_{35}H_{44}O_{16}$	Limonoid	Low toxicity	Brain disorder, coma, pregnancy problem, blood disorders, loss of consciousness
Bifenthrin	Bifenthrin 2 EC	$C_{23}H_{22}C_lF_3O_2$	Synthetic pyrethroid	Moderately hazardous	Abdominal pain, nausea, skin problem, cancer.
Clothianidin	Poncho, Prosper, and Votivo	$C_6H_8C_lN_5O_2S$	Neonicotinoid	Moderately hazardous	Nausea, vomiting, abdominal pain
Deltamethrin	Decis 100	$C_{22}H_{19}Br_2NO_3$	Synthetic pyrethroid	Moderately hazardous	Nausea, vomiting, abdominal pain, muscle twitches
Phosalone	Azonfene, Benzofos	$C_{12}H_{15}C_lNO_4PS_2$	Organophosphate	Moderately hazardous	Loss of consciousness, vomiting, headache, nausea
Acephate	Chrevron RE 12420, and Orthene 755	$C_4H_{10}NO_3PS$	Organophosphate	Slightly hazardous	Heart block, nervous disorder, eye problem

Buprofenzin	*Buprofenzin* 25% SC	$C_{16}H_{23}N_3OS$	Thiadiaz-inanes	No acute hazard at normal use	Neurotoxicity, eye irritation, sore throat.
Cypermethrin	Superkiller 10/25 EC	$C_{22}H_{19}C_{l2}NO_3$	Synthetic pyrethroid	Moderately hazardous	Headache, salivation, muscle weakness
Imidacloprid	Imidachloprid 30.5% SC (Super - Imida)	$C_9H_{10}C_1N_5O_2$	Nicotinoid	Moderately hazardous	Dizziness, breathlessness, vomiting, confusion
Monocrotophos	Azodrin, Bilobran, Crisodrin,	$C_7H_{14}NO_5P$	Organoph-osphate	Highly hazardous	Bradycardia, salivation, lacrimation, diaphoresis, vomiting, diarrhea
Cyflumetofen	Dhanuka Foster	$C_{24}H_{24}F_3NO_4$	Benzoyl acetonitrile	Low acute toxicity	Respiratory disorder

During the work, 21 synthetic pesticides were recorded. They were Dicofol, Ethion, Fenazaquin, Fenpyroximate, Quinalphos, Hexythiazox, Propargite, Spiromesifen, Etoxazole, Thiacloprid, Azadirachtin, Bifenthrin, Clothianidin, Deltamethrin, Phosalone, Acephate, Buprofenzin, Cypermethrin, Imidacloprid, Monocrotophos, and Cyflumetofen. These pesticides were recommended by Tocklai Tea Research Centre to use against tea pests. They belonged to different classes of pesticides. These 21 pesticides belonged to 13 different pesticide groups e.g., Organophosphate (5), Synthetic pyrethroid (3), Nicotinoid (3), Organoclorine (1), Quinazoline group (1), Pyrazole (1), Thiazolidine (1), Sulfite ester (1), Titronic acid (1), Diphenyloxazoline (1), Limonoid (1), Thiadiazinanes (1), and Benzoyl acetonitrile (1). According to The WHO recommended classification of pesticides by hazard and guidelines to classification: 2004, among the reported pesticides, one pesticide was highly hazardous, eleven pesticides were moderately hazardous and five of them were slightly hazardous or with low toxicity. For four pesticides, the information on their hazardous impact was not found (Table 1 & Fig. 1). According to various works of literature, the studied pesticides were responsible for around 36 diseases including cancer and cardiovascular diseases. Symptoms of 9 of these diseases were found among the pesticide handlers (Table 3 & Fig. 2)

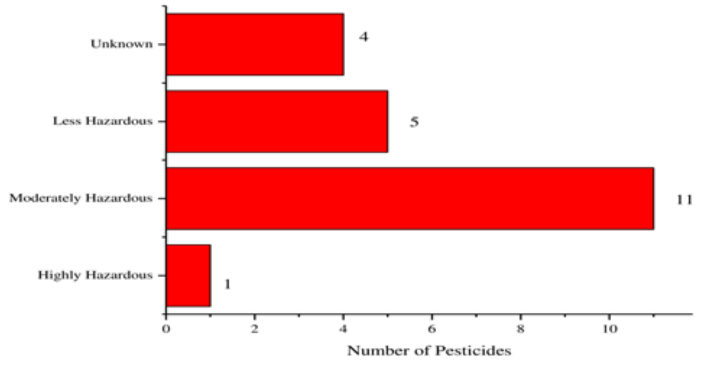


Fig 1. Distribution of Pesticides Based on Toxicity Level

Field Study and Collection of Data Through Questionnaire

A questionnaire was made to collect data regarding the proper management of pesticides and health-related issues from every sample area. 36 workers were interviewed with the help of questionnaires. Following data was collected through it.

Table 2.
Data Collected Through a Questionnaire (N=36)

S.N.	Questions (usage pattern of pesticides)	Number of respondents with affirmation	Percentage (%)
1.	Use of protective instruments.	34	94.4
2.	Spraying of pesticides with the hand pump.	33	91.7
3.	Consultation about the right use & store of pesticides from the expert.	15	41.7
4.	Storage of pesticides in the garden storehouse	36	100
5.	Uses pesticide containers afterward	0	0
6.	Disposal facilities of pesticide containers.	30	83.3
7.	Proper protection of the storehouses.	27	75
8	Prior information about the toxic effect of the pesticides	31	86.1

The data showed that 94.4 % of workers used protective instruments at the time of pesticide handling. 91.7% of

informants said that their respective tea estates used hand pumps for pesticide spraying. All the selected tea estates had proper pesticide storehouses whereas 83.3% of informants admitted to access proper disposal mechanism of pesticides in their gardens. According to 75% of the interviewed workers, their pesticide storehouses were properly protected. 86.1% of pesticide handlers knew the toxic effects of pesticides through different sources like training and awareness programs organized by garden management. Proper management of pesticides including their storage and handling is very important as it can cause serious consequences to humans and the ecosystem (Jean et al., 2017).

Pesticide Handling and its Associated Health Hazards

A direct interview was held individually with some selected pesticide sprayers of the sample sites. Overall 36 persons were interviewed in the course of the field study. Immediate health hazards encountered by the pesticide handlers are shown in table 3.

Table 3.
Health impact of pesticides on tea garden workers (sprayers)

Health impact	**No of victims (N= 36)**	**No of victims in %**
Dizziness	18	50
Headache	16	44.4
Vomiting	12	33.3
Stomach problem	16	44.4
Eye problem	16	44.4
Sore throat	17	47.2
Chest pain	8	22.2
Blurred vision	6	16.7
Breathing problem	11	30.5

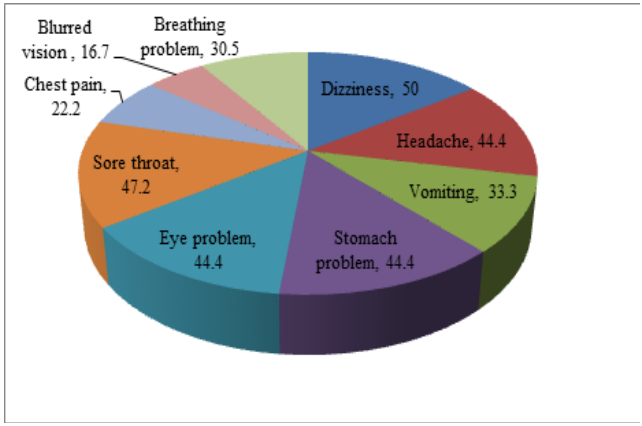


Fig 2.
Pesticide-Related Disorders Found Among Tea Garden Workers (sprayers).

Pesticide users are easy victims of its side effects. Globally various reports on pesticide-related sickness among the users are recorded which is a matter of concern at the present trend of agriculture (Matthews et al., 2003; Sonchieu and Ngassoum, 2007). Tea pesticides have some prominent side effects on manual workers. Fig 2 and table 3 show various pesticide-related health problems of the manual workers. Dizziness has been found as the most prominent disorder (50%), whereas, sore throat (47.2%), eye problems, headache and stomach problem (44.4% each), vomiting (33.3%), breathing problem (30.5%), chest pain (22.2%) and blurred vision (16.7%) were also found prominent among them.

Analysis of pesticides in Tea Leaves

Infrared spectroscopy can be effectively used for organic characterization (Rossel et al., 2006) and has been largely applied in the determination of pesticides in agrochemical formulations (Moros et al., 2006). Analysis of pesticides presence in tea leaves was done with IR spectroscopy. The compounds separated through column chromatography were characterized in IR Spectrophotometer and the spectrum obtained through it was compared with the standard FTIR spectrum of commonly used pesticides. The IR spectrums of different samples obtained in the experiment indicated the presence of Cyflumetofen and Hexythiazox.

The IR spectrum between 1650– 1950 cm^{-1} confirms a carbonyl group in the compound. It is because of C=O stretching. This is the most representative type of vibration localized in an individual bond. As we compare the stretching frequencies with that of the ranges of the functional group, it reveals that the spectrum of 2962 cm^{-1} and 2869 cm^{-1} shows that -OCH_3 and CH_3 are present respectively Likewise, the spectrum between 1000- 1350 cm^{-1} marks the existence of the C-F group and the spectrum between 750- 810 cm^{-1} deciphers about an aromatic C-H group present in the compound. And the IR spectrum between2240- 2260 cm^{-1} indicates about the CN group in the compound. Hence, the FTIR spectrum supports the residual existence of Cyflumetofen in the sample (Fig. 3).

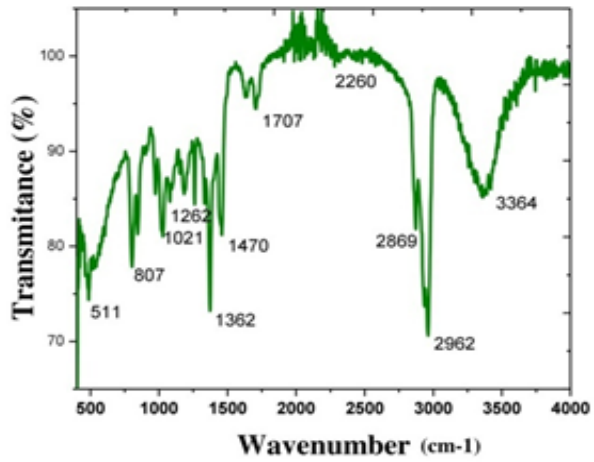


Fig 3. FTIR spectrum of Cyflumetofen

The sharp bands of spectrum in between 3200 cm^{-1} to 3400 cm^{-1} show that -NH- group's present in the compound. Spectrum ranging between 2850- 3000 cm^{-1} & 1650– 1950 cm^{-1} show the existence of a CH_3 group and a carbonyl group respectively. Similarly, a spectrum of 1450- 1600 cm^{-1} reveals that an aromatic C=C group's present in the sample. C-S stretching vibrations spectrum ranges between 800 to1500 cm^{-1}. These characteristic spectrums indicate the presence of hexythiazox in the sample (Fig 4).

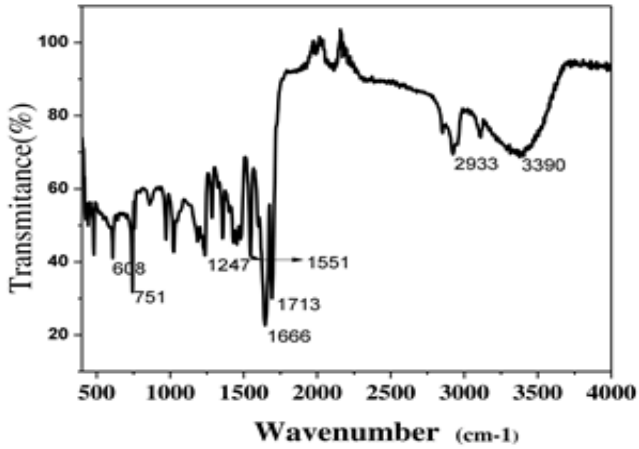


Fig 4. FTIR Spectrum of Hexythiazox

Conclusion

The tea industry of Assam consumed a greater amount of synthetic pesticides. These pesticides possess extensive health hazards to the pesticide handlers. Moreover, in the study, the presence of two pesticides namely Cyflumetofen and Hexythiazox were found, which could cause respiratory disease and cancer to the consumers. Moreover, the pesticide handlers were found to show symptoms of headache, vomiting, stomach problem, sore throat, eye irritation, dizziness, chest pain, and breathing problem. Additionally, synthetic pesticides always harm non-target organisms and lead to biodiversity destruction. Despite these health and environmental hazards of pesticides, only 41.7% of the sprayers were provided training. Therefore, tea garden management needs to be more cautious in the application of pesticides and every pesticide handler should get proper training from experts. The maximum use of organic pesticides could be an effective alternative in tea gardening.

References

1. Bora, S., Rahman, A., Sarmah, M. & Gurusubramanian, G. (2007 a). Relative toxicity of some commonly used insecticides against tea looper caterpillar, Buzura suppressaria Guen (Geometridae : Lepidoptera) and its effect on food consumption and utilization. International Journal of Tropical Agriculture, 25, 257-265.
2. Bora, S., Sarmah, M., Rahman, A. & Gurusubramanian, G. (2007 b). Relative toxicity of pyrethroid and non-pyrethroid insecticides against male

and female tea mosquito bug, Helopeltis theivora Waterhouse (Darjeeling strain). Journal of Entomological Research, 31(1), 37-41.

3. Borthakur, M., Rahman, A., Sarmah, M. and Gurusubramanian, G. (2005a). Predators of phytophagous mites of tea (Camellia sinensis) in North East India. In: Proceedings of 2005 International symposium on innovation in tea science and sustainable development in tea industry, 11-15 November, 2005, Hangzhou, China, 749-755.
4. Borthakur, M., Sarmah, M., Rahman, A. & Gurusubramanian, G. (2005b). Seasonal population fluctuation of Stethorus gilvifrons and effects of conventional pesticides and some herbal extracts on its survival and feeding potential. In: Proceedings of 34th Tocklai Conference – Strategies for Quality (Eds.: A.K. Barooah, M. Borthakur and J.N. Kalita). Tocklai Experimental Station, TRA, Jorhat, Assam, India, 332-339.
5. Ebadi, A.G., Zare, S., Mahdavi, M. & Babaee, M. (2005). Study and measurement of Pb, Cd, Cr, and Zn in green leaf of tea cultivated in Gillan province of Iran. Pakistan Journal of Nutrition, 4(4): 270- 272.
6. FAO, 1990. (http://www.fao.org/3/w2598e/w2598e07.htm)
7. Ground water information booklet Golaghat district, http://cgwb.gov.in/District_Profile/Assam/Golaghat.pdf, 2013. (Accessed on 27th August, 2021).
8. Ground water information booklet Jorhat district, http://cgwb.gov.in/District_Profile/Assam/Jorhat.pdf, 2013 (Accessed on 27th August, 2021).
9. Ground water information booklet Sivasagar district, http://cgwb.gov.in/District_Profile/Assam/Sibsagar.pdf , 2013. (Accessed on 27th August, 2021).
10. Gurusubramanian, G. (2005). Safe and economic pest management in tea, shade trees and green crops. In: Manual on tea culture for condensed course (Eds.: A.K. Dutta, N. Ahmed, B. Kotoky and D. Burugohain). Tocklai Experimental Station, TRA, Jorhat Assam Printing Works Private Limited, Jorhat, Assam, India, 113-127.
11. Jean, S., Benoit, N.M, Edouard, N.A. & Srivastava, L.P. (2017). Pesticide Applications on Some Vegetables Cultivated and Health Implications in Santa, North West-Cameroon. International Journal of Agriculture and Environmental Science, 4(2), 39-46.
12. Khanal, G. & Singh, A. (2016). Patterns of pesticide use and associated factors among the commercial farmers of Chitwan, Nepal. Environ. Health Insights, 10, 1-7. http://dx.doi.org/10.4137/EHI.S40973.
13. Laskar, N. & Thappa, S. (2015). A study on the present scenario of Tea industry in Assam-challenges ahead. Indian Journal of Applied Research, 5 (11), 533-537
14. Mada, D.A., Hussaini, I.D. & Adamu, I.D. (2014). Study on impact of annual Post Harvest Losses of Grain and Post Harvest Technology in Ganye Southern Adamawa State-Nigeria. IOSR Journal of Engineering, 4, 15-20. https://doi.org/10.9790/3021-04541520.
15. Matthews G., Wiles T. & Baleguel P.A. (2003). Survey of pesticide application in Cameroon. Crop Prottection, 22, 707-714.
16. Moros, J., Armenta, S., Garrigues, S. & de la Guardia, M.

(2006). Univariate near infrared methods for determination of pesticides in agrochemicals. Analytical Chimica Acta, 579, 17-24. https://doi.org/10.1016/j.aca.2006.07.009.

17. Rossel, R. A. V., McGlynn, R. N. & McBratney, A. B. (2006). Determining the composition of mineral-organic mixes using UV–vis–NIR diffuse reflectance spectroscopy. Geoderma, 137, 70-82. http://dx.doi.org/10.1016/j.geoderma.2006.07.004.
18. Sarnaik, S.S., Kanekar, P.P, Raut, V.M., Taware, S.P., Chavan, K.J. & Bhadbhade, B. J. (2006). Effect of application of different pesticides to soybean on the soil microflora. Journal of Environmental Biology, 27, 423-426.
19. Satake, M., Mido, Y., Sethi, M.S., Iqbal, S. A., Yasuhisa, H., & Taguchi, S. (1997), Environmental Toxicology, 185-197.
20. Schreinemachers, P., Chen, H.P., Nguyen, T.T.L., Buntong, B., Bouapao, Gautom, S., Le, N.T., Pinn, T., Vilaysone, P. & Srinivasan, R. (2017). Too much to handle? Pesticide dependence of smallholder vegetable farmers in Southeast Asia. Science of Total Environment, 593-594, 470-477.
21. Sonchieu J. & Ngassoum M.B. (2007). Pesticides cases recorded in Ngaoundere, Cameroon over a 27-month period. Toxicology and Environmental Chemistry, 89 (2): 295-296
22. Soomro, M.T., Zahir, E., Mohiuddin, A., Khan, N. & Naqui, I.I. (2007). Quantitative assessment of metals in local brands of tea in Pakistan. Pakistan Journal of Biological Science, 1 (2), 1-5.
23. The WHO recommended classification of pesticides by hazard and guidelines to classification: 2004, IPCC, 16-56
24. Tian, D., Mao, H., Lv, H., Zheng, Y., Peng, C. & Hou, S. (2018). Novel two-tiered approach of ecological risk assessment for pesticide mixtures based on joint effects. Chemosphere 192, 362–371. https://doi.org/10.1016/j. chemosphere.2017.11.001
25. Wang, W., Jin, J., He, R. & Gong, H. (2017). Gender differences in pesticide use knowledge, risk awareness and practices in Chinese farmers. Science of the Total Environment, 590-591, 22-28. https://doi.org/10.1016/j.scitotenv.2017.03.053.
26. Warra, A.A. & Prasad, M.N.V. (2020). Chapter 16: African perspective of chemical usage in agriculture and horticulture—their impact on human health and environment. Agrochemicals Detection, Treatment and Remediation Pesticides and Chemical Fertilizers, 401-436. DOI: 10.1016/B978-0-08-103017- 2.00016-7.
27. Zhen, X., Liu, L., Wang, X., Zhong, G. & Tang, J. (2019). Fates and ecological effects of current-use pesticides (CUPs) in a typical river-estuarine system of Laizhou Bay, North China. Environmental Pollution, 252, 573–579. https://doi.org/10.1016/j.envpol.2019.05.141

7.

Management of Grassland Ecosystem in Kaziranga National Park (KNP) of Assam, Northeast India

Dr. Azad Ali*

Introduction

Grassland is a type of terrestrial ecosystem. It occupies roughly around 19% of the earth's total surface area. **Abiotic components** of the grassland ecosystem are mainly supplied by water, CO_2, nitrates, phosphates and sulphates of the concerned ecosystem. On the other hand, **biotic component** includes the **producers or autotrophs.** Main producers of grasslans are basically tall and short grass species of that area. Grasslands also sometime covers few shrubs and forbs. **Primary consumers or herbivores** of grassland ecosystem are mainly grazers such as buffalo, deers, rhinos, elephants, rabbits etc along with lots of insect species which consumed on the leaves of the grasses. Small carnivores such as frogs, snakes, lizards and birds are main **secondary consumers** of grassland ecosystem. **Decomposers** are

***Associate Professor and Head, Department of Zoology, Animal Ecology and Wildlife Biologists, B. N. College, Dhubri, Assam, India.**

bacteria and fungi species and they work with the principle of **Bio-geo-chemical Cycle**.

The **Kaziranga National Park** (**KNP**) or **Tiger Reserve** of India presents an unique ecosystem where prescribed burning is used as a management tool for maintaining the grasslands ecosystem. Grasslands cover almost 66% of the Kaziranga National Park. Grass lands of Kaziranga composed of a locally known herbes called Jhau (*Tamarix dioca*) along with other tall and short grass species. Some of the known species of KNP are *Saccharum spontaneum*, *Imperata cylindrica*, *Erianthus ravennae*, *Narenga porphyrocome*, *Neyrandia neyaundiana*, *Cyminpopogon pendulus* etc.

The most common grass species of Kaziranga National Park is called Ekora (*Erianthus ravennae*). Some grasses are locally known in Assamese as "Kher" which are useful for all the herbivore species of the park with special reference to One Horned Rhinoceros. There are two Kher species such as 'Barata kher' (*Saccharum elephantinus*) and 'Ulu kher' (*Imperata cylindrica*). Khagori (*Phragmites karka*) and Nal (*Arundo donax*) are the two species found in the low-lying areas of the park. In marshy areas are covered with short grasses and they attract herbivore species of the KNP. Examples of such short grass species are *Cynodondactylon*, *Chrysopogon aciculatus*, *Andropogon* spp ., *Panisetum* spp., *Eragrostis* spp. (Web page[3]).

Fig. 1:
One horned Rhino in Grassland Ecosystem of Kaziranga National Park

Wildlife of Kaziranga National Park or Tiger Reserve includes 'BIGFIVE' wildlife species such as Great Indian

One Horned Rhinoceros (*Rhinoceros unicornis*), Asiatic Wild Buffalo (*Bubalus bubalis*), Asiatic Elephant (*Elephas maximus*), Swamp Deer (*Cervus duvauvceli ranjitsinghi*), and Royal Bengal Tiger (*Panthera tigris*). Out of these big five, four are grassland dwellers and depends on the grass species of the park for their food.

According to the recent animal census of 2018, the KNP has around 2,413 numbers of One Horned Rhinos which was recorded at 12 numbers only in the year 1908. Poaching is a major threat of Kaziranga national Park in the recent years. Despite serious poaching, conservation story of Rhinos of Assam is commendable one. Population of One Horned Rhinoceros is continuously growing in KNP (web page[2]). The numbers of other grasslans species such as Asiatic Elephants and Swamp Deers are also remarkable now in comparison to older data. Although KNP is rich in various wildlife species, its management authority has been found to be focused primarily on the conservation of endangered species with special reference to *Rhinoceros unicornis unicornis* and the conservation of its grassland ecosystem.

Fig. 2:
Asiatic Elephants and Swamp Deers in Grasslands of Kaziranga

Burning or fire practices have long been used in India's forests and grasslands. Native villagers set fires to light the way ahead for walking, remove tigers from forested areas near villages, clear land for agricultural practices etc.

Grassland of Kaziranga is managed by the governmental forest department of Assam. For that it has ten-year management plans which started in 1981. This 10 year plan has been again supplemented by annual plans of operation. Although fire is

a natural part of forest and grassland ecosystem, it can be managed by periodically done controlled burning practices. However it is also true that large scale burning is harmful from ecological point of view and it may cause serious air pollution in the concerned area.

Fig. 3:
Wild Water Buffalo and Asiatic Elephants in Kaziranga Grassland

Brief History of Kaziranga National Park and its Grassland Ecosystem

Kaziranga is considered to be the largest **protected area** on the southern bank of the River Brahmaputra. It is located in the floodplain of the River Brahmaputra in the Nagaon, Golaghat and Sonitpur districts of Assam, Northeast India, a biodiversity hotspot covering an area of 1030 km². Geographical location is estimated as 26°35'–26°45'N and 93°05'–93°40'E. In terms of regional biodiversity point of view, Kaziranga is situated along the **Eastern Himalayan Biodiversity Hotspot**.

At the very beginning, Kaziranga was declared as a '**Reserve Forest**' in 1908 with a main aim and objective to protect the Indian Rhinoceros (*Rhinoceros unicornis*) and its habitat (Lahan & Sonowal, 1973). It was then notified as'**Game Reserve**' in 1916 followed by the upgraded status of '**Wildlife Sanctuary**' in 1950. Finally in 1st January 1974, it was declared as one of the biodiversity rich **National Park** of India. It also got the recognition of **World Heritage Site** in 1985 (Barua and Sharma, 1999) and the decision was made in the 9th Session of the World Heritage Committee which was held in 6.12.1985

under the Article 2 of the convention concerning the Protection of the World Cultural and Natural Heritage (web page[1]). In 2006 of the current millennium, Kaziranga got the status of **Tiger Reserve,** since tiger population is also very high in the park as the habitat is also found suitable for tigers with strong woodland ecosystem in core areas of the park.

Grassland community and savanna vegetation (Choudhury, 2005) are conspicuous in Kaziranga National Park and it is known as Eastern Wet Alluvial Grasslands (Champion and Seth, 1968). Rao and Panigrahi (1961) described the vegetation as tropical grassland type interspersed by semi-evergreen and tropical moist deciduous forests. Study reveals that there are more than 61% of its total area was occupied by **tall grasses** and only 3% by **short grasses** besides 28% woodlands and 8% of waterlogged areas. Tall grasses are extensively distributed throughout the park and provide good shelter to large animals but happens to be poor forage value. Short grasses are only restricted to the edges of beels and other water logged areas with high forage value (Khatri and Barua, 2011).

Area and percentage coverage of Grassland and Woodland ecosystem in Kaziranga National Park as recorded in the year 1997 (excluding additions and eroded area) has been shown in the following table-

Table 1:
Coverage of Grassland and Woodland in Kaziranga National Park

Sl. No.	Type of land cover	Area (km^2)	Percentage of Area
1	Grassland - Tall grass	248.85	61.01
2	Grassland - Short grass	12.30	3.01
3	Woodland	114.01	27.95

Burning Practices in Kaziranga National Park

The annual burning of grassland is a well established management practice of Kaziranga National Park of Assam. Controlled burning has very little adverse impact on the biodiversity of the Park. It has been noticed that controlled burning is regularly practiced in Kaziranga National Park for management of the grassland ecosystem of the park.

Ecologically, grassland burning is an important tool for maintaining the grassland ecosystem.

Fig. 4:
Annual burning practices conducted in Kaziranga by the Forest officials of the park

The grass is burnt annually in a phased manner in dry season using scientific techniques ensuring that no animals are harmed during the process. In Kaziranga, burning of grassland is carried out in stages so that there are sufficient areas with tall grass left to act as a cover for smaller wildlife. Though, ideally, burning should be done between December and February, it usually extends till April due to climatic factors in Kaziranga (Bonal pers. Com.). So there are two schedule of burning can be seen in KNP, one is early burning practice which is generally held in dry or winter season and the other one is late burning practiced which is usually seen during Pre-monsoon period . According to B. S. Bonal, former Director of Kaziranga National Park, grassland burning is one of the habitat manipulation techniques applied for proper management of the world heritage site (web page[4]). This

phenomenon can be correlated with the process of community dynamics or ecological succession (Sharma, 1998).

For successful completion of the census programme o Rhino, burning practice is very important as without burning the patches of tall grass census workers cannot get proper visibility. However, in 2018, burning percentage was poor due to the high moisture content. Only 20% of the vegetation could be burnt in that year, as compared to the 60-70% set afire every year.

Importance of Grassland Burning in Kaziranga National Park:

Burning is very useful tool and there are number of importance or benefits of which can be obtained from grassland burning technique in Kaziranga National Park. They are as follows-

- ❖ One of the main importances of burning is to maintain as well as to increase the existing grassland habitat of the park.
- ❖ To provide food for the park's huge herbivorous population with special reference to the One Horned Rhino (Rhinoceros unicornis).
- ❖ The older grasses do not provide much nutritional value. So, after burning new shoots come out and the new shoots that come up after burning attract the herbivores.
- ❖ There is greater frequency of sighting of animals in burnt patches. It also provides an additional benefit like better visibility of wildlife for tourists and better visibility of poachers for the Forest Officers.
- ❖ Burning is also done to increase the visibility of the park as animals like rhinoceros, deer etc. are not visible properly for older tall grasses.
- ❖ Burning also enhances the carrying capacity of the park.
- ❖ One of the important reason of controlled burning is to avoid forest fires (Trigo, 2017); however burning of Kaziranga is done with a different motive and wild fire is not seen in Kaziranga's environment.
- ❖ Last but not the least, burning prevent the encroachment of forest trees and thereby maintain the sere or seral stage

of the existed grassland ultimately to manage the habitat change from the grassland to woodland ecosystem (Verma et al., 2015; Patnaik et al., 2019).

Negative Impacts of Burning

In my writing, I have tried to show grassland burning as a beneficial one for our herbivorous or grass-eating wildlife of Kaziranga National Park or to combat with the process of ecological succession. But it has some negetive impscts also in our immediate environment. So it can be termed as "green management technique" since large scale burning may increase carbon compounds (CO, CO_2 etc.) in our atmosphere.

Wild Fire

Wild fire is not yet reported from Kaziranga National Park. The climatic conditions of the KNP is not so harsh so that it can caught wild fire. Annual maximum temperatures of less than 34^0C and monsoon driven moisture in May are not sufficient to create the catastrophe of wild fires as it observed at some other parts of the world where wild fires cerates havoc in those areas.

Conclusion

According to Kushwaha *et* al. (2000), Kaziranga National Park is one of the unique protected area whole of Asia. Looking at the concentration of the grassland dwelling wildlife forms with special reference to One horned Rhinos of the park and to maintain its unique grassland habitat stable, annual controlled burning are very important for the National Park. However, we have to be very cautious, so that minimal faunal damage is done during the practice of burning by the authorities and at the same time we have to take care of the air pollution part also to give a healthy environment to the every life form live in and around the park.

References

- Barua, M., and P. Sharma (1999): Birds of Kaziranga National Park, India. Forktail, 15, 47-60.
- Choudhury, S. (2005): Assam's Flora (present status of vascular plants). ASTEC, Silpukhuri, Guwahati.
- Champion,H.G. and S. K. seth (1968): A revised survey of forest types of India. Govt. of India. New Delhi.
- Khatri, P.K. and K. N. Barua (2011): Structural Composition and Productivity Assessment of the Grassland Community of the Kaziranga

National Park, Assam. Rainforest Research Institute, Jorhat, Assam.

- Kushwaha, S. P. S., P. S. Roy, A. Azeem, P. Boruah, , and P. Lahan, P. (2000): Land area change and rhino habitat suitability analysis in KNP, Assam. Tiger paper, XXVII (2), 09-17.
- Lahan, P. and R. Sonowal (1973): Kaziranga Wildlife Sanctuary. Journal of Bombay Natural History Society, 70(2):245-278
- Patnaik, N. K., K. Sharma and P. Chaudhry (2019): Kaziranga National Park of India: Some wildlife and tourism management related pressing issues. Jharkhand Journal of Development and Management Studies XISS, Ranchi, Vol. 17, No.2, June 2019, pp. 8127-8141.
- Rao and Panigrahi (1961): Distribution of vegetational types and their dominant species in Eastern India. Jour. Ind. Bot. Soc., 40: 274-285pp.
- Sharma, P.D. (1998): Ecology and Environment. Rastogi Publications, Meerut, India. 7th Edition, pp 660.
- Trigo, Ricardo M.; Provenzale, Antonello; Llasat, Maria Carmen; AghaKouchak, Amir; Hardenberg, Jost von; Turco, Marco (2017): "On the key role of droughts in the dynamics of summer fires in Mediterranean Europe". Scientific Reports. 7 (1): 81.
- Verma, M., D. Negandhi, C. Khanna, A. Edgaonkar, A. David, G. Kadekodi, R. Costanza, and R. Singh (2015): Economic valuation of Tiger reserves in India: A value approach. Indian Institute of Forest Management Bhopal, India. A report submitted to National Tiger Conservation Authority (NTCA), Ministry of Environment, Forests and Climate Change, Government of India.

Web Pages

1. https://whc.unesco.org/document/6953
2. Grassland Refuge in Kaziranga National Park | RoundGlass | Sustain
3. http://www.rhinoresourcecenter.com/pdf_files/117/1175860305.pdf
4. http://www.rhinoresourcecenter.com/pdf_files/117/1175859965.pdf

◆ ◆ ◆

8.

Anthropogenic and Natural Hazards of the River Subansiri, A North Eastern Himalayan Tributary of the Brahmaputra River System Flowing Through Arunachal Pradesh and Assam, North East India

Dr. Pabitra Sarmah*

Introduction

Rivers are lotic habitats which are characterized by physical and chemical parameters of water. Water parameters play an important role for maintaining the diversity of aquatic flora and fauna. River is a freshwater ecosystem which is characterized by water current, land water interaction and oxygen tension. The present investigation has been conducted in the river Subansiri which originates from the Po Rom peak. Po Rom peak is about 30 km from the Tsangpo. It is the major tributary of the mighty river Brahmaputra. The river passes 143km in Tibet, 191 km in Arunachal Pradesh and 108 km in Assam. From its origin, the river crosses about 143 km through Tibet and then enters into Arunachal Pradesh of India. The river confluences into the Brahmaputra at

***Assistant Professor, Department of Zoology, Silapathar Science College, Amritpur, Dhemaji, Assam, India.**

Silikhaguri, Narayapur, Lakhimpur, Assam. The catchments area of the river is 10,148 sq miles in Arunachal Pradesh and 440 sq miles in Assam. It is the lifeline for a huge number of people of Lakhimpur and Dhemaji districts of Assam and home to a wide range of flora and fauna including the endangered Gangatic Dolphins (Wakid, 2009). The Subansiri river provides habitats such as stream, riparian zones, wetlands etc. in its downstream for living biota. These wetlands, stream and riparian zones are habitats of live indigenous fishes and migratory birds, aquatic plants, amphibians. IUCN red listed Gangatic Dolphins (*Platanista gangatica gangatica*) species of mahseer (*Tor*) and habitats of many indigenous deep water rice varieties (Hazarika, et al.,2008).

Under the above background information, the present investigation was undertaken to reveal the natural and anthropogenic hazards of the river. The present study on Subansiri river is attempted to examine the environmental changes that might occur after the construction of2000 MW hydroelectric project in the river.

Results and Discussion

Following are the main hazards both natural and anthropogenic of the river which were observed during this investigation -

1. **Flood:** This is the natural hazard in the downstream areas of the river. The most important factor of flood in Subansiri basin is the heavy and prolonged monsoon rainfall. The prolonged nature of the monsoon rainfall in these parts causes heavier flood. Historical data of flood of Subansiri river was officially recorded after the great earthquake in 1950. Narrow gorge and easy blocked of the river channel are other two causes of flood in this river and its adjoining areas in the districts of Lakhimpur and Dhemaji. Flood comes two to four times from May to August every year based on rate of rain fall which causes uncountable damages to the people of the both banks of the river. All the income sources of the fishers as well as other people of this area severely damaged by the flood.
2. **Erosion:** Erosion had been observed severely in this area since the great earthquake in 1950. Monsoon flood, illegal

use of land in hilly areas, illegal collection of sand, stone and gravel are the main causes of erosion. Flood and erosion are two sides of a coin. Erosion occurs during and after the flood. Erosion causes change in physio-chemical properties of the river water such as dissolved oxygen, chemical oxygen demand, free carbon dioxide, total hardness, PH, temperature, turbidity, alkalinity etc. It also makes the water more turbid i.e. prevents the penetration of light, increase sediment load and thus destroys the aquatic habitats of the cold water fishes. Erosion completely damages the agricultural land and its crops. Severe erosion causes bank line migration of the river and widening the catchment area of the river. Most of the villages situated on the bank of the river in Lakhimpur and Dhemaji districts are affected by erosion every year causing untold miseries to the people.

3. **Construction of Dam:** NHPC has been constructed the big dam on Subansiri river at Gerukamukh for generating electricity neglecting the ecology of the river and socio-economic life of the people of the downstream of the river and its adjoining areas. The construction of dam has been blocked the upstream and downstream migration of hill stream fishes which is now recognized as great threat to the icthyodiversity of the river. The proposed dam causes a real threat to the fresh water biodiversity of the downstream of Subansiri river basin by the registration of the river through diversion, impoundment and reducing water discharge to the main river stream. Until recently, the Subansiri river was considered as one of the safe havens for residential dolphin locally known as SIHU due to relatively healthy down stream environment coupled with awareness of riverbank communities (Hazarika et al., 2010). Fears for the future of the river dolphin in this river are rising after the launch of hydro-electric dam on this river.
4. **Use of Fertilizers and Pesticides:** Though artificial fertilizers, pesticides used less in agricultural fields of this area in comparison to other areas, a small amount of such chemicals are continuously discharging into the water of this river. Continuous discharging of such chemical substances

causes the mortality of plankton, fishes and other aquatic flora and fauna. Use of fertilizers and pesticides also affects the water parameters such as dissolved oxygen, chemical oxygen demand, free carbon dioxide, total hardness, PH, turbidity, alkalinity etc.

5. **Use of Explosive and Poisons:** During this investigation it was observed that fishes were killed illegally by using explosive and poisons in Subansiri river. Use of explosives and poisons leads to the death of aquatic organisms. The feeding and breeding grounds are also completely damaged by such types of illegal activities.
6. **Over Exploitation of River Resources:** Over exploitation of fishes, sand, stones etc. in upstream and downstream of the river Subansiri is another important hazard. It causes to destruction of fish stocks and threatens some valuable coldwater fishes. Illegal collection of sand and stone from the river bed causes the destruction of breeding ground of fishes (Sarmah and Dutta, 2017).
7. **Lack of Awareness:** During this investigation it was observed that the most of the people of the villages adjoining the bank of the river are not aware about the river health and ecology. They are yet to learn the importance of river resource conservation. The important point to remember is that changes in river ecology and environment are the primary means by which livelihood and development aspects are linked (Rao, 2006). Shortage of trained manpower in this areas is another cause of lake of awareness.
8. **Other Hazards:** Water of Subansiri river is mainly used for fishing, paddy farming, forestry, lemon farming, cattle wading. Stone, sand, gravel and soil collection from the river bed in large scale are the other hazards of the river observed during the study. Idol immersion during festival, vehicle washing, bathing, cloth washing, discharge of sewage are other hazards of the river. (Sarmah and Dutta, 2017)

Conclusion

Violation of environmental laws is a common practice in this region. Fishing was one of the most important economic activity in Subansiri river. Due to the deteriorations of water quality as well as the lowering of water level, this activity

is being threatened to a great extent. So, it is the time to total ban on poisoning, dynamiting, fishing during breeding season, violation of environmental laws, dam construction over exploitation of river resources etc. and should be enforced immediately for conservation of fish resources in Subansiri river.

References

- Das, J. D. (2004) : Active tectonics of the Eastern Himalayan foothills region and adjoining Brahmaputra basin based on satellite images, *International Journal of Remote Sensing*. 25 (3) : 549 - 557.
- Hazarika, L.P.; Barua, D. & Borah, S., 2008 : Pre dam inv*estigation on the ornamental fishes of the downstream of Subansiri river basin, Proceding of National Seminar on Wetlands and livelihood,* JN College, Boko, Assam, India, pp 158 - 164.
- Hazarika, L.P.; Barua, D.; Bakalial, B.; Borah, S.; Dutta, R.; & Biswas,S.P., (2010) : Dams doom endangered Ganges Dolphin and a traditional indigenous knowledge system of human-dolphin co-operative fishing in the Subansiri river, North Eastern India, *Proceding of National Seminar on Ecology and Socio-economic consequences of Large Dams,* Lakhimpur Girls' College, Khelmati, Lakhimpur, Assam, India, pp 86 - 96.
- Gogoi, C. and Goswami, D. C. (2013) : A study on the bank erosion and bank line migration pattern of the Subansiri river in Assam using remote sensing and GIS technology. The *International Journal of Engineering and Science (IJES)*, 2 : (9) pp. 01 - 06.
- Goswami, D. C., (2002) : Channel pattern, Sediment transport and Bed regime of the Brahmaputra river, Assam. In: *Recent Advances in Geomorphology, Quaternary geology and Environmental Geosciences : India. Case Studies* (eds. S. K. Random and B. Thakur), Manisha Publication, New Delhi, pp. 143 - 156.
- Sarmah, P. and Dutta, A., (2017) : *Fish and Fisheries of Subansiri river, Assam*. An Ph.D. thesis , Gauhati University, Assam, pp. 124 - 128.
- Rao, V.V.R., (2006) : *Hydropower in the North East potential and harnessing strategy frame work*. Draft Discussion - June 2006 - background paper no. 06.
- Wakid, A. (2009) : Protection of Endangered Ganges Rivers Dolphin in Brahmaputra river, Assam, India. *Final Technical Report to Sir Peter Scott Fund. IUCN*

◆ ◆ ◆

9.

Climate Changes and Food Sustainability: Implications on Food Security

Anukriti*

Introduction

What we eat influences our climate. This statement might seem like an exaggeration but our food choices are inextricably linked to the future of the planet. Despite so many technological advancements in the 21st century, sustainable eating has been a constant challenge. Even more so, the availability of natural resources is being constantly affected by unsustainable practices.

Some foods such as meat and dairy are associated with a huge climate footprint and are responsible for generating over 14.5% of the world's greenhouse gases every year. [1]

There has been evidence of disrupted food supplies in various continents across the globe owing to the unprecedented changes in biodiversity and natural ecosystems. One such instance occurred in parts of East Africa and Southwest Asia where swarms of locust destroyed crops because of unexpected

***Research Scholar, Department of Human Development and Family Studies, Babasaheb Bhimrao Ambedkar University A Central University, Lucknow.**

heavy rains. [2,3]

Climate change has been worsening over decades if not centuries. At the same time, the environmental impact has been leading to a further decline in food security rates. The situation is worse in countries with high poverty and hunger rates. Arid, semi-arid and small island states are the most vulnerable to the effects of climate change on food security. This, in turn, has contributed to new risks such as the impact on the livelihood of people in those areas, health issues, and unstable food prices [4,5,6]

To meet the global demands of food consumption, it is imperative to address the climate change crisis and expand our efforts to ensure food security. These enormous challenges need a strategic action plan to reduce anthropogenic greenhouse gases (GHG) emissions - which are at 30% due to ongoing agricultural practices and deliver food security. [12,13,16]

The Concept of Healthy, Sustainable Diets

The term 'Sustainable diets' refers to the dietary pattern that is accessible, healthy, affordable, and safe with a fairly low environmental impact. A sustainable and healthy diet aims to promote optimal growth and well-being of individuals with adequate nutrition and safety. At the same time, a sustainable diet is based on minimal processing to reduce the risk posed on climate and is rooted in practices that help preserve biodiversity and maintain greenhouse emissions. [22,25]

Additionally, sustainable diets should be easily accessible as well as affordable. They should also be culturally acceptable and equitable so that unintended socio-cultural consequences can be avoided.

A healthy and sustainable diet should ideally encompass all environmental, physical, mental, and socio-cultural aspects of all living generations to promote overall planetary health. [21]

Impacts of Climate Change on Agriculture

Climate change has profoundly impacted agriculture and continues to do so in many ways. However, the severity of impact differs from region to region. Climate change has resulted in changes in temperatures on a global scale. This further makes it difficult to make accurate weather predictions as the effects are unevenly impacting the planet.

Other negative impacts include the changes in average rainfall and extreme weather events such as cyclones, floods, heatwaves, and hurricanes. Due to the variability in precipitation, it is tedious to make accurate models for rainfall predictions. Additionally, extreme climate events are making it difficult to secure a good crop year after year. Droughts and water shortages are common events that make it unsuitable to cultivate and produce crops in certain regions. [26]

Changes in atmospheric carbon dioxide have been affecting the quality of yield as it has increased the distribution of weeds which are further competing with the main crops. As a result, many regions across the globe are experiencing lower yields year after year. For instance, many regions of tropical grasslands have been gravitating towards more arid climates and losing farmland. This is negatively impacting the crop

yield and eventually raising the concerns of food security.[27]

The accelerated effects of climate change can be seen mostly in economically weak countries and regions. For example, sub-Saharan Africa reported a huge loss of arable land area which accounts for a staggering loss of 10 to 20 million hectares of land for double cropping and about 5 to 10 million hectares for triple cropping systems. These changes have a subsequent impact on agriculture with a plethora of negative outcomes including food insecurity.

With agricultural lands becoming less and less productive, many other ill effects can be seen which include -

- ❖ Loss of biodiversity
- ❖ Economic and social consequences
- ❖ Migration
- ❖ Displacement of livestock
- ❖ Increase in yield variability
- ❖ The disappearance of plant and animal species
- ❖ Increased food imports

These situations are further exacerbated when economically weak countries lack technical and economical capacity to handle such threats. This is also leading to a widening gap between developed and developing countries.

Agriculture is highly vulnerable to temperature shifts. Increasing temperature encourages weed proliferation which, in turn, reduces the crop yield. Elevated temperatures also make it hard to undergo pest management. This implies that farmers have to use more pesticides to combat pests and save their crops. Heatwaves caused due to rising temperatures are negatively affecting the crop cycle. The plants' life cycles are altered and high transpiration rates are leading to increased wilting in plants. As a result, crop yield loss is common. Even though irrigation can compensate for such losses, it is not a feasible solution for countries with limited irrigation supplies.

Climate changes have created water shortages and their availability for agriculture. With the consistent rise in temperatures, irrigation needs are anticipated to increase in near future. Heavy rains, on the other hand, can cause floods and threaten food security. Waterlogging can prove detrimental

to the soil structure as well as crop yield.

The development of aquaculture has increasingly been impacted by climate change. Both marine and freshwater environments are susceptible to prevalent changes in the environment and resulting in physical and chemical changes such as the impact on oxygen concentration, salinity, storm systems, temperature fluctuation on the water surface, to name a few.

Coral reef bleaching and migration of various fish species have been impacting the marine potential on a global scale. Severe disturbances in the availability of various marine catches have been reported by researchers.

There is a dire need for serious agricultural innovations to effectively deal with climate changes and produce resilient varieties that can tackle fluctuating temperatures and water conditions. While researchers are already working on such hybrid crop varieties, it might take years, if not decades to develop.[30]

Impact of Agriculture on Climate Change

The relationship between agriculture and climate change is interdependent. Agriculture is one of the leading contributors to anthropogenic GHG emissions. In addition to that, the increasing conversion of forest areas into farmlands is further worsening climate change.

According to the estimates, the agriculture sector has contributed to over 22% of global greenhouse emissions in 2010. These emissions are very hard to detect and measure therefore, it is even harder to control them. In absence of a strong and stringent measure, it is difficult to mitigate the issues posed by the ongoing agricultural practices on climate change and food security.[1]

Keeping 'sustainability' at the forefront, it is crucial to set changes in motion that can help solve the problems of increasing GHG emissions. While it may take time to see these changes in effect, it is nevertheless good for the planet in the long run.

There are different sources of greenhouse gases within agriculture with livestock alone accounting for over 44% methane, 53% nitrous oxide, and 5% carbon dioxide emissions.

Methane is primarily produced due to rice fields and digestive processes in cattle. Nitrous oxide results as a by-product from using fertilizers in the crops or manure. Carbon dioxide has a comparatively small emission value and it mainly results from powering the machines used for farming.

One effective way to successfully reduce GHG emissions is by reducing emissions of food output. The sustainable management of crop production and livestock can further help to manage climate change to a good extent.

This calls for actionable steps such as restoring soil's organic capacity, improving manure and grazing management, reduced food transportation, among others.

Developing Climate-Smart Agriculture

Aside from being a contributor, agriculture can also work as a potential solution to combat climate change and its ill effects. The radical transformation in the agricultural industry can be brought by simple practices to make sustainable and healthy diets available for all.

The Climate-smart agriculture (CSA) approach helps create an enabling environment to transform the current agricultural system to fulfill three main objectives -

- ❖ Achieve sustainable agricultural productivity
- ❖ Building resilience to climate change
- ❖ Reduce or remove GHG emissions

Most of the developing and under-developed countries thrive on agriculture for their livelihood. Therefore, farmers are the most impacted due to the undue effects of climate change. Climate-smart farming techniques can help farmers to better tackle the effects of climate change on their crop yield and income. Fishers also need to be educated on these practices to better adapt to climate changes.

Climate-smart agriculture is not a one-size-fits-all technique but an approach that may differ concerning the geographical region. Experts need to analyze and assess the impacts of climate change on a particular area to be able to identify the right strategies that will help create an enabling environment for the agriculture sector and enhance food security. Next, the practices need to be implemented through the support of local

projects and institutions that can help impart knowledge to farmers and encourage the adoption of climate-smart strategies for farming and fishery. [23,24]

Navigating the Concept of Austainability

Sustainability practices have been followed since the 1980s and are advancing over time. But the overall impact largely depends on the underlying vulnerabilities of the system. These vulnerabilities have increased with time impacting environmental integrity. Several reports suggest an ongoing increase in food shortage crisis, soil degradation, depletion of the underground water table, and more.

Poorer countries are at much greater risks and it is economically challenging to navigate sustainability. With their livelihoods impacted by climate change and limited access to resources, such communities are highly exposed and continue to be so. The only feasible way to cope is to migrate to a different geographical location.

Ensuring food nutrition in sustainable terms is another challenge. Those who are largely dependent on natural resources for farming or food supplies are in dire need of social protection policies and programs that help protect their livelihood in the event of a climate change crisis.

Therefore, taking that big leap from a food system to a 'sustainable food system' will require drafting a framework to address key issues and get positive outcomes.

Drafting a working plan of action for a sustainable food system is not enough. It needs to be followed by a successful implementation to get desired, favorable outcomes as elaborated in **Table 1.**

Factors	Current food system scenario	A sustainable and healthy food system
Outcomes	Diet can be healthy or unhealthy and not necessarily sustainable	Diets should follow the sustainable and nutritional guidelines
	Human health should be at the core of food security	Human health should be at the core of food security
	It may be processed and have a negative environmental impact	Should be less processed with the lowest possible or no environmental impact
		Should follow sustainable environmental practices to have a positive impact on local biodiversity and ecology

Impacts	May have positive or negative impacts on the food system	Minimized negative impacts
	Negatively impacts environment	Work towards conservation of environment
	May or may not improve the economic situation of cultivators from food system activities	Work towards the improvement of socio-economic welfare
	Does not consider cultural adequacy of the food system	Considers culturally adequate food system
Compensation	Gravitates toward finding a win-win arrangement	Food sustainability is at the central core of the system
Goal	Entails a relatively linear food system that may or may not follow an action-oriented approach	To attain food sustainability and food security at a global scale through a holistic approach

Expected Outcomes

To avoid the devastating impacts of climate change on food security, it is of paramount importance to sift the focus on nutrition and sustainable farming practices. Strategies for disaster risk management and disaster risk reduction (DRM/DRR) are required for proactive management of natural events to decrease their effects.[27,28]

Agricultural systems need to implement local measures to be more resilient towards climate change and stay productive. A major area of concern is that the livelihood of people inhabiting the area prone to climate change should not be affected. Investments and social protection policies are necessary to tackle such problems and result in sustainable outcomes.

Communities	Issues/Indicators	Sustainability Objective	Recommended Solutions
Agriculture	Depletion or reduction of natural resources as a result of unsustainable agricultural practices; energy and land use	Emphasis on animal welfare and nutrition within the food systems	Sustainable and climate-smart agriculture to be used as the guiding principles for achieving a fine balance between sustainability and productivity
Value chain for nutrition	The efficiency of the value chain measured in terms of finances or income with little to no focus on nutrition	Sustainability is defined through the ecological dimension which has a limited scope	Ensuring the availability of affordable nutrition to the target groups especially poor and economically weak sections

Ecology	Threats to food security due to the combined effects of climate changes in the context of social, political, and economic changes	Focus on three core dimensions of sustainability - ecological, economic, and social	Broadening the concept of sustainability within food systems by a thorough analysis of food production, distribution, and consumption on food security
Nutrition	Impact of climate changes on nutrition and quality of food groups	Follows a limited approach by focusing on only the environmental dimension of sustainability	Encourage policies that ensure the 'right to food' for all and adopt the framework of sustainable practices on a large scale to improve nutrition

Table 2 explains how different systems with specific objectives can bring about sustainable outcomes.

For instance, building a resilient food system requires adapting changes in crop management and effective use of scarce resources. Since climate change is largely affecting the average rainfall, it is important to adopt measures like water harvesting, improvement in irrigation technologies, and improve soil's water retention to make efficient use of water as a resource.

Soil management also helps improve the quality of soil thereby increasing its productivity. For instance, reduced tillage is a practice that involves minimal soil disturbance by keeping the crop residue to remain intact and retains carbon levels in the soil. This sustainable practice can help farmers improve their soil health and save time and money on extra labor.

By considering the use of more tolerant crop varieties or one with broader tolerance to different environments, a productive crop yield can be maintained. Diversifying varieties of crops can also prevent the risk of crop failure. Such strategies have been able to increase crop yield between 7 to 15% depending on the region and choice of crop. After harvesting the crops, attention should also be paid to how those crops are stored to prevent them from getting spoiled.[31]

Reducing food wastes accounts for over 8% of GHG emissions which need to be addressed. Switching to sustainable and healthy diets and reduced meat consumption may help reduce the global carbon footprint.

For the ecosystem to be healthy and sustainable, it should be better able to cope with negative stressors and biotic or abiotic influences. Some examples of the best practices that can maintain diversified and sustainable forest systems include - forest fire management, pest management, reduce the impact of livestock grazing in forests, restoration of degraded forest lands, and permitting forest activities at sustainable levels. The practice of Agroforestry practiced across Latin and Central America involves creating 'carbon sinks' in croplands and pastures to conserve them from soil erosion. It also helps promote the diversity of species.

At the landscape level, the physical features of an area need to be taken into consideration to improve the coping capacity. Actions such as zone management, erosion control, fire management, water storage management, and disease control can improve the lives of communities inhabiting that area while ensuring optimal food production within the food system.

R&D investments to improve food nutrition followed by an action plan to make it accessible, as well as affordable, will play an essential role in eradicating hunger and supporting sustainable development in the long run. Policies will be required to enable access to insurance, low-interest credits, and financial services to reduce financial risks for farmers. Exchange of knowledge about sustainable food systems on local and international levels can educate farmers and prepare them better against economic and environmental shocks.

Apart from the agricultural, socio-economical, and environmental aspects, there is an increasing need for strategies for behavioral changes to impart education to the consumer as well. This will ensure that consumers understand the impact of their diets on climate change and ensure an effective approach to counter it. Educating individuals will make them aware of various aspects of nutrition and the safety of sustainable diets for the planet as a whole.

The recent Food Systems Summit was held on 23 September 2021 during the UN General Assembly in New York under the leadership of Secretary-General António Guterres. The summit proposed landmark solutions to accelerate sustainability

efforts and achieve Sustainable Development Goals (SDGs) by 2030. The summit spurred the conversation encompassing various aspects of food security and nutrition with the concept that 'food is more than what we eat.' The discussions covered multi-dimensional objectives spanning sustainable food production and effectively develop holistic solutions to enhance productivity and resilience of food systems on an international scale. Achieving the SDGs will transform the future of food systems and show improvement in three fundamental areas - People, Planet and Prosperity.

The five key action areas discussed in the summit include -

- ❖ Nutrition for all
- ❖ Equitable livelihoods
- ❖ Build resilience to environmental and ecological shocks
- ❖ Nature-based solutions
- ❖ Accelerate implementation on the ground level

The coordination hub includes government, public and private bodies to jointly collaborate on the development of strategies and ensure their implementation to support the objectives set by the Food Systems Summit.

Conclusion

Understanding the cascade of risks posed by climate change on agriculture production, ecosystem, nutrition, and the economy is crucial to preventing its long-term effects. The changes on the ground level are needed to protect the most vulnerable populations and reducing the net effect on food security as well as nutrition.

By careful and thorough assessment of risks, we can plan strategies and put policies in place to cater to all dimensions of sustainability - social, economic, and environmental in a balanced manner. Such strategies to integrate food security and nutrition should also be supported with nationwide or worldwide implementation to enable adaption. The paradigm shift is needed to mitigate climate change and its impacts on future generations and safeguard food security for one and all.

References

1. Allen, T., & Prosperi, P. (2016). Modeling sustainable food systems. Environmental Management, 57, 956–975.
2. Bilic, M. ABC de Nutritie; Curtea Veche: Bucures¸ti, Romania, 2016; ISBN 978-606-588-852-4.
3. Brundtland, G. H. (1987). Our common future, Report of the World Commission on Environment and Development. World Commission on Environment and Development.
4. Burlingame, B., and S. Dernini. 2012. Sustainable Diets and Biodiversity: Directions and Solutions for Policy, Research and Action. International Scientific Symposium, Biodiversity and Sustainable Diets United Against Hunger, FAO Headquarters, Rome, Italy, 3–5 November 2010. In Sustainable Diets and Biodiversity: Directions and Solutions for Policy, Research and Action. International Scientific Symposium, Biodiversity and Sustainable Diets United Against Hunger, FAO Headquarters, Rome, Italy, 3–5 November 2010. Food and Agriculture Organization of the United Nations (FAO).
5. Cembalo, L.; Lombardi, A.; Pascucci, S.; Dentoni, D.; Migliore, G.; Verneau, F.; Schifani, G. "Rationally Local": Consumer Participation in Alternative Food Chains: Consumer Participation in Alternative Food Chains. Agribusiness 2015, 31, 330–352.
6. Dubé, L., Webb, P., Arora, N. K., & Pingali, P. (2014). Agriculture, health, and wealth convergence: Bridging traditional food systems and modern agribusiness solutions. Annals of The New York Academy of Sciences, 1–14. https://doi.org/10.1111/ nyas.12602. Issue: Paths of Convergence for Agriculture, Health, and Wealth.
7. FAO UN. Dietary guidelines and sustainability. In Sustainable Diets and Biodiversity; FAO UN: Rome, Italy, 2010.
8. Gillespie, S., & van der Bold, M. (2017). Agriculture, food systems, and nutrition: Meeting the challenge. Global Challenges 1. https://doi.org/10.1002/ gch2.201600002.
9. Global Panel on Agriculture and Food Systems for Nutrition. (2016). Food systems and diets: Facing the challenges of the 21st century. London, UK, p. 133.
10. Herforth, A., & Ahmed, S. (2015). The food environment, its effects on dietary consumption and potential for measurement within agriculture-nutrition interventions. Food Security, 7, 505–520.
11. Haddad, L., & Hawkes, C. (2016). A new global research agenda for food. Nature, 540, 30–32.
12. HLPE. 2017. Nutrition and food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.
13. http://www.fao.org/climate-smart-agriculture-sourcebook/concept/module-a1-introducing-csa/chapter-a1-1/en/
14. http://www.fao.org/climate-smart-agriculture-sourcebook/concept/module-a1-introducing-csa/chapter-a1-3/en/
15. Johnston, J.L., Fanzo, J.C. and Cogill, B., 2014. Understanding sustainable

diets: a descriptive analysis of the determinants and processes that influence diets and their impact on health, food security, and environmental sustainability. Advances in Nutrition 5(4), 418–429.

16. Lang, T., & Barling, D. (2012). Food security and food sustainability: Reformulating the debate. The Geographical Journal, 178(4), 313–326. https://doi.org/10.1111/ j.1475-4959.2012.00480.x.
17. Nikolic´, A.; Uzunovic´, M.; Spaho, N. Lifestyle pattern underlying organic and traditional food consumption.
18. Br. Food J. 2014, 116, 1748–1766.
19. Pollan, M. In Defense of Food: An Eater's Manifesto; Penguin Press: New York, NY, USA, 2008; ISBN 978-1-59420-145-5.
20. Petrini, C. Food & Freedom: How the Slow Food Movement Is Changing the World Through Gastronomy; Rizzoli Ex Libris Publishing House: New York, NY, USA, 2015; ISBN 978-0-8478-4685-6.
21. Popkin, B.M. Global nutrition dynamics: The world is shifting rapidly toward a diet linked with noncommunicable diseases. Am. J. Clin. Nutr. 2006, 84, 289–298.
22. Pretty, J. (2008). Agricultural sustainability: Concepts, principles and evidence. Philosophical Transactions B: Biological Sciences, 363, 447–465.
23. Perignon, M., Vieux, F., Soler, L.-G., Masset, G., & Darmon, N. (2016). Improving diet sustainability through evolution of food choices: Review of epidemiological studies on the environmental impact of diets. Nutrition Reviews, 75(1), 2–17.
24. United Nations (UN) General Assembly. (2005). 2005 World Summit Outcome, Resolution A/60/1, adopted by the General Assembly on 15 September 2005.
25. Scholliers, P. Novelty and Tradition. The New Landscape for Gastronomy. In Food. The History of Taste; Freedman, P., Ed.; California Studies on Food and Culture, # 21; University of California Press: Berkeley, CA, USA; Thames and Hudson: London, UK, 2007; pp. 332–357; ISBN 978-0-520-25476-3.
26. Stroia, A.; Din, M.L. Analysis of the effects of modernity on traditional Romanian food behavior. Forum Ware Int. 2011, 1, 227–234.
27. Teodoroiu, F. Traditional Food. Case Study: Romanian Local Food. Rev. Manag. Comp. Int. 2015, 16, 256–268.
28. United Nations (UN) General Assembly. (2005). 2005 World Summit Outcome, Resolution A/60/1, adopted by the General Assembly on 15 September 2005.
29. Urban, T.N. Agricultural Industrialization: It's Inevitable. Choices Mag. Food Farm Resour. Issues 1991, 6.
30. Velten, S., Leventon, J., Jager, N., & Newig, J. (2015). What is sustainable agriculture? A systematic review. Sustainability, 7, 7833–7865.
31. Wallace, D. Sustainable Industrialization; Routledge: London, UK, 2019; ISBN 978-1-351-38285-4.

10.

Analysis of Corporate Social Responsibility Viz-A-Viz Environment Impact Assessment

Mr. Ahtshamuddin Ansari*

Introduction

The supporters of Milton Friedman School of Thought[1] may find it nothing more than a big talk that there could be any social responsibility of a corporate organization, which has been formed, with the motive of maximizing profits and doing business.

Similarly, it is also presumed that State is the strongest potential human right violator and accordingly, the Article 13 of the Indian Constitution has been interpreted so far in the judicial pronouncements. But since recent times, such presumptions and thoughts have been made subject to scrutiny

1. **In his book "Capitalism and Freedom" 1962, Milton Friedman advocated for minimizing the role of government in a free market as a means of creating political and social freedom and said that there is one and only one social responsibility of business-to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud.**

***Assistant Professor and Head of Department, College of Law, IIMT University, Ganga Nagar, Meerut.**

especially in wake of expansion of private sector. Such a rethinking is necessary because today, in the present scenario, expansion of private organizations is a reality and therefore, their functioning in the society cannot be overlooked.[2]

In this respect, one crucial kind of responsibility, which can be studied separately from other human rights responsibilities is that related to environment. In pursuance of business, the corporate bodies tend to disregard the effect of their activities on the immediate environment and this disregard itself becomes the reason responsible for several other problems related to both human beings and the environment in general.

The *raison de etre* of most business organizations is to make money, perhaps as much of it as possible. This is not an immoral objective in itself, but neither is it necessarily a moral one.[3] However, there is a growing discourse, of much wider concept of corporate responsibility and accountability, not just among philosophers or social critics but also in the business community itself.[4] Under the present discourse on human rights, business is seen as accountable to not just the shareholders but also the 'Stakeholders'.

Another important question is why Corporates are implementing CSR practices because of the compulsion of Law. Companies often use CSR practice to gain reputation and public opinion about their business. Various corporate scams have revealed deceptions and proved that different external pressure groups put pressure on companies for proper implementation of practice of CSR. Due to a pressure from stakeholders that companies be more transparent about the company's business, some legislations and obligatory reports are being laid down. CSR benchmarks against which the social and environmental

2 In his "Corporate Citizenship" (1998) Malcolm McIntosh argued that for many people responsible corporate citizenship is only an ethical issue, but actually there are also compelling arguments for adopting a responsible approach.

3 Tom Campell, "Moral Dimensions of Human Rights", Human Rights and the Moral Responsibilities of Corporate and Public Sector Organizations 11-30 (2004).

4 Doreen Mc Barnet, "Human Rights, Corporate Responsibility and the New Accountability", Human Rights and the Moral Responsibilities Of Corporate And Public Sector Organizations, Tom Campbell and Seumas Miller (Eds.) 63 (2004)

performance of businesses can be measured and compared are useful to provide transparency and facilitate an effective and credible benchmarking. The interest in benchmarks has resulted in an increase of guidelines, principles and codes during the last decade[5].

The financial benefits of Environmental CSR activities are not immediately visible and in spite of heavy expenditure on Environmental CSR activities. A large number of researches have a goal to investigate connections between environmental CSR activities and their economic performance and public opinion. Some results show that business environment trade-offs has positive impact on economical results in companies[6]. Other authors criticize these results because they find that companies do not sacrifice their profit for environment protection on voluntary basis, because there is no positive connection between present expenses and later gains[7]. External stakeholders pressurizes that companies adhere to the environmental standards in their operation. The sole objectives of Environmental CSR is to take responsibility for current activities and do not jeopardize the needs of future generations.

Porter and Linde suggest that in a broader sense, CSR environmental activities can trigger innovation, reduce costs, save resources thus making competitive advantage and loyal consumers[8]. Aside from pollution prevention, companies must think about environmental improvements in order to achieve higher resource productivity. Resource productivity means energy savings, labour improvements and efficiency in the use of raw materials as well as control and reduction of waste. If investment in environmental protection actually increases

5 European Commission. Green paper, Promoting a European framework for corporate social responsibility, Brussels, European Commission, 2001.

6 S. Waddock, S. Graves, The corporate social performance–financial performance link, Strategic Management Journal 18, (1997), 303–319.

7 M. Wagner, N. Van Phu, T. Azomahou, W. Wehrmeyer, The relationship between the environmental and economic performance of firms: an empirical analysis of the European paper industry, Corporate Social Responsibility and Environmental Management 9, (2002), 133–146.

8 M.E. Porter, C. van der Linde, Toward a New Conception of the Environment Competitiveness Relationship, The Journal of Economic Perspectives 9, no. 4, (1995), 97-118

profitability, is it necessary to have regulations? Regulations should be enacted and improved by companies, governments, different organizations and international counterparts.

Reputation Risk Management

Managing risk is a central part of many corporate strategies. Reputations that take decades to build up can be ruined in hours through incidents such as corruption, scandals or environmental accidents. These events can also draw unwanted attention from Regulators, Courts, Governments and Media. Building a genuine culture of 'doing the right thing' within a corporation can offset these risks.[9] In Nigeria, the Shell Company's operations came under criticism for its oil extraction exercise and it was seen as a Public Relations Disaster which was followed by Shell's plan to dump its Brent Spar Oil rig at sea.

In this context, the new philosophy of corporate social responsibility adopted by the company[10] can be seen as a response to a very old way of crisis management. Importance of reputation has been implicit in factors such as public relations crisis management.[11]

Thus, Corporate Social Responsibility is a part of process of managing the costs and benefits of business activity to both internal and external stakeholders. It is interesting about Bhopal, which can be called a gross instance of corporate environment "Irresponsibility", it is also observed that it has influenced corporate behavior on health, safety and environmental issues and has pushed back the frontiers of the law on Corporate Social Responsibility.[12]

---

9 Available at http://www.ksg.harvard.edu/m-rcbg/CSRI/publications/workingpaper_10_kytle_ruggie.pdf (Last visited on 17/01/2021)

10 As is evident from the language used in its First Annual Social Report, which reads as, "…how we, the people companies and businesses that make up the Royal Dutch/Shell Group are striving to live-up to our responsibilities-financial, social and environmental".

11 Doreen Mc Barnet, "Human Rights, Corporate Responsibility and the New Accountability", Human Rights and the Moral Responsibilities Of Corporate And Public Sector Organizations, Tom Campbell and Seumas Miller (Eds.) 74 (2004)

12 See Remarks by Ved P. Nanda, 79 American Society of International Law Proceedings 303, April 25-27 (1985)

Corporate Environment Responsibility and EIA

Environment Protection constitutes a precondition for the effective enjoyment of human rights protection. The two concepts have become interlinked and interdependent now. Synergies have developed between these previously distinct fields.[13] In fact, some hold it strongly that there is the obvious relationship among the environment, economic development and human rights that occurs with global problems involving the shared concerns of health, safety and individual well-being.[14] It is certainly reasonable to claim that development is about improving the quality of life and, therefore, inappropriate development is development inconsistent with basic human rights.[15] It is further reasonable to claim that development at the expense of environmental quality is detrimental to our human condition.[16]

Corporate Social Responsibility is a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis and from this has emerged the concept of Corporate Environmental Responsibility (hereinafter, CER). CER signifies the environmental commitments of the companies through material and energy management and a transparent working within ecological limits.

An Environmentally responsible company aligns its business with ecological principles and can be expected to abide by the following[17]

- Embraces sustainability and the 'precautionary principle';
- Adheres to and goes beyond government regulations;
- Uses the Earth resources efficiently;

13 Prof. G.S. Karkara, Human Rights, Development and Environmental Law: An Anthology, S.C. Shastri (Ed.) 52 (2006)

14 Panelists: Robert E. Lutz, Ibrahim Shihata, David Wirth, Philip Anston, Stephen C. Mc Caffffrey, John Porter and John Warren kindt: "Environment, Economic Development And Human Rights: A Triangular Relationship?", 82 American Society of International Law Proceedings 40 (April 20-23, 1988)

15 Id at 41.

16 Id at 41.

17 "Defining Corporate Environment Responsibility"; Available at http://www.pollutionprobe.org/Reports/cerreport.pdf **(last visited on 12/11/2021)**

- Internalizes environmental costs and benefits; and
- Measures and regularly reports the results and impact of its activities on the environment and so on.

Out of these, the CER assessment tools of measuring, auditing and reporting are important and indispensable from the point of view of obtaining information on the status of environmental policy of companies. The phrase 'Environmental Impact Assessment comes from Section 102 (2) of the National Environmental Policy Act (NEPA), 1969, USA. EIA is an effort to anticipate measure and weigh the biophysical changes that may result from a proposed project. It assists decision-makers in considering the proposed project's environmental costs and benefits. Where the benefits exceed the costs, the project can be viewed as environmentally justified.[18]

EIA is an important management tool for ensuring optimal use of natural resources for sustainable development. It is a formal study process used to predict the environmental consequences of any development project. EIA thus ensures that the potential problems are foreseen and addressed at an early stage in project planning and design.

Environment Impact Assessment (EIA) As a Tool and Version of Precaution

At its core, the precautionary principle of the environmental law is a risk management theory that elaborates on the simple command "show me". It decides whether the regulator or the regulated must be "shown". It decides whether "show" means proof to a scientific certainty or scientific consensus, a scintilla of evidence, a wild hunch, or some other standard.[19] It decides when the showing is to start, when it must be completed, what the consequences of not showing are, what roles the regulators and the regulated have in the process of showing, and whether showing should protect the public interest primarily under a liability model or a preventive model.[20]

---

18 **Shyam Divan and Amin Rosencranz, Environmental Law and Policy in India 417 (2001)**

19 **Phillip M. Kannan, "The Precautionary Principle: More Than a Cameo Appearance In United States Environmental Law?" 31 William and Mary Environmental Law and Policy Review 409 (Winter, 2007)**

20 *Ibid.*

The precautionary principle has been adopted in such a widespread fashion that it is now difficult to find in either the international environmental arena or countries with advanced environmental protection frameworks, an environmental policy document, a new environmental law, or even a political statement about environmental management that does not include a reference to the principle or reflect some of the core ideas of the precautionary concept.[21]

The precautionary principle or approach is generally understood to include three elements: "fully assessing possible impacts of an action, shifting the burden of proof to those whose activities pose a threat to the environment, and not acting if there is significant uncertainty or risk of irreversible harm.[22] The first two elements are procedural, and the third is substantive. And Environment Impact Assessment (EIA) is the most rational vehicle of the precautionary principle because it is a practice, which is appropriate for considering precaution; namely, whether to proceed with development proposals in situations where uncertainty exists about future environmental effects.

Judicial Pronouncements and EIA and CSR

In India, while examining the issue whether mining activity in an area up to 5km. from Delhi-Haryana border on the Haryana side of the ridge and also in Aravali hills causes environment degradation. The Supreme Court of India in a PIL in *M.C. Mehta v. Union of India*[23] held that the precautionary principle requires anticipatory action to be taken to prevent harm. The harm can be prevented even on a reasonable suspicion. It is not always necessary that there should be direct evidence of harm to the environment.

---

21 Warwick Gullett, "The Precautionary Principle in Australia: Policy, Law & Potential Precautionary EIAs", 11 Risk: Health, Safety and Environment 93 (Spring, 2000)

22 See Charmian Barton, "The Status of the Precautionary Principle in Australia: Its Emergence in Legislation and as a Common Law Doctrine", 22 Harvard Environmental Law Review 509-515 (1998); also see Phillip M. Kannan, "The Precautionary Principle: More Than A Cameo Appearance In United States Environmental Law?" 31 William and Mary Environmental Law and Policy Review 409 (Winter, 2007)

23 AIR 2004 SC 4016

The precautionary principle has been again affirmed and well explained by the Supreme Court of India in *Andhra Pradesh Control Board v. M.V. Nayadu*[24]wherein it was held that 'the principle of precaution involves the anticipation of environmental harm and taking measures to avoid it or to choose the least environmentally harmful activity. It is based on the scientific uncertainty. Environment protection should not only aim at protecting health, property and economic interests but also protect the environment for its own sake. The principle suggests that where there is identifiable risk or serious irreversible harm, it may be appropriate to place the burden of proof on the person or entity proposing the activity that is potentially harmful to the environment'.

Justice Bharucha's dissenting opinion in the *Narmada Bachao Andolan v. Union of India*[25]Case highlighted the importance of EIA of the Narmada Sagar Project in absence of which he judged that the construction work on the dam should cease. Perhaps, this view of the honorable Judge is one of the first explicit and elaborate judicial recognition of EIA wherein it conveys that EIA should not be run on the discretion of the administrative branches of the government because it derives its strength from the law itself.

In the case of *Mohd. Ahmed (Minor) v. Union of India & Ors*[26], it was held that the Central and State Governments can certainly tap the resources of the civil society to provide healthcare access to the poor and unprivileged. The Governments can and should attract donations to the healthcare sector. Both CSR and donations need to be made particularly attractive for pharmaceuticals and other companies involved in the sector, as the drugs, implants and devices required are often very expensive and inaccessible to the common man.

In another case of *D. Narayanasamy v. The District Collector*[27], it was held that one of the important features of the new amended Companies Act 2013 is the mandate for companies of a certain size and minimum profitability to undertake Corporate Social Responsibility. In a study conducted by the

24 AIR 1999 SC 812

25 AIR 2000 SC 3751.

26 2014 SCC Online Del 1508.

27 Writ Petition No.61 of 2009.

Business Standard in January 2013, it was found that 457 out of 500 companies on the BSE 500 Index will have to provide for Corporate Social Responsibility.

In the case of *Mr. Sandeep Shah v. State of Rajasthan & Ors*[28]. it was held that Corporate Social Responsibility of a mine industry include:

(a) Regular health check up camps for the workers engaged in mines shall be organized;

(b) Occupational health surveillance program of the workers shall be undertaken periodically to observe any contractions due to exposure to dust and take corrective measures, if needed;

(c) Insurance cover to all workers engaged in mines shall be provided;

(d) Common vocational training center shall be set up at district level.

In the case of *Amrit Cement Industries Ltd. v. The State of Meghalaya and Ors*[29]. the petitioner-company had entered into Agreements and Memorandum of Understanding with some village authorities committing Corporate Social Responsibility initiatives for the welfare of local residents by way of setting up of a higher secondary school, dispensary, drinking water facility, merit scholarship to deserving candidates for pursuing further education and production-based contribution to the village fund for carrying out development projects, etc.

In *Dr. Md. Rezaul Karim & Ors. v. The State of West Bengal & Ors.*[30] it was held that any clinical establishment which has received land or other facility from the Government during initiation and in course of continuance of their projects shall be responsible to provide completely free treatment to 20 percent of Outdoor Patient Department patients and 10 percent of Indoor Patient Department patients in such manner as may be prescribed as part of their Corporate Social Responsibility.

Politics of EIA Notifications in India: Dilution of Law

A beginning was made in our country with the impact

28 Civil Writ (PIL) Petition No.11584/2013.

29 W.P. (C) No.395/2013.

30 W.P. No. 14039 (W) of 2017

assessment of river valley projects in 1978-79 and the scope was subsequently enhanced to cover other developmental sectors such as industries, thermal power projects, mining schemes, etc. Prior to January 1994, EIA in India was carried out under administrative guidelines, which required the project proponents of major irrigation projects, river valley projects, power stations, ports and harbors, etc. to secure a clearance from the Union Ministry of Environment and Forests.

On 27th January 1994, the Ministry notified mandatory EIA under Rule 5 of the Environment (Protection) Rules of 1986 for 29 designated projects. The notification made it obligatory to prepare and submit an EIA, an Environment Management Plan (hereinafter, EMP) and a Project Report to an Impact Assessment Agency for clearance. The Ministry of Environment and Forest was designated as the Impact Assessment Agency which was required to consult a multi-disciplinary Committee of experts.

Environmental Assessment is to be taken up in this exercise as a rapid assessment technique for determining the current status of the environment and identifying impact of critical activities on environmental parameters. Based on this analysis, the Ministry of Environment and Forest can draw up an Environmental Management Plan that would ensure impact monitoring and mitigation planning.[31]

But, most unfortunately these attempts to create a successful strategy for commercial environmental compliance (through EIAs, in case of India) have been unsuccessful due to the voluntary nature of existing guidelines and at the end of the day, they remain mere "soft law" recommendations.[32]

Right to Development Vis-À-Vis the Right to Clean Environment

If they are in clash then the balance that needs to be struck is in favor of the development at the cost of environment at

---

31 Available at http://envfor.nic.in/divisions/iass/iass.html Environmental Assessment Division, Ministry of Environment & Forests, Government of India (Visited on: 07/11/2021)

32 See, Sophie Hsia, "Foreign Direct Investment and the Environment: Are Voluntary Codes of Conduct and Self-Imposed Standards Enough?" 9 Environmental Lawyer 673 (June 2003)

least in the present time in India. Though there is no legally recognized right to development, this right limits the application of the right to environment.[33] Probably, more than any other jurisdiction on Earth, the Republic of India has fostered an extensive and innovative jurisprudence on environmental rights.[34] But, EIA process has been seen as anti-development and therefore, not being implemented properly. And, there have been both practices and arguments either to counter the establishment of EIA procedures or to avoid/evade them.

The dramatic surge of private investment capital into emerging foreign markets, while assisting developing countries in the struggle for sustainable development, has created greater pressures on the environment.[35] The intense competition for international capital contributes to the lack of adequate environmental regulation because of the fear of pricing out of international investments, resulting in pollution havens and environmental malfeasance.[36]

EIA Notification 2006: Doubtful Attempts of Decentralization

On September 14, 2006, the Ministry for Environment and Forests (MEF) issued a notification replacing the earlier EIA law, despite furious lobbying and campaigns by Environmental Organizations and some parliamentarians in the weeks preceding this notification.[37]

In 2005 the Ministry of Environment and Forests published a note that the Environment Clearance Process shall be "re-engineered" and this was being thought as a step towards bringing the improvements needed in the EIA process also. But when the notification was issued in 2006[38], the law got further weakened. The major difference in the new EIA Notification 2006 from the earlier one of 1994 is its attempt to decentralize

33 M.R. Anderson, Human Rights Approaches to Environmental Protection: An Overview, 19-20 (1996)

34 Ibid

35 Supra Note 23

36 Ibid.

37 Bharat Jairaj, "EIA 2006 leaves much to be desired", The Hindu (September 23, 2006)

38 Available at http://envfor.nic.in/legis/eia/so1533.p0df (last visited on 18/01/2021)

power to the State Government.[39]

The new EIA law categorizes projects as A and B, for the purpose of clearance by the Centre or State respectively. While, 'decentralization' effort is appreciated, the handing over of the EIA evaluation responsibility to the state governments without any system of checks and balances is unacceptable. In several projects, for e.g., thermal power plants up to 500MW, State Governments directly promote the project and in fact, compete with each other to seek more investments.[40]

The area where there could have been major improvements in environment clearance process, i.e. public consultation, the new EIA notification is a major disappointment. The public consultation as was earlier done will still be conducted at the end of the environment clearance process where there is very little scope for the public to play any active role.[41] The new EIA law also exempts several projects from the EIA process. Construction projects less than 20,000 square meters and new townships less than 50 hectares, for instance, are exempted from going through the EIA process. In its zeal to implement the Govindrajan Committee recommendations to expedite the entry of FDI into the country, the Ministry has committed a serious mistake in prioritizing time limits over the "precautionary principle".[42]

The focus of the New Notification has been to reduce the time required for the entire environment clearance process. There seems to be no justification for this and may result

39 The terms of reference (TOR) of the project will now be decided by the State Environment Appraisal Committee (SEAC) at the State level and by Environment Appraisal Committee (EAC) at the Central level. The matter will be decided on the basis of the information provided by the proponent. If needed the SEACs and EACs would visit the site, hold public consultation and meet experts to decide the TOR. The final TOR has to be posted in the website for public viewing. Though this seems good on paper, however, the proponent itself is providing the information for finalization of TOR and moreover there is no compulsory provision for public consultation. Further, if the EAC does not decide the TOR within the stipulated time, the project proponents can go ahead with their own TOR.

40 *Ibid.*

41 See,http://www.cseindia.org/programme/industry/eia/existing_notification.htm **(Visited on 10/10/2021)**

42 Ibid.

in compromising on the efficiency and transparency of the clearance process, which was quite evident from the earlier notification even though the process had more time.[43]

Importance of Public Participation in EIA

An ideal Environment clearance process requires that there are "frequent public involvement provisions, full access to information, the right to appeal to an independent third party, the full involvement of interested and affected parties and an explicit decision making role for the public." Public participation deserves attention because the degree of participation affects the quality of the environmental impact analysis process, which, in turn, affects the quality of the decision about a project.[44]

Broader participation creates more information and alternatives to be presented to decision makers, enhancing the opportunity to mesh public values and government policy.[45]

The public needs to be aware of the procedures for participation in environmental decision-making, have free access to them and know how to use them. But he Environmental Public Hearing (EPHs) process that began from 1997 in India fails to make any necessary changes in the project. This is because, industries violate the legal provisions and go for hearing only after their projects have become functional and not prior to it, as is mandatory.[46]

Years after they were first introduced, public hearings continue to be organized with an extremely casual and token approach. In a public hearing for opencast mining proposed in Bandurang (Jharkhand) on 25th February 2004, the EIA and Environment Management Plan were not made available prior

---

43 The earlier process took around 14-19 months for Rapid EIA and 21 to 28 months for comprehensive EIA. As per the new notification, the category A project will be completed only in 10.5 to 12 months. See, http://www.cseindia.org/programme/industry/eia/existing_notification.htm **(Visited on 10/10/2021)**

44 Willaim A. Tilleman, "Public Participation In The Environmental Impact Assessment Process: A Comparative Study Of Impact Assessment In Canada, The United States and the European Community" 33 Columbia Journal of Transnational Law Association 337 (1995)

45 *Ibid*

46 "How Public Are 'Public' Hearings?" The Times of India, Ahmedabad (January 30, 2002)

to the hearing, clearly violating what law otherwise mandates.[47]

EIA ensures good CER practice and is far the most powerful and well-known regulatory measure in India. But unfortunately EIA procedure in India remains half-hearted. The principal flaw is that Ministry of Environment and Forests has an inadequate machinery to monitor whether or not the conditions are met. Due to the weak incorporation of it in the legislation, there is little or no jurisprudence on the principle.

The EIA process must be triggered where there is uncertainty regarding the possibility of serious environmental impact. Although the parameters of environmental uncertainty are elusive, particularly at the larger scale, guidelines could be prepared to render this threshold operable. This is where more work on risk assessment and uncertainty analysis needs to be undertaken.[48] To be sure, the EIA process can be contentious when countervailing interests use EIA studies to emphasize their various positions. In a democracy, however, it is better to have the reasoned examination of those contending views in the factually informed context of EIA than to ignore them or treat them exclusively as political views.[49]

Conclusion

Environmental Assessment enables us in carrying out Environmental Cost-Benefit Analysis of projects at an initial stage. It is thus, a pre-cursor to detailed analysis of environmental impacts, which are taken up only if a need for the same is established. It gives a view of the actors involved in the development-environment linkages. This is required in view of the fact that the community at large is always at a loss in terms of deterioration of living environment that accompanies industrial development. Based on Environmental Assessment, the regulatory measures can be identified and the roles of concerned agencies defined for achieving more efficient

47 **Kanchi Kohli "An impacted assessment process" (April 2004) Available at** www.indiatogether.org/2004/apr/env-eiarules.htm **(Visited on 10/10/2021)**

48 **Warwick Gullet, "The Precautionary Principle in Australia: Policy, Law & Potential Precautionary EIAs", 11 Risk: Health, Safety and Environment 93 (Spring 2000)**

49 **Nicholas A. Robinson, "International Trends In Environmental Impact Assessment", 19 Boston College Environmental Affairs Law Review 591 (Spring 1992)**

environmental management.

In view of the fact that development is an ever-growing process, its impact on the environment is also ever increasing, leading to rapid deterioration in environmental conditions. As such, Environmental Assessment provides a rational approach to sustainable development and therefore should be made more effective.

India's current emphasis on economic development seems to eclipse its environmental protection efforts. But the combination of strong legislative mandates, an activist judiciary, aggressive public interest litigators, and a proliferation of highly committed environmental NGOs means that India is no longer the haven it once was for industries indifferent to environmental values.[50] Thus, one may hope that the history of environmental degradation that has characterized investment in India's power and industrial sectors has begun to slow.[51]

The biggest problem facing India's environment is not a lack of environmental laws. Nor is it a lack of precedent to protect our environment. The single biggest issue facing India's beleaguered, yet resilient environment today is the failure of the Indian government to adequately enforce existing environmental laws.[52]

The public needs to be aware of the procedures for participation in environmental decision-making, have free access to them and know how to use them. Years after they were first introduced, public hearings continue to be organized with an extremely casual and token approach. EIA ensures good CER practice and is far the most powerful and well-known regulatory measure in India. But unfortunately EIA procedure in India remains half-hearted. The principal flaw is that Ministry of Environment and Forests has an inadequate machinery to monitor whether or not the conditions are met.

---

50 Armin Rosencranz and Kathleen D. Yurchak, "Progress On The Environmental Front: The Regulation Of Industry and Development In India", 19 Hastings International and Comparative Law Review 489, (Spring 1996)

51 *Id.* At 527

52 Book Excerpts from M.C. Mehta, "The Accountability Principle: Legal Solutions To Break Corruption's Impact On India's Environment" 21 Journal of Environmental Law and Litigation 141 (2006)

Due to the weak incorporation of it in the legislation, there is little or no jurisprudence on the principle.

The EIA process must be triggered where there is uncertainty regarding the possibility of serious environmental impact. Although the parameters of environmental uncertainty are elusive, particularly at the larger scale, guidelines could be prepared to render this threshold operable.

◆ ◆ ◆

11.

Risk of New Technologies on the Environment

Dr. Rajesh Kumar*

Introduction

No doubt we are living in a world of technologies and technology has become a part and a parcel off our life. With the passage of time new technology coming in our daily life. Now it has become difficult to live withouttechnology. But we cannot deny using these technologies everyday which disturbs the environment day by day. These technologies have coasted of the environment which we think to use new technical devices to make easy work.

Which we use in daily life to make easy life Smart phones, electrical devices, laptops and tablets etc. Modern electronic devices have made life comfortable. These devices have changed the status of human beings.

The emerging technologies in one hand are very attractive for positive and social change but on the other hand they are great threat to our environment and also health.

***Assistant Professor, Department of Mathematics, Upadhi (P.G.) College Pilibhit.**

Many international organizations and countries have come forward to make aware of this risk Leader of many countries have held meetings to minimize the effect of technologies on the environment.

Theft and Espionage

With the advancement of new technologies, there has been increase of theft and espionage. So, the technologies bring rewards to some and the great loss to others. Wemention some examples of theft and espionage here.

A government property have been converted by the scientist in 2014 Lianyu Huang for the foreign commerce. Huang, a U.S. citizen from China brought sensitive information with him. Similarly in July 2016 much property of a company has been stolen by few men in Taiwan just like an intellectual property. 3D printing and other new higher technologies poses new risks too countries like China and America are often accused to be engaged in espionage Not only countries ever the leaders and rich people are also engaged in intellectual theft and espionage.

Loss of Control and Sabotage

The new technologies are also responsible for the loss of control and Sabotage.Hackers target internet and also control the account of many private and government agencies. They can take the secret information and either destroy it or use it for their benefit. For example, Hackers theft a large portion of internet in 2016. On dams in measuring water levels the sensors are used can be manipulated by new technology. It may be a great threat to environment. The new risks are created by artificial intelligence for the militaries of many nations.

Terrorism and Weapons of Mass Destruction

The new technologies has also enhanced terrorism and weapons of mass destruction now a days the terrorists use new technology for the destruction .They have sophisticated weapons which make their work easy .

The most notable technological development of the 20th century is the nuclear fusion which is a great threat to environment and the health of the human being. Now a day's more energy just created by these new technologies in the world, they fulfill of panic relation and fear of cyber theft and

nuclear weapons.

Technologies and Pollution

New technologies which are being used in the field of industry ,have brought a great development in this field but together they have also enhanced pollution which make adverse effect on our environment .These technologies have divided the world in two steps one is pollution and second is depletion of the natural resources. Air pollution occurs harmful gases such that carbon dioxide, methane, Sulphur dioxide, nitric oxide and carbon mono oxide are introduced in to the earth'satmosphere.

The consequences of air pollution negative health impacts for living beings it also increases the global warming to raise water pollution. Water pollution is the cause of different types of diseases such as typhoid and destroys ecosystem and many types of fiver`s. Which makes negative effect upon the food chain? Depletion gives the negative impact of the new technologies on the environment for resources.

Mining for Minerals

When analyzing the technologies cost on the environment it is important that what materials should be used to making them and where those materials came from. Much natural resource and precious metals are used into making the electronic devices and other new technology. This indefinite drain of the natural resource also creates a great risk to the environment. The disposal of the used electronic devices also creates a threat to environment**.**

Technology and Radiation

The new technologies are also responsible for radiation and this radiation is a great risk for our environment. It is often seen that birds are dying day by day because of this radiation created by the new technologies. This also makes bad effect to our ecosystem and disturbs food chain. Radiation also causes negative effect upon the plants and crops. We know very well that our lives depend upon the health of trees. If they are not healthy how we can live wealthy. In this process goes on, that day is not very far when the ecosystem food chain, trees and plants will be healthy affected and disturbed.

This disturbance also makes negative effect upon every living creature directly or indirectly. Radiation is responsible for the abnormal growth of plants and living being .it is also the cause of different diseases .Radiation steals the peace of mind of the human being and they are becoming more and more violent .this violent nature of human being is a great risk to atmosphere where they live.

Conclusion

In many ways the new technologies are boon for human beings but they are the curse to our environment. They enter risk and affect environment badly.

The present time country has taught us the scientific technology can be our greatest friend and our worst enemy.

It is also true that now we cannot live without technology and technology also creates risks to our environment. What we should do now? We must use technology with wisdom to reduce the risk of environment.

References

1. Zeltmann, S.E.Gupta ,N.,Tsotsos,N.G. et al. Manufacturing and Security Challenges in 3D Printing . JOM (2016) 68: 1872. Doi.1007 /s11837 -016-1937-7.
2. Fear and Loathing .Economist ,jan 1,2005 p 7.
3. Nakajima, N, Nishi C; Li,F.M. ikada,Y photo induced cytotoxicity of water soluble fullerene .Fullerene Sci .Technol 1996,4,1-19.
4. Radford ,Y.Prince sound new nanotech alert .Guardian ,Londan,july 12, 2004 p 10.
5. Feder ,B.from Nanotechnology sidelines ,one more warning New York times ,late ed, New York ,March 29,2004,p C5.
6. Newm,an, Lily H. 2016 December 9, Wired .com. The Botnet that internet is not going away.
7. Clark,C (2016,August 8) Artificial intelligence Drone Defeats Fighter Pilot The future ? BreakingDefense.
8. Meyerson,B (2015, March 4) Top 10 emerging technologies of 2015 .
9. Nanotechnology Now (2008, May) Daughter suspects poisoning in death.
10. Ledford, H. (2015, June 3) CRISPER, the disruptor. Nature, 522(7554).

◆◆◆

12.

Biosensors for Environmental Monitoring

M. Kanthimathi*
S. Kanimozhi**

Introduction

Monitoring the environment is very important which is related t o monitoring of human health system. Ecosystem monitoring refers to determining of physical, biological and chemical variables over a period in order to give information on the environmental changes. It can be possible only by careful observation that we can measure the issues arise in our natural resources and decide the science-based management. Environmental measuring is also used in the preparation of environmental impact assessments (EIA), as well as in many circumstances in which anthropogenic activities causes hazardous effects to the environment. The purpose of environmental measuring is to find the quality of the environment and to make a comparative analysis between the past and the present. It is easy to make decisions for many companies, governmental and private organizations

***Sri Paramakalyani Centre for Environmental Sciences, Manonmaniam Sundaranar University, Azhwarkurichi, Tamilnadu, India.**

****Department of Biotechnology, Bharath Institute of Higher Education for Research, Selaiyur, Chennai, India.**

for ensuring company's compliance with environmental regulations, to find risks to human and wildlife and it is also used to reduce the environmental pollution. The quality of air, water and soil in the environment also monitored. Development of inventive analytical tools those are rapid, sensitive, specific and eco-friendly to reduce the environmental pollution. A powerful analytical technique is biosensors compared to other conventional techniques.

Biosensors are used for monitoring the condition of environment has gained much attention (Mehrotra 2016). It monitors the quality of air, water and soil by checking the various contaminants present in it. A very low concentration also detected by using biosensor for protecting the environment (Rodriguez-Mozaz et al. 2006). The analytical device of biosensor detects the contaminant that is chemical substance which is combined with biological element with the help of physicochemical detector (Turner et al. 1987, Banica et al. 2012, Dincer et al 2019). In this, enzyme, antibody and nucleic acid are example for biological component which is communicates via analyte being tested and therefore the biological elements replies are often become an electrical signal using the transducer. These sensors are advanced within the conditions of selectivity also as sensitivity. The main features of biosensors are sensitivity, stability, cost, and reproducibility.

Biosensors used for environmental monitoring have several advantages over other conventional systems and methods, mainly its portability, miniaturization and measurement of a pollutant with minimal samples (E. Gieva, 2014). A various contaminants like chemical, hazardous materials and toxins in soils and water ecosystem are detected by using biosensor regularly (Kimmel et al. 2007).. Recent development of nanoparticles incorporated with biosensor for enhancing the various parameters like sensitivity, stability, reliability, lower detection limit and validity (Malekzad et al. 2017) (Fig. 1).

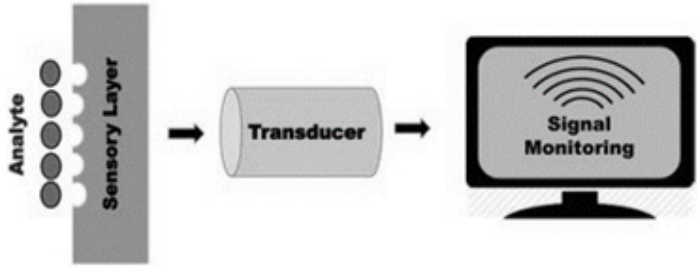
Components of Biosensor

The biosensor consists of a sensitive biological component that incorporated with analyte, transducer or detector and reader. The biological element can be tissues, microbes, cells, enzymes, etc. which is either a materials are derived from

biologically or biomimetic element produced by bioengineering methods that can specifically interacts with the analyte. The physicochemical detector or transducer helps to transform the biological signals that results from incorporation between the biological component and analyte into an signal. There are numerous kinds of transducers are available, among them optical, acoustic calorimetric, potentiometric, amperometric and piezo-electric transducers are commonly used (Zakir Hossain 2019). The reader device helps in signal processing and that are used to display results which can be measured and quantified (Cavalcanti 2008).

Fig:1

Components of a Biosensor



Types of Biosensors Used in Environmental Monitoring

Biosensors are grouped into two categories such as biological component/element and transduction element/component. Biological components are enzymes, antibodies, biological tissues, DNA and micro-organisms. Antibody-based biosensors are termed as immuno sensors. In the affinity based biosensor, analyte interact with biological based materials which is present in the biosensor. In metabolism sensor, a chemical change occurred when the interaction taken place between the analyte and biological component. Membrane plays an important role in biosensor which protects the biological element. The main functions of this membrane for selective permeability and control the diffusion of analyte, used to support the biological element and protect against mechanical stress.

The method of transduction element method is based on the types of changes in physicochemical resulting from the sensing element. Transducing element are often categorised as follows

such as

- **Electrochemical**: Most generally used electrochemical transducers are amperometric and potentiometric transducers. The electrodes used in amperometric transducer are metals like platinum, gold, stainless steel, silver or carbon like materials. These materials are inert when the electrochemical reactions occur. Fix the potential between two electrodes and the electric current formed by oxidation or reduction process is measured which is associated with the concentration of the analyte.
- **Optical**: Enzymes and dyes (fluorescent) are immobilized on the tips of fibre optic probes are used. There are two fibres in optic probes. One fibre produces excitation wave when it is connected to light source at any given wavelength. Other fibre detects the optical density at particular wavelength when it is connected to a photodiode.
- **Calorimetric**: Its measure the temperature of a reaction at the sensing element. These devices are divided according to transformation of heat. Isothermal calorimeters maintain the reaction temperature at constant level using Joules and its measure the amount of energy required. Heat conduction calorimeters used to measures the changes in temperature between the reaction cell and isothermal temperature sink surrounding it.

Biosensors are classified based on the biorecognition principle as follows such as:

- **Enzymes**: Enzymes are biological component have been used to examine the concentration of different analytes based on their specificity. The commercially available enzymes are highly pure and they can be widely used for mass production of enzyme sensors. It has some limitations like ionic strength, pH, chemical inhibitors and temperature.
- **Antibodies**: Antibodies is a biological sensing element used to measures the antibodies which show specific selectivity. Antibodies are synthesized by the B lymphocytes when foreign material i.e. antigen interacts to the organism. These foreign materials like larger molecule trigger the immune response for the production of antibodies. But small molecules such as vitamins or hormones are haptens

which could not stimulate immune response if it is not react with lager molecules like proteins i.e. bovine serum albumin (BSA). Various commercially available antibodies are used for detection methods like immunoassays.

- **Microbes**: Micro-organisms are used as bio recognition element in the biosensor. The measurement is based on the metabolism of micro-organisms. In the metabolism of micro-organism, oxygen consumption or releasing of CO_2 was takes place which is measured electrochemically.

Application of Biosensors in Environmental Monitoring

BOD Measurement

Biochemical oxygen demand (BOD) is one of the processes for the water to determine the requirement of oxygen for degrading the organic materials. But it has a limitation such as time consuming process. This limitation can be overcome by using biosensor based method for determination of BOD. The measurement of BOD based on the respiration rate of bacteria to the transducer in BOD biosensor. Multiple sample analysis also can be done by using BOD sensor. It is used in industries for waste water treatment process. Optical biosensor has been established by Nga Yan Kwok et al (2005) for BOD determination in waste water process. Optical biosensor, sense the oxygen film which is immobilized on sample cell for determine the concentration of oxygen dissolved in waste water. Sample vials loaded with microbes which is immobilized on oxygen sensing film and determine the BOD value from the amount of oxygen consumption by *Escherichia coli* (Rodriguez-Mozaz et al., 2006, Robarts et al 2007)

Heavy Metal Measurement

The most serious problems in the environment are heavy metal pollution. Heavy metals are non-biodegradable and very low concentrations of heavy metals are serious hazardous materials to the environment and also human health. It causes severe damage to human health including increase the mortality rate when people exposed on these pollutants. A various types of bacterial biosensors were established for the analysis heavy metals in the environment. It uses specific genes which is responsible for bacterial resistance to biological receptors. A various number of metals have been isolated such

as copper, zinc, tin, silver, cobalt and mercury as an example for biological receptors (Ademola et al 2020).

Nitrogen Compound Measurement

Nitrites are extensively used for soil fertilization to growth the plants. However, causes severe health problem for the human by the continuous use of nitrates for fertilization applications. Because it's directly affects the normal function of haemoglobin. It is also harmful to aquatic environment by increasing the rate of nitrites in the surface water and ground water. An amperometric biosensor was established for the analysis of nitrite using enzyme such as cytochrome c nitrite reductase (ccNR) derived from *Desulfovibrio desulfuricans* that are incorporated and connected to carbon electrode by entrapment process. This biosensor exhibited a quick response of nitrite within five seconds. A very quick, highly sensitive and stable enzymatic biosensor also used for the analysis of nitrites in water (Dhewa, 2015; Xiao, 2010).

PCBs Measurement

The amount of Polychlorinated Bis Phenyls present in the environment is purely depends on its source from where it is originated. Nearly 209 PCB congeners exist worldwide which is is distributed in environment and pass through each trophic levels of Food Chain and Food Web. Based on chlorine moieties PCBs are classified into three main types viz. Coplanar, non coplanar and mono/ortho coplanar. Conventionally PCBs are analysed with the help of GC-MS techniques Moreover, immunoassay techniques, are sensitive, specific, simple and reliable for PCBs testing. Among them, the ELISA with Calorimetric detection is widely used. Immunobiosensors are also another existing approach which uses antigens, antibodies and biological recognition elements. To analyse PCB congeners concentration in soil, a novel piezoelectric immunosensor was developed (Pribyl et al, 2003).

Multi-Analyte Determination

Biosensors have the ability to determine several analytes, allows fastest and low volume samples and other required chemical reagents and it is qn important tool for environmental monitoring. Large scale biosensors has a miniaturised signal transducer, that helps in real time monitoring and it

plays a key role in research field. Now a days multi analyte determining biosensors, portable surface plasmon resonanse immunosensors are mainly used for onsite analysis. An another surface plasmon resonance biosensor that is specially designed with a prism element which divides the radiation into several wavelengths on serial sensing channel, which is used for the analysis of 2 - hydroxybisphenyl and benzopyrene. For the multi compound and single compound analysis, a planar array immunosensor was developed which has a diode laser as a light source and a charge coupled device was used as a detector. In this type of biosensor, both a single and multiple analyte can be analysed simultaneously (Mansour et al 2019).

Table 1:
Summary of Recent Biosensors Used for Environmental Monitoring

Analyte/ Pollutant identified	Types of Biosensor	Biorecognition element	Electrode or Sense materials	Limit of detection	References
Pathogens Escherichia coli	Piezoelectric (Quartz crystal microbalance)	Polymerizable form of histidine	Gold substrate	1.54 X106 CFU/ml	Idil et al., 2017
	Electro-chemiluminescence (Optical)	Antibodies (Polyclonal)	Glass carbon electrode with polydopmine imprinted polymer and nitrogen doped quantum dots	80 CFU/ ml	Chen et al., 2017
Legionella pneumo-phila	Single plasmon resonance (Optical)	Antibodies (Polyclonal)	Gold substrate with protein A assembled monolayer	103 CFU/ ml	Zhang et al., 2017
Bacillus subtilis	Amperometric (Electrochemical)	Antibodies (Polyclonal)	Gold electrode with Single walled carbon nanotubes	102 CFU/ ml	Yoo et al., 2017
Pesticides Carbofuran	Amperometric (Electrochemical)	Enzyme AChE	Glass carbon electrode with NiO nanoparticles-carboxylic graphene composite	0.5pM	Yang et al., 2013
	Voltammetric (Electrochemical)		IrOx-chitosan nanocomposite	3.6nM	Jeyapragasam et al 2014

Methyl parathion	Amperometric (Electrochemical)	Enzyme Acetyl choline Esterase (AChE)	Graphite and micro algae	1.5-1.8 ng/ml	Nunes et al., 2014
	Impedimetric (Electrochemical)	Enzyme hydrolase	Screen printed electrode with Fe3O4 and gold nanoparticles	0.1ng/ml	Zhao et al., 2013
Paraoxon	Voltametric (Electrochemical)	Enzyme butyryl cholinesterase	SPE with carbon black nanoparticles	5 µg/l	Arduini et al., 2015
	Calorimetric (Optical)	Enzyme AChE and Choline oxidase	Iodine- Starch	4.7ppb	Guo et al., 2017
Carbaryl	Impedimetric (Electrochemical)	Enzyme AChE	Interdigitated array microelectrodes with chitosan	3.87nM	Gong et al 2014
	Impedimetric (Electrochemical)		Gold electrode with cysteamine monolayer	32nM	Santos et al 2015
Atrazine	Field efficient transistor (Electrochemical)	Antibodies (Monoclonal)	Single walled carbon nanotubes	0.01ng/ ml	Belkhamssa et al., 2016
Pathogens Escherichia coli	Piezoelectric (Quartz crystal microbalance)	Polymerizable form of histidine	Gold substrate	1.54 X106 CFU/ml	Idil et al., 2017
	Electro-chemiluminescence (Optical)	Antibodies (Polyclonal)	Glass carbon electrode with polydopmine imprinted polymer and nitrogen doped quantum dots	80 CFU/ ml	Chen et al., 2017
Legionella pneumophila	Single plasmon resonance (Optical)	Antibodies (Polyclonal)	Gold substrate with protein A assembled monolayer	103 CFU/ ml	Zhang et al., 2017
Bacillus subtilis	Amperometric (Electrochemical)	Antibodies (Polyclonal)	Gold electrode with Single walled carbon nanotubes	102 CFU/ ml	Yoo et al., 2017
Heavy metals Hg2+	Fluorescence (Optical)	DNA	Metal organic framework (UiO-66-NH2)	17.6nM	Wuu et al., 2016
	Evanescent – wave optical fibre (Optical)	Nucleic acids	Optical fibre platform	1.2 nM	Gao et al., 2017

Pb2+	Flourescence (Optical)	DNAzymes	Carboxylated magnetic beads	5 nM	Ravikumar et al., 2017
			Graphene quantum dots and gold nanoparticles	16.7 nM	Niu et al., 2018
		Aptamers	Micro spin column	61 nM	Chen et al., 2018
Endocrine disrupting chemicals Bisphenol A	Fluorescence (Optical)	Aptamers	Gold nanoparticles	0.1 ng/ml	Wang et al., 2015
			Molybdenum carbide nanotubes	0.23 ng/ml	He et al., 2017
	Evanescent (Optical)		Optic fibre surface	0.45 ng/ml	Yildirim et al., 2014

Recent Advancement in Biosensors for Environmental Application

The environmental biosensors that were designed with improved characteristics of novel nanomaterials and nanocomposites got more attention with focus on the realtime pollutant detection combined with other techniques. Nowadays environmental monitoring became a field of interest for application with drones in agricultural surveillance, air and water quality monitoring, volcanic gas emission measurements etc. Biosensors including aptasensors, immunosensors, enzymatic biosensors and genosensors have reported for monitoring different environmental pollutants using antibodies, enzymes, proteins and nucleic acid as recognition elements. A brief summary of various biosensors used in environmental monitoring was provided in Table 1. A compact whole cell biosensor was incorporated with drones to check the quality of air and control water pollution in remote areas (Lu et al, 2015). The future environmental monitoring system depends on conjugation of drones and biosensors for remote access due to their cost effectiveness, portability an low power consumption (Chouler, 2019).

Conclusion

Conventional analytical techniques, though highly specific, suffer from various disadvantages like high cost, skilled labour and are mostly laboratory bound. Biosensors because of their fast response time, specificity, low cost, portability

and user friendly are highly recommendable one than any other analytical techniques. Their biological base makes them ideal for toxicological measurements in health, safety and environmental applications. Commercial application of biosensors is still limited due to several factors such as the cost, detection range, leakage of biological elements etc. scientists must consider those factors when designing the advanced biosensors in future. Advances in biotechnology, nanotechnology, microfluidics, and other fields are promising and can be used to improve biosensor technologies. Even though, there are significant advancement in this field, a lot more has to be accomplished and a long way to explore.

References

1. Adekunle A, Rickwood C and Tartakovsky B (2020). Online monitoring of heavy metal–related toxicity using flow-through and floating microbial fuel cell biosensors. Environ Monit Assess 192: 52.
2. Arduini F, Guidone S, Amine A, Palleschi G, Moscone D (2013). Acetylcholinesterase biosensor based on self-assembled monolayer-modified gold-screen printed electrodes for organophosphorus insecticide detection. Sens. Actuators B Chem. 179: 201–208.
3. Bănică, Florinel-Gabriel (2012). Chemical Sensors and Biosensors: Fundamentals and Applications. Chichester, UK: John Wiley & Sons. p. 576.
4. Belkhamssa N, Justino CIL, Santos PSM, Cardoso S, Lopes I, Duarte AC, Rocha-Santos T, Ksibi M (2016). Label-free disposable immunosensor for detection of atrazine. Talanta. 146: 430–434.
5. Cavalcanti A, Shirinzadeh B, Zhang M, Kretly LC (2008). "Nanorobot Hardware Architecture for Medical Defense" . Sensors. 8 (5): 2932–2958.
6. Chen S, Chen X, Zhang L, Gao J, Ma Q (2017). Electrochemiluminescence detection of Escherichia coli O157:H7 based on a novel polydopamine surface imprinted polymer biosensor. ACS Appl. Mater. Interfaces. 9: 5430–5436.
7. Chen Y, Li H, Gao T, Zhang T, Xu L, Wang B, Wang J, Pei R (2018). Selection of DNA aptamers for the development of light-up biosensor to detect Pb(II). Sens. Actuators B Chem. 254: 214–221.
8. Chouler J, Monti MD, Morgan WJ, Cameron PJ, Di Lorenzo M (2019). A photosynthetic toxicity biosensor for water. Electrochimica Acta. 309: 392–401.
9. Dhewa, T. (2015). Biosensor for environmental monitoring: An update. International Journal of Environmental Research, 3(2): 212–218.
10. Dincer, Can, Bruch, Richard, Costa-Rama, Estefanía, Fernández-Abedul, Maria Teresa, Merkoçi, Arben, Manz, Andreas, Urban, Gerald Anton, Güder, Firat (2019). Disposable Sensors in Diagnostics, Food, and Environmental Monitoring. Advanced Materials. 31 (30): 1806739.
11. Gao S, Zheng X, Wu J (2017). A biolayer interferometry-based competitive

biosensor for rapid and sensitive detection of saxitoxin. Sens. Actuators B Chem. 246: 169–174.

12. Gieva E, Nikolov G, Nikolova B (2014). Biosensors for environmental monitoring. Conference paper, Challenges in Higher Education & Research. 12: 123 – 127.
13. Gong Z, Guo Y, Sun X, Cao Y, Wang X (2014). Acetylcholinesterase biosensor for carbaryl detection based on interdigitated array microelectrodes. Bioprocess. Biosyst. Eng. 37: 1929–1934.
14. Guo X, Sang S, Jian A, Gao S, Duan Q, Ji J, Zhang Q, Zhang W (2018). A bovine serum albumin-coated magnetoelastic biosensor for the wireless detection of heavy metal ions. Sens. Actuators B Chem. 256: 318–324.
15. He MQ, Wang K, Wang J, Yu YL, He RH (2017). A sensitive aptasensor based on molybdenum carbide nanotubes and label-free aptamer for detection of bisphenol A. Anal. Bioanal. Chem. 409: 1797–1803.
16. Idil N, Hedström M, Denizli A, Mattiasson B (2017). Whole cell based microcontact imprinted capacitive biosensor for the detection of Escherichia coli. Biosens. Bioelectron. 87: 807–815.
17. Jeyapragasam T, Saraswathi R (2014). Electrochemical biosensing of carbofuran based on acetylcholinesterase immobilized onto iron oxide-chitosan nanocomposite. Sens. Actuators B Chem. 191: 681–687.
18. Kimmel DW, LeBlanc G, Meschievitz ME, Cliffel DE (2007). Chemical sensors and biosensors. Anal Chem 84(2):685–707.
19. Lu Y, Macias D, Dean ZS, Kreger NR, Wong PK (2015). A UAV-mounted whole cell biosensor system for environmental monitoring applications. IEEE Trans. Nanobiosci.14: 811–817.
20. Malekzad H, Sahandi Zangabad P, Mirshekari H, Karimi M, Hamblin MR (2017). Noble metal nanoparticles in biosensors: recent studies and applications. Nanotechnol Rev 6(3):301–329.
21. Mansour Mahmoudpour, Jafar Ezzati Nazhad Dolatabadid, Mohammadali Torbatib, Aziz Homayouni-Rad (2019). Nanomaterials based surface plasmon resonance signal enhancement for detection of environmental pollutions. Biosensors and Bioelectronics. 127: 72–84
22. Mehrotra P (2016). Biosensors and their applications - a review. J Oral Biol Craniofac Res. 6(2):153–159.
23. Nga -Yan Kwok, Shaojun Dong, Waihung Lo, Kwok yin wong (2005). An optical biosensor for multi-sample determination of biochemical oxygen demand (BOD). Sensors and Actuators B: Chemical. 110 (2): 289- 298.
24. Niu X, Zhong Y, Chen R, Wang F, Liu Y, Luo D (2018). A"turn-on" fluorescence sensor for Pb2+ detection based on graphene quantum dots and gold nanoparticles. Sens. Actuators B Chem. 225: 1577–1581.
25. Nunes G.S., Lins J.A.P., Silva F.G.S., Araujo L.C., Silva, F.E.P.S., Mendonça, C.D., Badea, M., Hayat, A., Marty, J.L. Design of a macroalgae amperometric biosensor, application to the rapid monitoring of organophosphate insecticides in an agroecosystem. Chemosphere. 2014, 111, 623–630.
26. Pribyl J, Hepel M,Halamek J, Skladal P (2003). Development of piezoelectric immunosensors for competitive and direct determination of aztrazine. Sens Actuat B. 91: 333-341.

27. Ravikumar A, Panneerselvam P, Radhakrishnan K, Morad N, Anuradha CD, Sivanesan S (2017). DNAzyme based amplified biosensor on ultrasensitive fluorescence detection of Pb(II) ions from aqueous system. J. Fluoresc. 27: 2101–2109.
28. Robarts RD, Barker SJ, Evans S (2007). Water quality monitoring and assessment: Current status and future needs. Taal 2007: The 12th World Lake Conference, Organized by International Lake Environment Committee Foundation (ILEC), Jaipur.
29. Rodriguez-Mozaz S, Lopez De Alda MJ, Barceló D (2006). Biosensors as useful tools for environmental analysis and monitoring. Anal Bioanal Chem. 386(4):1025–1041.
30. Santos CS, Mossanha R, Pessôa CA (2015). Biosensor for carbaryl based on gold modified with PAMAM-G4 dendrimer. J. Appl. Electrochem. 45: 325–334.
31. Turner, Anthony, Wilson, George, Kaube, Isao (1987). Biosensors:Fundamentals and Applications. Oxford, UK: Oxford University Press. p. 770.
32. Wang Q, Fang J, Cao D, Li H, Su K, Hu N, Wang P (2015). An improved functional assay for rapid detection of marine toxins, saxitoxin and brevetoxin using a portable cardiomyocyte-based potential biosensor. Biosens. Bioelectron. 72: 10–17.
33. Wu LL, Wang Z, Zhao SN, Meng X, Song XZ, Feng J, Song SY, Zhang HJ (2016). A metal-organic framework/DNA hybrid system as a novel fluorescent biosensor for mercury (II) ion detection. Chem. Eur. J. 22: 477–480.
34. Xiao, N. (2010). Using functionalized nanoparticles as sensors for rapid monitoring of drinking water quality. Iowa State University. Retrieved from https://lib.dr.iastate.edu/ etd
35. Yang X, He Y, Wang X, Yuan R (2017). A SERS biosensor with magnetic substrate CoFe2O4@Ag for sensitive detection of Hg2+. Appl. Surf. Sci. 416: 581–586.
36. Yildirim N, Long F, He M, Shi HC, Gu AZ (2014). A portable optic fiber aptasensor for sensitive, specific and rapid detection of bisphenol-A in water samples. Environ. Sci. Process Impacts.16: 1379–1386.
37. Yoo MS, Shin M, Kim Y, Jang M, Choi YE, Park SJ, Choi J, Lee J, Park C (2017). Development of electrochemical biosensor for detection of pathogenic microorganism in Asian dust events. Chemosphere.175: 269–274.
38. Zakir Hossain M and Noureddine Mansour S (2019). Biosensors for on-line water quality monitoring – a review. Arab journal of basic and applied sciences. 26 (1): 502–518.
39. Zhang W, Han C, Jia B, Saint C, Nadagouda M, Falaras P, Sygellou L, Vogiazi V, Dionysiou DD (2017). A 3D graphene-based biosensor as an early microcystin-LR screening tool in sources of drinking water supply. Electrochim. Acta.236: 319–327.
40. Zhao Y, Zhang W, Lin Y, Du D (2013). The vital function of Fe3O4@ Au nanocomposites for hydrolase biosensor design and its application in detection of methyl parathion. Nanoscale. 5: 1121–1126.

13.

Worm Manure Production - A Viable Non-Toxic Nutrient

Nitya Jeeva Prada P*
Ch. Srinivasa Reddy**

Introduction

Eco- friendly worm technology is a valuable source of manure making method nothing but excreta of earthworm is one of the best soil amendments. Red wigglers *Eisenia fetida* (Red earthworm), *Eudrilus eugenia* (night crawler), Perionyx excavates decomposing vegetable or food waste, cattle dung and green litter was vermicasts. Vermicomposting is a high-quality compost that consists mainly of worm casts and decayed organic matter (Devi and Prakash 2015). Earthworms consume cow dung voraciously along with other organic wastes and pass it through their body and in the process convert it into vermicasts. This is the recycling of agricultural wastes, looks like fine peat material having good water holding capacity, aeration and porosity (Edwards et al., 2011) Vermicomposting is an excellent option to restore the nutrient losses with simple technique in a less space and the preparation is accepted as soil booster. Commercially raised worms are usually of

***HOD,Department of Zoology, Maris Stella College, Vijayawada, Krishna District, (A.P.)**

****Assistant Professor, Department of Botany, SRR & CVR Government Degree College, Vijayawada, Krishna District, (A.P.).**

the epigeic type, *E.fetida* can tolerate a wide temperature range (0 and 35 °C). Its cocoons (eggs) have been shown to remain viable after having been frozen for several weeks to handle for rough treatment. Litter-dwelling worms has the capacity for very rapid reproduction rate. So *E. fetida* the natural choice for vermicomposting outdoors, year-round, in climates with harsh winter conditions. Traditional compost usually requires 8-10 months to decompose wastes whereas vermicomposting needs 3-4 months days to fully decompose and it is an excellent growth promoter, protector and sustainable alternative to chemical fertilizer (Sinha et al. 2011; Chauhan and Singh, 2015).

Worm product provides an opportunity to use by small scale farmers because it is a low-cost, quick acting fertilizer environmentally safe solution. According to Singh et al., (2013). Vermicomposting improves the physical, chemical and biological conditions of the soil along with micro and macro nutrients. Large scale production is done at commercial scale by recycling large quantity of organic waste into vermicasts nearly 50 -100 tonnes annually. It helps to convert organic waste like agro-waste, animal manure, litter and domestic refuse into high nutrient fertiliser for soil and plants (Gajalakshmi and Abassi 2004).The increase growing demand for crops creates organic production, cultivation which are perceived to be healthier for consumers and has become environment friendly (Kaplan, 2016).

Research on vermicomposting will provide farmers with an environment-friendly fertilizer and assist in promoting the agriculture sector towards a greener future. The presence of humic acids and plant growth hormones in vermicast can increase plant growth and crop yield in both natural and managed ecosystems. Vermicompost contains essential micronutrients and the nutrient status is in line with that reported by earlier researchers (Ismail 1997; Ansari and Sukhraj 2010; Ansari et al., 2016).Cow dung is a starter for microbial degradation of plant litter and the latter on partial decomposition in presence of cow dung which would normally take 3 to 4 weeks, becomes an excellent food for earthworms which are introduced at the end of 3 to 4 weeks to feed on and grow. Fresh cow dung should not be used as a medium to grow earthworms as their growth and development would not be proper due to lack of adequate aeration. As cow dung undergoes natural degradation i.e., when agricultural wastes are to be converted to vermicompost they are mixed with cow dung. Upon addition of the earthworms, the worm's first start feeding on the residual cow-dung and then go to

feed the agro-waste substrates and quickly convert them into worm compost. Vermicast acts as a buffer, it has a significantly lower volatile solid content and high N, P, and K content which is easily available for the plant.

Materials and Methods

Vermicomposting unit was started at the college campus for the last 5 years with CPE funds. Construction of pucca shed of different stages, viz. building of a vermicomposting bed epigenic earthworm i.e., composting *worms Eisenia fetida* from Nuzvid Mandal, Krishna District and cow dung, coir pith and green litter- dried leaves used were the raw materials used.

Stage 1: Construction of the Composting Bed

A composting bed is rectangular in shape of 50×4×1ft. was built in a shaded area 2 beds were set up. The roof of the unit was made of corrugated Asbestos sheets with underneath gunny bags thatching to ensure a cool environment. The walls of the vermicomposting unit was built of wired mesh to facilitate air flow easily.

- **1st layer**: A basal layer of worm bed comprising broken bricks, then a layer of sand to the thickness of 6-8 cm was set up to ensure proper drainage.
- **2nd layer**: Coconut shells were spread over the first tier which moistened. The earthworms *Eisenia fetida*, their cocoons introduced this layer.
- **3rd layer**: Semi solid cattle dung scattered over the dry leaves
- **4th layer**: The red soil was then covered with cocoon pillar material.

Stage-2 In this stage, two hundred (200) composting earthworms, *Eisenia fetida* (epigeic species), were brought from Krishna vermi unit-Nuzvid,,K.Dt.along with cocoons soil-pillar material.

The earthworms were cultured for 4 months in one unit and were used for the production of vermicomposting from dry leaves and cow manure. 1 tone of cow dung(30 days old) and domestic/kitchen waste and garden waste ie.,(organic waste consisted of 5 kg cow manure and 2 kg dry material) on a two crops basis.

Structure of Red Worm -*Eisenia fetida*

Body length 3-10 cm; Body weight 0.4-0.6g; Maturity 50-55 days-highly prolific breeder. Conversion rate 1.0 q/1000worms/2 months; Cocoon production 1 in every 3 days; Incubation of cocoon

20-23days.Worms have a Muscular, 2-4 microns size Gizzard, acts as grinding mill as it grinds sand and mineral particles finely and allows microbial action.

For the 1 Ton=1000 kg, 1 Quintal=100kg production, bed was set initially placing a basal layer of comprising of broken bricks (3-4 cm) followed by a course sand to a total thickness of 6-8 cm, to ensure proper drainage.15cm moist layer of loamy soil along with coconut coir pith spread over the first layer. The entire unit was covered with banana leaves to protect the earthworms from sunlight and birds. Bed was kept moist by sprinkling of water twice a week and turned once a week, up to harvest of the vermicomposting. The bed was covered with old gunny sacks, 40-60% relative humidity was maintained in the bed.

Chemical analyses Vermicompost (Edwards and Bohlen 1996)

1. Using a pH meter- for pH (Acid and Base balance).
2. Electrical conductivity (MS/cm)
3. Titrimetric method
4. C: N ratio Spectrophotometer.

Compost analysis (Edwards and Bohlen 1996) by Hand separation of earthworms by sieving and the total compost (weight in kg)-weighing balance.

Analysis of Earthworm Castings

It reveal that worm castings are rich in all minerals and but application rates are much lower. But cow dung is a farm yard source i.e., mostly excretory waste of cattle as it contains 90% water, 2.5% urea, hormones, salts, and 2.5% enzymes. It may also contain approx. 12.48% calcium oxide, 0.9% magnesium oxide, 0.3% calcium sulphate, 20% aluminium oxide, 20% iron oxide and 61% silica. So safely it can be introduced in beds and was mixed with the pre-digested substrate in a 3:1 ratio (Yuvaraj et al., 2018) and dumped into the beds. At the beginning of worm composting time , introduce 100 to 200 clitellar *E. fetida* worms, cow dung as feed, green leaves, coir pith and domestic waste were added. The vermi-composting process was checked once a week and thorough mixing of all substrate material was done to ensure the availability of all feeding materials required for vermi-culturing. The temperature (26 °C-30 °C) and moisture contents (65%–70 %) were maintained by the sprinkling of water regularly. After 90 days there is a change in the

texture, appearance, colour, electrical conductivity, temperature, moisture, and the earthy odour was observed which indicated the formation of vermi-compost. Finally, the prepared product was sieved through a 2 mm size mesh and stored. Total biomass of consumed by *Eisenia fetida,* a total number of juveniles in a selected sample area, adults worms and cocoons were recorded, separated and introduce them in fresh beds. .Mineral availability -NPK, helps to grow of beneficial microorganisms. The most important significance of cow dung and cow manure is to maintain the organic microbial and mineral micronutrient richness of compost (Cattle manure contains an average of 1.04 % Nitrogen, 0.15% Potassium and 0.78% phosphorus and 32 micronutrients). Cow dung manure for plants is an excellent fertilizer highly rich with organic matter which help to improve aeration and break up compacted mud.

Result

Table-1:
Annual Production of Vermicompost from 2015-2020

Raw material & dry Leaves	Year	Production from 2 beds
Cow dung/tractor load/lorry	2015-16	2 Quintol-200 kg/crop
Cow dung	2016-17	2 Quintol-200 kg/crop
Cow dung	2017-18	2 Quintol-200 kg/crop
Cow dung	2018-19	2 Quintol-200 kg/crop
Cow dung	2019-20	2 Quintol-200 kg/crop

Table-2:
Vermicomposting & cow manure.

Parameter	Vermicomposting (%)	Raw materials (%)	Cow manure (%)
Organic carbon	18.53	42.96	42.96
Nitrogen	1.35	1.87	1.78
Carbon: Nitrogen ration	0.55	0.35	0.65
Phosphorus	0.58	0.27	0.78
Pottasium	0.54	1.28	0.78

Table-3:
Comparison of Various Parameters in Different Duration

S.No	Parameter	Duration 0 day	Duration 30-40 days	Duration 60-70 days	Usefulness
1	pH	7.7	7.5	7.2	Excellent
2	Total Nitrogen	0.10	0.49	0.71	Good
3	Phosphorus	0.20	0.90	1.40	moderate
4	Potassium	1.010	1.220	1.37	good
5	Carbon: Nitrogen	39.11	25.33	10.8	moderate

The total potassium was 0.56% in the vermicompost, 1.23% in raw material and 0.86% in cow manure, indicating a decrease compared to the cow manure and raw material. The total zinc, manganese, copper and iron concentrations are higher and accumulation of micro-elements is lower than in cow manure. Vermicompost contains essential micronutrients and the nutrient status reported by earlier researchers (Ismail 1997; Ansari and Sukhraj 2010; Ansari et al., 2016). The vermicompost produced can be of significant value to the end users like farmers for replacement of chemical fertilizers and procuring better prices for the organic produce using such composting material locally available at much lower cost. In a second crop 1.6% of Nitrogen, 0.6% of Potassium, 0.5% of Calcium, 0.7%, Phosphorus and 24.5% of Zn were recorded.

Discussion

The resultant worm product contains high levels of nutrients, so fast growth of plant appears, that signifies the non-toxic nature. At the time of harvest many researchers have reported that most species of earthworms prefer a pH of about 7.0 (Panday and Yadav, 2009). The total amount of the worm compost produced was collected in polythene bags and weighed in kilograms and packed. Productivity of vermicomposting was calculated in percentage followed by the chemical analysis and the feeding materials (dry waste and cow dung).

References

1. Ansari, S. and Jaikishun.,S. **Vermicomposting of sugarcane bagasse and rice straw and its impact on the cultivation of** *Phaseolus vulgaris* **L. in Guyana, South America. J. Agric. Tech.**2011. 72 : 225-234
2. **A**nsari, A.A., and Ismail, S.A. Role of earthworms in vermitechnology. **Journal of**

Agricultural Technology. 2012. 8(2): 403-415.

3. Ansari, A.A.; Jaikishun, S.; Islam,S.K.; Kuri, K. F.; Nandwani, D. **Principles of vermitechnology in sustainable organic farming with special reference to Bangladesh,** D. Nandwani (Ed.), Organic Farming for Sustainable Agriculture. Sustainable Development and Biodiversity. **Springer International Publishing**, Switzerland. 2016. 9: 213-229.
4. Devi, J. and Prakash, M. Microbial Population dynamics during vermicomposting of three different substrates amended with cow dung. **Int J Curr Microbiol Appl Sci.** 2015. 4(2):1086–1092.
5. Domínguez, J.J. and Edwards, C.A. Biology and ecology of earthworms species used for vermicomposting. In: Edwards CA, Arancon NQ, Sherman RL (eds) Vermiculture technology: earthworms, organic waste and environmental management. **CRC Press**. Boca Raton. 2011: 27–40
6. Edwards, C.A., Subler, S.; Arancon, N. Quality criteria for vermicomposts. In: Edwards CA, Arancon NQ, Sherman RL (eds.) Vermiculture technology: earthworms, organic waste and environmental management. CRC Press, Boca Raton. 2011. 287–301.
7. Gajalakshmi, S. Microbial Population Dynamics during Vermicomposting of three different substrates amended with cow dung. **International Journal of Current Microbiology and Applied Sciences.** 2015. 4(2):1086-1092.
8. Gajalakshmi, S. and Abassi, S.A. Earthworms and Vermicomposting. **Int J Biotechnol**. 2004.
9. Ismail, S.A. Vermicology: the biology of earthworms. Orient Longman Press, Hyd.1997. p 92
10. Ismail, S.A. The earthworm book. Other India Press, Mapusa, 2005. pp 101.
11. Kaplan, M. The National Master Plan for Agricultural Development in Suriname. Final Report. Kaplan Planners Ltd. Regional and Environmental Planning.2016. pp 255.
12. Sinha, K.; Valani,D.; Soni,B.; Chandran,V. **Earthworm Vermicompost: a Sustainable Alternative to Chemical Fertilizers for Organic Farming** Agriculture Issues and Policies**.** Nova Science Publishers **Inc,** New York **. 2011. p.** 71
13. Panday, S.N. and Yadav, A. Effect of vermicompost amended alluvial soil on growth and metabolic responses of rice (*Oryza sativa* L.) plants. **J. Eco-friendly Agric .** 2009.4(1):35–37
14. Sinha, R.K. and Rajiv, K. **Organic farming: an economic solution for food safety and environmental security** Green Farming. **Int. J. Agri. Sci. 2008.** 1 : 42-49.
15. Sinha, R.K. and Agarwal, S. and Chauhan, K. Agricultural Science. 2010; 1(2):76-94.
16. Yuvaraj, Thangaraj, R. Maheswaran, R. **Decomposition of poultry litter throu vermicomposting using earthworm** *Drawida sulcata* **and its effect on plant growth Inter. J. Enviro. Sci. Technol.,** 2018. 120 :187-197.

14.

Different Types of Pollution

Shakuntla Darji*

Introduction

Pollution is a very critical issue that faces our environment. To control this pollution, we need to understand the characteristics and behavior of different pollutants to provide effective strategies and legislation. Pollution impacts our environment in many ways that are evaluated and controlled. Ionization is one of the most harmful contaminations. It affects living organisms' genetic characteristics, but with some interventions, we can minimize its effect. As pollution has a significant impact on our environment, the manipulation of food is required to improve our nutritious food. All of these strategies and controls are evaluated, and the data obtained from it can help to improve these policies.

- Environment Pollution is the addition of contaminants into the natural environment that causes detrimental effects to nature, natural resources and mankind.

***Research Scholar, Mahatma Jyoti Rao University, Jaipur, Rajasthan.**

- ❖ Any unnatural and negative changes in all the dimensions like chemical, physical and biological characteristics of any component of the ecosystem i.e. air, water or soil which can cause harmful effects on various forms of life and property is called environmental pollution.
- ❖ Any substance which causes harmful effects or uneasiness in the organisms, then that particular substance may be called as the pollutant.

The Materials that Cause Pollution are of two Types:

1. **Persistent Pollutants:** Those pollutants which remain consistent in the environment for a long period of time without any change in its original form are called persistent pollutants. For example pesticides, nuclear wastes, and plastics etc.
2. **Non-Persistent Pollutants:** These pollutants are the opposite of persistent pollutant and break down in the simple form. If this process of breaking down is done by living organisms, then such pollutants are referred to as biodegradable pollutants.

From another perspective, pollutants can be classified as follows:

1. **Primary Pollutants:** Primary pollutants are those which remain in the form in which they were added to the environment for ex. DDT, Plastic
2. **Secondary Pollutants:** Secondary pollutants are formed due to interaction of primary pollutants amongst themselves viz. PAN by the interaction of NOx & Hydrocarbons.

According to their Existence in Nature:

1. **Quantitative Pollutants:** These substances are already present in the atmosphere but they become pollutant when their concentration level reaches to a particular level which is above a threshold limit.
2. **Qualitative Pollutants:** These are man-made pollutants eg. Fungicides, herbicides etc.

According to Origin:

1. Man-made Pollutants
2. Natural Pollutant

According to the Nature of Disposal:

1. Biodegradable Pollutants
2. Non-biodegradable Pollutants

Air Pollution

- Air pollution is the presence of one or more disadvantageous content in such quantity and for such duration, as it is catastrophic, or tend to be catastrophic, to human health and welfare, animal or plant life.
- It is the contaminants of air by the discharge of detrimental substances.

Some of the Air Pollutants, their Sources and Effects:

Name of the pollutants	Sources	Health effects
Nitrogen oxides	Industries, vehicles and power plants	Problems in the lungs, respiratory systems and causes asthma and bronchitis.
Carbon monoxide	Emission and burning of fossil fuels	Severe headache, irritation to mucous membrane, unconsciousness and death.
Carbon dioxide	Burning of fossil fuels	Vision problem, severe headache and heart strain.
Suspended particulate matter	Vehicular emission and burning of fossil fuels.	Lung irritation reduces development of RBC and pulmonary malfunctioning.
Sulphur oxide	Industries and power plant	Irritation in eyes and throat, allergies, cough etc.
Smog	Industries and vehicular pollution	Respiratory and eye problems
Hydrocarbons	Burning of fossil fuels	Kidney problems, irritation in eyes, nose and throat, asthma, hypertension and carcinogenic effects on lungs.
Chlorofluorocarbons	Refrigerators, emission from jets	Depletion of ozone layer, global warming

- Other pollutants are cadmium, lead, mercury, silica, coal dust and particles and radioactive pollutants

Water Pollution

- Addition of certain substances such as organic, inorganic, biological and radiological to the water, which degrades the water quality and makes it unhealthy for use.
- Water pollution is not only confined to surface water but also spread to groundwater, sea and ocean.

Effects

- An excessive amount of mercury in water can cause Minamata disease in humans and dropsy in fishes; Lead in large amount can cause dyslexia, Cadmium poisoning causes Itai – Itai disease etc.
- Polluted water has less amount of Dissolved oxygen (DO) content which is important for sensitive organisms, thereby eliminates sensitive organisms.
- Excess of nitrate in drinking water is dangerous for infants and human health, excess fluoride cause neuromuscular disorder and teeth deformity, hardening of bones and painful joints.
- Biological magnification and eutrophication.

Soil Pollution

- Addition of unwanted substances to the soil which negatively affects physical, chemical and biological properties of soil and reduces its productivity is called soil pollution.
- The factors which disturb the biological balance of the soil and deteriorate the quality, texture and mineral content are called soil pollutants.
- Use of fertilizers, pesticides, insecticides, dumping of solid waste, deforestation and pollution due to urbanization and other anthropogenic substances causes soil pollution.

Sources

- **Industrial Waste:** lead, cadmium, mercury, alkalies, organic substances and chemicals.
- **Agricultural Waste:** fertilizers, pesticides, insecticides and manures.
- Discarded materials and radioactive elements and plastic bags.

Effects

- **Agriculture:** It reduces soil fertility and thus crop yields; increase soil erosion and salinity.
- Ecological imbalance and imbalance in flora and fauna further increases.
- Problems in urban areas like clogging in drains, release of gases, foul smells and problems in wastewater management.
- Release of radioactive rays, bio magnification and pollutant gases cause health problems.

Control Measures

- Afforestation, reforestation and use of organic farming.
- Solid waste management and reduction of waste from the construction area.
- Stop the use of plastic bags and use bags of degradable materials like paper and cloth.
- Biomedical waste should be collected and incinerated in incinerators.

In developing countries, the aging of the population structure will be faster than that which occurred during the previous century in industrialized countries. Such a rapidly aging population in countries with limited financial resources will raise a multitude of problems. Health problems-and in particular those associated with infectious disease-are only one element in this complex situation. But, as was sadly demonstrated by the AIDS epidemic, medical problems can overwhelm and destroy all other aspects of society.

We would, however, like to emphasize that the aging of the population in developing countries should not be viewed as problem per se. On the contrary, the increasing population of elderly individuals represents a formidable chance for the preservation and transmission of knowledge and competence to younger generations. In 1962, the Malian writer Amadou Hampate Bâ said a sentence that has become a famous quote: "When an old man dies a library horns down"

Conclusion

Controlling pollution is not a mission impossible, It just needs effective strategies to be implements. These strategies

must be evaluated by using data. The study of pollution behavior helped scientists to expect the pathway of it and to control all types of contamination; however, there are some places that pollution has not been controlled.

References

1. R.G. harrison, K.A. Nicoll, and K.L. Aplin, 'vertical profile measurements of lower troposphere ionisation', Journal of Atmospheric and Solar-Terrestrail Physics, Vol. 119, pp 203-210, 2014.).
2. A. Marais, M. Hardy, M Booyse, and A. Botha, 'Effects of monoculture, crop Rotation, and Soil Moisture Content on Selected Soil Physicochemical and Microbial Parameters in Wheat Fields',Applied and Environmental Soil Science, Vol. 2012, Artical ID 593623, 13 pages, 2012 doi;10.1155/2012/593623
3. B. Botkin, D, Edward, A.K, 2011, Environmental Science Earth as living Planet-8th Edition, USA John Wiley & Sons Inc.
4. BBC, Chemicals in the Air, [online],http://www.bbc.co.uk/schools/gesebitesize/science/21c pre 2011/atmosphere/ chemicalsairrev2.shtml, [Accessed 22/06/2015].
5. CCOHS, Radiation- Quantities and Units of lionizing Radiation, [online], http:/www.ccohs.ca/oshanswers/phys_agents/ionizing.html,[Accessed 02/07/2015].
6. Defined according to the Palmer drought index that distinguishes between moderate, severe and extreme drought.
7. See for instance T. N. Palmer and J. Raisanen, 2002, Nature 415, pp. 512-14.
8. E. J. Burke, S. J. Brown and N. Christidis, 2006, Journal of Hydrometeorology, 7, pp. 1113-1125
9. Harris, C.D., 1943, 'A Functional Classification of Cities in the United States'. Geographical Revew 33, pp. 86-89
10. Heitmann, A. 'Cities are India's Future' The Times of India 31st May, 2011, New Delhi ed. p.20.
11. Husain, M., 1979, Human and Econoic Geography, New Delhi, NCERT.
12. Husain, M., 2011 Geography of India, New Delhi, Tata Mcgraw Hills.
13. Leong, G.C. and Morgan, G.C., 1992, Human and Economic Geography, Oxford, Oxford University press.
14. Taylor, P.J., 1986, 'The Error of Developmentalism'. In Gregory, D. and Walfard, R., eds. New Horizons in Geography, London, Macmillan.
15. Jacob, J., 1970, The Economy of Cities New York Vintage Books.
16. Hussasin, M., 2007, Models in Geography, Jaipur, Rawat Publications.
17. Northam, Ray, 1975, Urban Geography, New York, Wiley.
18. Wirth, Louis, 1964, On Cities and Social Life, Chicago University Press.
19. Jefferson, M., 1939, 'The Law of the Primate City' Geographical Review Government Printing Office, pp. 226-32.

15.

Different Types of Pollution : Causes and Treatment

Dr. S.G. Shukla*
Varsha Shukla**

The atmosphere that surrounds and affects the living organisms is called environment. Every living organism requires a conducive environment for normal and healthy living. When the conducive environment is changed by harmful elements or entities, the environment gets polluted and the harmful elements or entities causing pollutions are called pollutants. These pollutants pollute air, water, soil and oceans. Unpleasant and unwanted sound causes noise pollution. Waste heat discharged to water by refineries, thermal and nuclear plants causes thermal pollution. Ioinization particles released as a result of natural decaying of radioactive substances cause nuclear pollution. Sewage sludge, industrial wastes, agrochemicals, detergents, waste heat etc. cause marine pollution. Environmental pollutions cause adverse effects on human health and marine life. Different environmental pollutions can be controlled by legislation and preventing their root causes.

***Associate Professor, RMP (PG) College, Gurukul Narsan, Haridwar (Uttarakhand).**

****M.Sc. (Zoology), Ex. U.G.C. Research Fellow, D.A.V. (PG) College, Dehradun (Uttarakhand).**

The atmosphere that surrounds and leaves adverse effects on the living organisms is called environment. According to the Environment Protection Act, 1986, environment includes all the physical and biological surroundings of an organism alongwith their interactions.

Types of Environmental Pollution

The environmental pollution is of the following types :

1. Air Pollution
2. Water Pollution
3. Soil Pollution
4. Noise Pollution
5. Thermal Pollution
6. Nuclear Pollution
7. Marine Pollution

Air Pollution

When the atmosphere surrounding the living organisms contains some harmful substances (even its normal constituents in excess) which leave adverse affects on the organisms, it is called air pollution.

The harmful substances causing air pollution are oxides of sulphur, oxides of nitrogen, carban monoxide, volatile hydrocarbons; particulate pollutants like smoke, fumes, fly ash, soot, dust, aerosols, pollen grains, liquid droplets and radioactive substances etc.

Causes of Air Pollution

The causes of air pollution are of two types viz; natural and anthropogenic or man made.

Natural Causes

The natural causes of air pollution are volcanoes, wild fires, dust, pollen grains of flowers, mold spores, radioactive minerals of the earth crust etc.

Anthropogenic Causes

Vehicular emissions, factories, brick-field chimneys, industrial units, thermal power plants, fuel burning, agricultural operations etc. are the anthropogenic causes of air pollution.

Indoor Air Pollution

Pollution inside buildings, houses and offices is called indoor air pollution. The principal cause of this pollution is radon gas which is emitted by the building materials like bricks, tiles, concrete etc. which are made from the soils containing radium. Ground water and natural gas also emit radon while their indoor use.

Effects of Air Pollution on Human Health

Air pollutants cause lung cancer deaths, asthma, chronic bronchitis, emphysema, suffocation, dizziness, mutation and organ cancer. Radon gas and its radioactive daughters cause lung cancer deaths.

Control of Air Pollution

Air pollution can be controlled by :

1. Minimizing the activities which cause air pollution.
2. Use of low sulphur coal or removing sulphur from coal before its use in industries.
3. Replacing polluting old vehicles.
4. Modification of engines to reduce emission.
5. Use of mass transportation system.
6. Using less polluting fuels in vehicles.
7. Using biological filters and bioscrubbers.
8. Using non-conventional sources of energy.
9. Planting trees to utilize emitted CO_2.
10. Physical absorption of gaseous pollutants at source on porous solid materials like silica gel, activated charcoal, Fuller's earth etc.
11. Using liquid absorbent such as liquid ammonia to absorb sulphur dioxide. Gaseous pollutants absorbed this way can be removed by the process of condensation.
12. Particulate (microscopic and suspending in air) pollutants can be controlled by using bag house filters, wet scrubbers, electronic precipitators etc.

Water Pollution

Any change in physical, chemical or biological properties of water which makes it unsuitable for its designated use is called

water pollution

Causes of Water Pollution

Since water has the property of dissolving many substances in it, due to this property water gets easily polluted. It can be polluted at point sources or non-point sources.

At Point Sources

Industries, coal mines, power plants, offshore oil wells etc. are the point source sites of water pollution which directly discharge liquid wastes into water.

Non-Point Sources

These are not particular sites, but scattered which individually or collectively pollute water. Over flowing drains, rain water sweeping roads and fields, surface run-off from agricultural lands are the non-point sources of water pollution.

Effects of Water Pollution

Sewage contains disease causing micro-organisms and viruses which cause water borne diseases in human like typhoid, jaundice, cholera, dysentery etc.

Control of Water Pollution from Point Source

Water pollution from point source can be easily controlled by legislation process.

From Non-point Source

Although it is difficult to prevent water pollution from non-point source due to absence of action plan, yet it can be prevented by :

1. Sensible use of agro-chemicals and avoiding their use on sloped land.
2. Preventing run-off of fertilizers.
3. Use of nutrients rich water in place of fertilizers.
4. Sowing nitrogen fixing leguminous crops to supplement fertilizers.
5. Less use of pesticides by integrated pest management.
6. Preventing over flow of sewage with rain water by providing separate drainage for sewage and rain water.

Soil Pollution

Soil pollution can be defined as the contamination of soil with industrial wastes, sewage sludge, dump site leachates, agro chemicals, solid wastes and radioactive substances.

Causes of Soil Pollution

1. Dumping of domestic and industrial wastes.
2. Leachates from dumping sites and sewage tanks.
3. Insecticides and pesticides.
4. Human and animal excretas.
5. Radioactive substances.

Effects of Soil Pollution

1. Chemicals discharged by industries reduce the fertility and productivity of the soil.
2. Pathogenic micro-organisms, viruses and intestinal worms present in sewage sludge cause human diseases like typhoid, jaundice, cholera, dysentery, anaemia etc.
3. Production of toxic vapours from decomposition of organic matters in soil.
4. Bone diseases in grazing animals due to radioactive effects on pastures.
5. Radon gas and its radioactive dughters cause lung cancer deaths in human.
6. Percolation of chemicals or their degradation products contaminate ground water.

Control of Soil Pollution

1. Proper treatment of effluents before their discharge on to the soil.
2. Utilization of wastes for making useful products.
3. Proper collection and disposal of the solid wastes.
4. Use of cattle dung and night soil (human faeces) for production of methane gas.
5. Microbial degradation of biodegradable substances.
6. Use of biodegradable organic wastes for production of biogas.

Noise Pollution

Any unpleasant and unwanted sound is called noise. The sound of DJ may be pleasant to a person, but it may be a noise to another person. Thus the sound of DJ which is not a pollutant to a person may be a pollutant to another person.

Causes of Noise Pollution

1. **Mobile Sources:** Various modes of transportation such as road, rail and air transportations are the mobile sources of noise pollution.
2. **Stationary Sources:** Social and religious functions, elections, electric home appliances, industrial operations and construction activities are the stationary sources of pollution.

Control of Noise Pollution

Noise pollution can be controlled by :

1. Entry of heavy and old vehicles in populated area should be strictly prohibited.
2. Care and maintenance of the domestic appliances.
3. Use of silencer in noise making vehicles.
4. Keeping the noise making machines in the containers to interupt the noise path.
5. Plantation of broad-leaf trees.
6. Use of legislation.

Effects of Noise Pollution

1. Affects communication.
2. Exposure to continuous noise pollution leaves adverse effects on the functioning of various body systems. It may also cause sleeplessness, hypertension, blood pressure, digestive and gastro-intestinal disorders, peptic ulcer, change in the behavior and emotion etc.

Thermal Pollution

Thermal Pollution is caused by the heat lost to water by the heat producing plants.

Causes of Thermal Pollution

Thermal power plants, nuclear power plants, steel mills and refineries are the major sources of thermal pollution.

Effects of Thermal Pollution

1. Waste heat discharged near the shores kills the young fishes and disturbs spawning.
2. Thermal zones formed by discharge of waste heat affect the fish migration.
3. Aquatic organisms require more oxygen at high temperature, whereas thermal pollution reduces the level of oxygen.
4. Increased temperature of water functions as a barrier for oxygen to penetrate into deep cold water.
5. Chemicals, pesticides and detergent become more toxic due to thermal pollution.

Control of Thermal Pollution

Thermal Pollution can be controlled by cooling the hot water by means of spray ponds, cooling ponds and cooling towers.

Nuclear Pollution

Stable isotopes formed from unstable isotopes by the process of natural decay of the radioactive substances present in the nature produce energy in the form of gamma rays and ionization particles which cause harmful change in the body cells of living organisms. Besides this, they also cause harmful changes at genetic level.

Causes of Nuclear Pollution

1. **Nutural Causes:** The natural causes of nuclear pollution are radioactive substances.
2. **Anthropogenic (Man-made) Causes:** Nuclear power plants, nuclear explosions, test laboratories, diagnostic kits, x-rays etc. are the anthropogenic sources of nuclear pollution.

Effects of Nuclear Pollution

1. Ionization radiation causes genetic damage by inducing mutation in DNA which is often seen in the offspring. The damage may get transmitted upto the next several generations.
2. Ionization radiation also causes, somatic damage such as eye cataract, skin burns, cancer of body organs etc.

Control of Nuclear Pollution

1. Nuclear power plants should be set up only after studying their short term and long term effects.
2. Wastes from laboratories using radioisotopes should be properly disposed off.

Marine Pollution

When oceans get polluted by the discharge of industrial wastes, sewage sludge, agrochemicals, detergents and waste heat etc., it is called marine pollution.

Causes of Marine Pollution

1. Discharge of industrial wastes, sewage sludge, agrochemicals, detergents and waste heat etc.
2. Rivers carrying pollutants from their drainage basins join the oceans and pour the pollutants into them.
3. Human settlement on coastal areas.
4. Oil drilling and shipment.

Effects of Marine Pollution

Marine Pollution causes adverse effects on the marine life. Fishes get death when their gills get filled with oil.

Control of Marine Pollution

Marine pollution can be controlled by :

1. Ban on discharge of toxic pollutants from industries and sewage treatment plants into the oceans.
2. Ban on dumping of oil into the ocean.
3. Preventing the sewer overflow.
4. Preventing the run-off from non-point sources.
5. Protecting ecologically sensitive coastal areas from oil drilling.
6. Processing of used oil and greese for their reuse.

References

1. Environmental Studies by Anubha Kaushik and C.P. Kaushik
2. Environmental Science by Sovan Roy

◆◆◆

16.

An Introduction to Solid Waste Management

Dr. Radha Krishan Sharma*

Dr. Vikrant Upadhyaya**

In ancient time, the favoured means of disposal was to dump solid waste just in open pits outside the city or village limits, and occasionally burn to compact them. The first known law forbidding this practice was established in Athens 320 BC and thereafter, a system of waste removal began to evolve in several eastern Mediterranean cities. As the population increased, efforts were made to transport the waste farther away from cities, thus creating city dumps. Solid waste management is an essential service in any society; however, the disposal of municipal solid waste did not attract much public attention.

What is Solid Waste and Its Management?

Firstly, we need to understand what is solid waste; secondly, where does it come from; thirdly, how to categorise and lastly, how to manage it. These are few questions that arise in our minds, let's find answers according to the data available. India produces approximately 277 million tons of solid waste every

***Assistant Professor and HOD, Dept. of Zoology, N. M. S. N. Dass (P.G.) College, Badaun India.**

****Associate Professor, Dept. of Teacher Education, NMSN Dass (PG) College, Badaun, India.**

year as per a survey conducted in 2016. This above-mentioned figure is about 13% of the global waste generated every year and about 80% of 334 million tons of solid waste generated across South Asia. It is alarming!

Firstly, solid waste refers to trash arising from human and animal waste that are accounted useless and unwanted. It is generated from various places such as industrial, residential and commercial activities in a given area. Solid waste is based on the type of material used, such as plastic, paper, glass, metal or organic remains. It is also based on hazard potential including radioactive, inflammables, infectious, toxic and non-toxic materials. These are also classified on factors such as the origin of waste as sanitary, municipal, industrial, commercial, institutional, construction and demolition. Regardless of the origin, content or hazard potential, it needs to be managed systematically so as to ensure best environmental practices and minimum environmental pollution. To ensure we impart a beautiful and healthy environment to our future generations, it is of utmost importance that we manage environmental hygiene in such a way that solid waste management is regulated and incorporated into environmental planning and implementation. We must manage the solid waste in such a way that it does not interfere with a healthy environment for their physical and mental growth.

Classification of Solid Waste

The solid waste may be classified on the basis of physical form, chemical nature, source of generation, toxicity and degradation properties *etc.* But keeping in view the efficient, meticulous and economic management of solid waste we may classify it as follows:

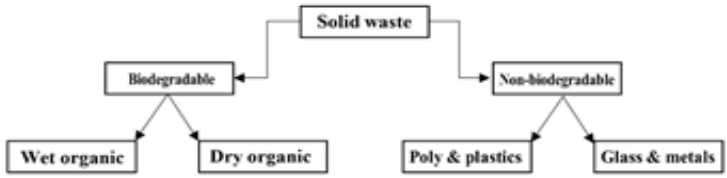


Fig 1: Categories of solid waste

Wet organic waste includes vegetable peelings, spoilt fruits, agriculture remains, solid excreta from animal sheds *etc.*; dry organic waste includes paper cuttings, hard boards, wooden pieces, cartons, straw, dry leaves, cloth pieces and rags *etc.*; non-degradable waste includes plastic bottles, cans, glass bottles, clinical equipment, metal containers, polythene bags and other plastic materials.

Criteria of Solid Waste Management

There are five practical constituents for solid waste management listed as under:

1. **Control on Trash Generation:** We need to create a system where we must control or minimize the wastage of resources or ensure the reduce or reuse of material ready for disposal.
2. **Segregation:** The solid waste must be segregated on site in different bins on the basis of their processing criteria so as to reduce the transportation costs to the processing plant as well as to minimize the use of dumping grounds. For example, dry and wet biodegradable organic waste and non biodegradable polywares, plastics and glass containers etc. should be seperated on site.

Hazardous waste should be necessarily kept in altogether separate bins. For example, clinical waste from hospitals.

3. **Collection:** The next important step is municipal collection of waste. It includes placement of waste bins for different types of wastes at desired locations. Timely collection of the wastes and its accumulation on designated dumping area from where it would transport to processing plants.
4. **Transport:** It includes the transportation of wastes already segregated from local dumping ground to regional waste disposal site of the concerned city or town via large carriers.
5. **Processing, Recovery and Disposal:** It refers to systematic processing of waste using appropriate techniques, facilities and related equipment to ensure proper disposal. However, certain material like glass or plastic may be reduced and recycled for other use. Biodegradable waste can be disposed to provide biomass to obtain gas and manure. Materials that are hazardous and non-recyclable must be disposed by

burning in an eco-friendly manner.

Techniques for Solid Waste Management

How much ever we advocate the lesser amount of solid waste generation, yet there is a huge amount of solid waste that exists which needs to be properly recycled or reduced in order to ensure proper solid waste management. There are a few techniques that may be employed to dispose the solid waste. These techniques are listed below and they may come with certain limitations of their own.

1. Biogas Production

Biogas is produced by anaerobic digestion of municipal solid waste in which organic materials are degraded by microbes in the absence of oxygen. In this method organic waste is filled in large digesters made of concrete or metal. The anaerobic digestion of organic materials produces a combination of gases mainly Methane some carbon dioxide and traces of other gases. The slurry left after the digestion process is dried and used as an organic manure.

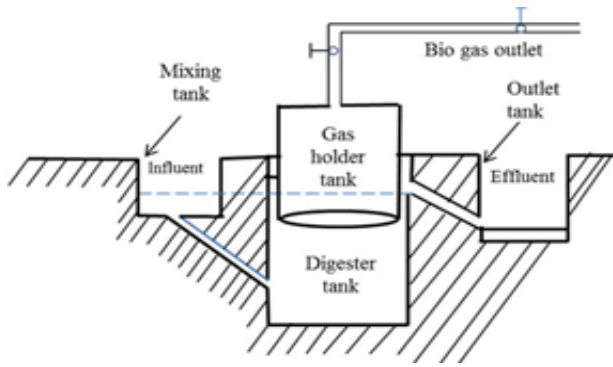


Fig. 2. Biogas Plant Design
(Source: https://www.researchgate.net/publication/318503013)

Biogas is a green energy which can replace LPG and CNG. It can also be used as fuel directly in power engines. In India the estimate for production of biogas is more than 2 million metric tons per year. This is equivalent to the 5% of the total LPG consumption in the country as quoted by Mr Piyush Goyal minister-in-charge New and Renewable Energy Ministry. Unfortunately, most of the biogas plants are primarily based on

cattle dung therefore this technique of solid waste management has not been able to produce desired results. Therefore, this technique is not being utilised to the optimum for solid waste management where in it needs to be diversified.

2. Bio Digestion

It refers to gastric digestion of food remains, peeling, spoiled or rotten fruits and vegetables *etc.* from hotel industries, food markets and households to convert it into dung. The process of gastric digestion is steady and quick which provides partially hydrolysed organic material in few hours. This can be achieved by feeding waste food, unfit for human consumption to cattle. It can be done on a large scale as the government of several states has opened *'GOUSHALA'* scheme where stray cattle are kept. The only factor here is the collection and transportation of it to cattle sheds.

This will also impact the agriculture produce in a positive manner as fodder growing by farmers will be reduced. The dung produced in this process can be used for bio gas and composting.

3. Vermicomposting

Natural bio-geochemical cycles reflect role of various organisms in the decomposition of dead organic materials. These materials are decomposed and broken down by scavengers, insects, worms and finally by fungi and bacteria. It results into the formation of mineral rich soil called 'compost'. Vermicomposting is a process of culturing earthworms by utilizing organic wastes as a culture bed. This technique has been evolved for various species of earthworms. For example, *Perionyx excavatus* and *Lampito mauritii.*

Vermi-bed is the layer of moist loamy soil placed at the bottom, about 15 to 20 cm thick above a thin layer (5 cm) of broken bricks and coarse sand. For this a pit having size 1x2x0.5 meter is sufficient to start the vermiculture. The pit is filled with organic waste like straw, dried leaves, grasses, dried dung, vegetable peels *etc.* and then covered by a sack to keep it moist. A solution of jaggery at the rate 250 gm/l is also sprinkled over vermi-bed. A culture of microorganisms is inoculated as per need which are available commercially. After 30 days local species of earthworm is introduced at the rate 75

individuals/m^2 area.

The content of the pit is turned over every fortnight. It takes about three fortnights to start the decomposition. In 60 to 90 days the soil compost thus formed is rich in nutrients. Normal composition of nutrients and minerals in vermicompost is following:

C (org)	:	9.5 – 17.98%
N	:	0.5 – 1.50%
Ca	:	0.45 - 0.93%
Mg	:	0.28 – 0.58%
K	:	0.15 – 0.56%
P	:	0.1 – 0.30%
Na	:	0.06 – 0.30%
S	:	128 – 548 ppm
Zn	:	5.70 – 11.50 ppm
Fe	:	2.61 – 9.30 ppm
Cu	:	2.23 – 9.50 ppm

It is collected by sieving method of separation and the earthworms are transferred back to the pit for new decomposition cycle.

4. Incineration

Incineration is a process of burning dried non degradable waste like plastic, polythene *etc.* along with biodegradable waste like paper, cloth, cotton, wooden boxes, *etc.* in a properly designed furnace under suitable temperature and operating conditions. In fact, it is a chemical process in which combustible waste is burnt by complete oxidation and results into the release of heat, carbon dioxide, water and fumes. Modern incinerators are equipped with pollution safety devices in which toxic fumes are trapped using suitable solvent and it is disposed separately in landfills. The ashes collected during this process are used for brick formation.

An efficient incinerator can reduce solid waste by about 75% in weight and 90% in volume. Various types of incinerators with the different capacities are available commercially. For example, Fluidized bed, Catalytic combustion, Moving grate, Fixed grate, Rotatory klin *etc.*

Fig 3: Solid Waste Incinerator:
Capacity 25kg (Source: Indiamart, online shopping portal)

Plasma arc Gasification

It is a waste treatment technology that uses high temperature and electricity to turn solid waste into usable by product without burning. In this process a mixture of hydrogen is produced which is known as synthesis gas or 'syngas'. The syngas is further utilised for the production of methanol and other fuels via the Fischer Tropsch process.

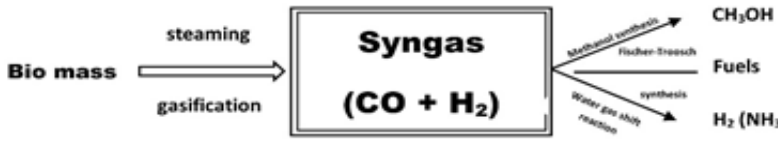


Fig 4:
Process of Syngas Production

The success of solid waste management programme depends upon three key operators *i.e.,* individual human as waste generator, municipal bodies as waste collectors and processors and government as law and policy makers. These entities must work in coordination to harness the best results. Solid waste management will prevent spread and cause of diseases, control pollution, boost recycling of resources and keep the country clean and green.

References

1. De, A K (2006) Environmental Chemistry. New Age International (P) Limited.
2. Bhatia, H S (2019) A Comprehensive Book on Solid Waste Management with Application. Misha books.
3. Bharucha, Erach (2015) Text book of environmental studies. Universities Press (India) Pvt Ltd.
4. Debi Aloka (2013) Environmental Science and Engineering. Universities Press (India) Pvt Ltd.
5. Rahman, M M; Hasan, M F; Saat, A; Wahid, M A (2017) Economics of biogas plants and solar home systems. https://www.researchgate.net/publication/318503013
6. Burri, M (2011) Biogas from Solid waste. Thesis, Swiss Fed. Inst. Tech., Zurich (ETH)
7. Chhatwal, G R et al. (1989) Environmental Water Pollution and its control. Anmol Publication.
8. Dubey, R C (2009) A textbook of Biotechnology. S. Chand & Company Ltd.
9. Saravanan, R; Kumar, R D; Suriya, A (2017) Municipal solid waste management. Suchitra Publication.

Websites

- Tamil Nadu Agriculture University https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html
- Books by local authors http://www.easyengineering.net/
- Incineration technologies https://www.inciner8.com/
- Central Pollution Control Board https://cpcb.nic.in/
- Central Pub Health and Env. Eng. Org. http://cpheeo.gov.in/index.php
- Ministry of Statistics and Programme Implementation http://mospi.nic.in/
- Ministry of New and Renewable Energy https://mnre.gov.in/waste-to-energy

Acknowlegement

We sincerely thank Principal of our college Dr. P. Kohli for his moral support and District Forest Department, Badaun and Regional Pollution Control Board for providing necessary information.

◆ ◆ ◆

17.

"Endemic Medicinal Flora of Western Ghats and Its Sustainable Utilization"

Dr. H.P. Shinde*

Western Ghats- 'An Emporium of Medicinal Plants.'

The endemic medicinal plants can be considered as one of the most important genetic resource of the whole Western Ghats and also; it accounts for the rich biodiversity comprising about 6000 species of the flowering plants. From the ancient times; the endemic medicinal flora forms a base for today's wild edible plants like most of the food grains, fruit plants as well as plants species used as spices, condiments etc. At global level; there are about 34 hotspots exhibiting rich floristic diversity and showing abundant endemic medicinal flora; are undergoing enormous habitat loss due to several known factors. As recognised by the World conservation monitoring centre in 2000; there are 17 mega diversity countries of which India alone represents a total of 47,513 plant species (Singh & Dash, 2014). In the Indian context; the floristic diversity is abundant in the four biodiversity hotspots which are the regions belonging to

***Botany Department, K.V.N. Naik S.P. Sanstha's, Arts Commerce & Science College, Nasik.**

Eastern-Western Himalayas, northeast part & few Islands of India. Geographically; the Western Ghats in India; comprises a chain of mountains which run from north to south direction across the several states like Maharashtra, Gujrat, Karnataka, Tamil Nadu, Kerala etc.

From the ecological or ecosystem diversity point of view; India possesses 12 biogeographical provinces, 5 biomes and 3 bioregion domains (Cox & Moore, 1993) mainly comprising tropical wet evergreen forests in Northeast India and the Western Ghats; mangroves of Sundarbans and fresh water aquatic to marine ecosystems (Sharma & Singh, 2000). In India; the major biodiversity rich areas that include Western Ghats, Himalayas, Andaman & Nicobar Islands are needed to be floristically explored & inventorised.

Endemic Medicinal Flora in Western Ghats

As far as the floristic diversity in terms of medicinal plants is concerned; Western Ghats shows affinities with the flora of other landmasses like South America, Eastern Africa, Malaysia islands, Sri Lanka etc. A pioneer attention to the traditional utility of endemic medicinal plants of Western Ghats was paid by pioneer & fundamental floristic surveys carried out by many workers. It has been observed from past research experience that endemic medicinal plant species having great medicinal potential are becoming rare, endangered & threatened day by day; most obviously due to the known factors like non judicious use of these plants for various purposes mostly for manufacturing of herbal drugs.

From the ancient times; endemic medicinal plants are being used to cure various ailments & diseases. Significantly large number of endemic medicinal plant species have been described in Indian medicinal system i.e. 'Shushruta Samhita' which exist as a rich ancient medicinal heritage.

Medicinal plant species of Western Ghats were found to be restricted to these areas and are rare and threatened in occurrence, their populations have been declining rapidly due to habitat destruction and anthropogenic activities. (Deshmukh and Waghmode 2011, Chandore 2015, Pethe et.al. 2015). In India, it becomes highly essential to highlight the diversity of endemic medicinal plant resources in a conservation

perspective. Various floristic studies have been carried out at Western Ghats across India; mostly involving systematic enumeration, categorization, diversity of ethnobotanicals used by local tribal communities as well as their ecological aspects. Also, such kind of studies have been conducted at hilly & forest areas for example; Nasik & Trymbakeshwar, Harsul, Peith, Kalwan, Surgana region of Maharashtra. Kakulte and Gaikwad *et.al.* (2014); Auti et.al. (2020).

Sustainable use & Bio Prospection of Endemic Medicinal Flora

In India; industries especially pharmaceutical industries are expanding very rapidly. According to the current official records; over 2000 endemic medicinal plant species collected from the wild; have found their place in the active trade by the pharmaceutical industries. However; raw material used by medicinal industry poses a problem of authenticity. Industries rely on availability & continuous supply of medicinal plants and also require an information regarding plant part used, formulations, doses etc. Such data is collected from the local medicine men and traditional practitiners. Moreover; this practice does not guarantee the authenticity of plant part used and also requires considerable period of time interval between collection of medicinal plants & its final product. Similarly harvesting of medicinal plants in a non-scientific way causes destruction of soil mycoflora and vital medicinal plant parts or even the whole plant. Such kind of factors are known to be contributors in posing threats to the medicinal plant diversity. Though there has been considerable work done in terms of floristic diversity of Western Ghats; the research in terms of endemic medicinal plants has enormous scope in coming years.

Although the new reports and discovery of new taxa are being made by taxonomists; the rapid rates of industrialization and urbanization have resulted into the uncontrolled exploitation of endemic medicinal plants and also the ever-increasing tourist activities has been one of the important cause of depleting medicinal plants including ornamentals such as *Orchids, Begonias, Impatiens* etc. Also, the Western Ghat region has been studied floristically by many researchers earlier, however; there exists a considerable research gap

regarding the precise geographical locations, current status of the endemic medicinal plants and the bioprospection. In this context; the rich floristic diversity, changing habitat that results into intra specific variation and diverse chemo profile especially in wild aromatic medicinal plants needs to be evaluated in a comprehensive way. For example; the medicinal plant species like *Gloriosa superba, Curcuma inodora* and *Iphigenia* spp. have great potential for extraction of secondary metabolites like colchicine and many others. Also, the bulbs of different species of *Ceropegia* and *Brachystelma* are eaten by local people and tribals in raw condition. Corms of different *Dioscorea* spp. are also edible. Some species are critically endangered in wild; However; Western Ghats offers significant opportunities for bio prospection, particularly in terms of chemo- prospecting of wild aromatic plants like *Cymbopogon flexuosus*, *Artemisia nilagirica*, *Curcuma* spp. etc. Moreover, studies involving survey & systematic documentation of endemic medicinal plants will contribute in conservation of floristic diversity of Western Ghats. (Singh, 2002).

Need of Policy-Making and Bioprospection

Earlier studies on exploration of floristic diversity suggests that bio prospection of both the explored & unexplored flora need to be done on priority basis. Such studies can contribute significantly towards an assessment of genetic variations developed in wild endemic medicinal plants; this information can be instrumental in developing databases on wild genetic resources.

In the current scenario; bio prospection of endemic medicinal plants for novel genes; has become quite rapid and easy with an advancements of technological aspects & expertise from the disciplines like botany, ecology, molecular biology, biotechnology. Likewise; research involving multidisciplinary collaboration of such expertise is need of an hour so as to ensure sustainable utilization for human welfare.

Government can strongly recommend that the conservation of such endemic medicinal plant species can be achieved by establishing protected areas, botanical gardens and other such germplasm preservation centres especially in academic units in urban area as well as in rural areas. Such initiatives will

not only serve as the centres of studying the varied aspects like reproductive biology, agro technology etc. but also support for identification & evaluation of germplasm storage. In order to ensure the constant supply of local endemic medicinal plants; pharmaceutical units can also be encouraged for their active participation in cultivation, propagation and conservation programmes

There are several threats due to developmental activities with increased population pressure and anthropogenic activities and encroachment on local flora by many invasive alien species. To check all these ill effects policies of the government policy can be formulated so as to get better management of these valuable plant resources, proper regulation of plant based industries that solely depend upon wild resources of local endemic flora. Such policy making may involve active conservation efforts through participation of local government bodies, NGO's, academic bodies etc. which will eventually result in economic upliftment of the local inhabitants.

References

1. Cox, C.B. & Moore, P.D. 1993. Biogeography: An ecological and evolutionary approach. *Blackwell Publishing*, Oxford.
2. Sharma, J.R. and Singh, D.K. 2000. Status of plant diversity in India: An overview. In: Roy, P.S., Singh, S. & Toxopeus, A.G. (*Eds.*), Biodiversity & Environment. Remote Sensing & Geographic Information System Perspectives. *Indian Institute of Remote Sensing, National Remote Sensing Agency,* Dehradun.
3. Singh, P. and Dash, S.S. 2014. Plant Discoveries 2013 -New genera, species and new records. *Botanical Survey of India*, Kolkata.
4. Lakshminarasimhan P. and Sharma B. D. (1991) Flora of Nasik district. *Botanical Survey of India.*
5. Deshmukh B. S. and Waghmode, Ahilya. 2011. Ex-situ conservation of some rare endemic and medicinal plant species from Akole taluka (MS), India. *Bioscience Discovery* 02 (2):171-173.
6. Chandore A. N. 2015. Endemic and threatened flowering plants of Western Ghats with special reference to Konkan region of Maharashtra. *Journal of Basic Sciences,* 2, 21-25.
7. Pethe J., Tillu A. and Watve A. 2015. Threat status assessment of *Ceropegia anjanerica* Malpure et al. (Magnoliopsida: Gentianales: Apocynaceae) from Anjaneri Hills, Nashik District, Maharashtra, India. *Journal of Threatened Taxa*. 7(3): 6965–6971.
8. Khairnar D. N. (2010) Studies on some Threatened and Endemic Ethnomedicinal Plants of Nashik District (North Sahyadri), Maharashtra. *Nature Environment and pollution Technology*. Vol. 9 No. 2 pp. 299-303.

9. Kakulate, V.R. Gaikwad, K.N. and Jadhav, S.U. 2014. Diversity of ethno botanical plants used by rural community of Trambakeshwar hill of Nashik district, Maharashtra, India. *International journal of life Science and pharma research* Vol.4, Issue 2, ISSN 2250-0480.

10. Auti, S.G., S.S. Kambale, K.V.C. Gosavi & A.N. Chandore (2020). Floristic diversity of Anjaneri Hills, Maharashtra, India. Journal of Threatened Taxa 12(10): 16295–16313. https://doi.org/10.11609/jott.3959.12.10.16295-16313.

◆ ◆ ◆

18.

Ecosystem Management and Conservation

Dr. V. B Sonawane*

Introduction

According to 1992 UN Earth Summit, biological diversity is the variability among living organisms from all sources including terrestrial, inter alia, marine and other aquatic ecosystem and ecological complexes. Environmental science is a multidisciplinary subject that deals with the systematic study of every environmental issue which effects the living organisms and human beings on the surface of the earth. Environmental science is a collective study of many subjects and its components include Biology, Physics, Chemistry, Geography, Sociology, Anthropology, Economics, Statistics, Ecology, Engineering and Philosophy. Environmental knowledge is plays an importance role in our daily life. It helps in solving the various problems which are arising in the environment rapidly and without any checks. The government is trying their level best to bring environmental awareness in common media.

Environmental difficulties represent some of the most

***Assistant Professor, Department of Botany, MVP Samajs Arts, Commerce and Science College Nandgaon, Dist. Nashik, Maharashtra.**

complex and pressing contemporary social issues. Beyond physical changes to the environment, threats such as those posed by global climate change present difficult challenges, from public health hazards to threats to societal and political institutes, community infrastructure (Doherty & Clayton, 2011; Intergovernmental Panel on Climate Change, Swim, Clayton, & Howard, 2011). These destabilizing features can have both social causes and social consequences. For instance, carbon dioxide is currently being produced by the collective consumption of fossil fuels at approximately twice the rate at which it is being removed from the atmosphere by natural processes. As a result, the current period is the warmest on record in the history of modern civilization, with impacts that disproportionately affect poorer nations (Wuebbles et al., 2017). Goals should be set as a result of negotiation between all stakeholders, and indicators should be chosen carefully to match the goals. Adaptive management is the key to dealing with the highly complex, uncertain and unpredictable nature of socio-ecological systems (Williams et al 2011). Typical steps in setting up a sustainable ecosystem management system (Tallis et al., 2010). Ecosystem means the Convention on Biological Diversity means a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit (UNEP 1992). Ecosystem conservation involves protection and regulated utilization of the ecosystem.

Environmental management is defined as the management of the interaction and effect of human actions on the natural environment through the identification and management of factors that have a stake in the competitions that may rise between meeting social and financial needs but protecting the environment. Environmental conservation is the protection, renovation of natural environments. The main idea of ecosystem management is to maintain long term sustainability for the manufacture and ecosystem services.

Ecosystem Management is a Process that Aims and Objective

1. Ecosystem management is a process that aims to conserve major ecological services and restore natural resources

while meeting the socio-economic, political and cultural and needs of current and future generations.

2. The main objective of ecosystem management is the efficient maintenance and ethical use of natural resources. It is a multifaceted and holistic approach that requires a significant change in how the natural and human environments are identified.
3. Many people and organizations have defined ecosystem management. The following examples represent a cross-section of definitions.
4. The ecosystem was first defined by A. Tansley in 1935. As per Tansley, the ecosystem has two major components and there is the interaction between and within the components.
    1. "A strategy or plan to manage ecosystems for all associated organisms, as opposed to a strategy or plan for managing individual species "(Forest Ecosystem Management Assessment Team, 1993)
    2. "A resource management system designed to maintain or enhance ecosystem health and productivity while producing essential commodities and other values to meet human needs and desires within the limits of socially, biologically and economically acceptable risk" (American Forest Paper Association Forest Resources Board, 1993)
    3. "Integrating scientific knowledge of ecological relationships within a complex socio-political and values framework toward the general goal of protecting native ecosystem integrity over the long term" (Grumbine, 1994)
5. Environmental conservation refers to the protection of the environment from being destructed through practicing various ways of environment protection such as destocking, afforestation, recycling wastes and planting of cover plants. It is the responsibility of everyone to ensure that our environment is conserved since a better environment is good for all of us.

Scope

1. The growing awareness that ecosystem services are closely linked to human health and well-being has focused attention on devising new ways to understand and manage humankind's relationship with the natural world, in the interest of respecting and sustaining biodiversity and functioning ecosystem.
2. To identify the environmental problem and to find its solution. To limit and regulate the exploitation and utilization of natural resources.
3. Ecosystems provide important supporting, provisioning, regulating and cultural services, such as carbon sequestration, climate regulation, food, fresh water production, flood regulation etc.
4. To control environmental pollution and gradation.
5. It further means ensuring that species within ecosystems the unbelievable variety of microbes, plants and animals can fulfil their biological natures and functional roles as symbiotic members of ecosystems in support of human and non-human life.

Effective of Environmental Conserved

1. Reducing the harmful effects of hazardous and dangerous materials
2. To promote economic policy.
3. Building up suitable capacity to prevent environmental pollution
4. Reducing the amounts of waste produced.
5. Preparing to affect the setting of targets for the next phase of the implementation of the United nation Climate Protocol, and then carrying out the necessary measures.

Methods of Conservation

1. **Soil Conservation-** The conservation of soil for environmental conservation, essential for conservation of soil has to attract the harmful effect of soil pollution. Soil is the important element, role in soil erosion, land degradation and floods. Soil is filled with rich nutrients for plant production. Soil conservation can be carried out by

ensuring smallest use of composts and toxic elements as well as eradicating the disposal of harmful industrial waste in the soil.

2. **Managing Waste** – We can select for various technique like Reuse, Recycle, dry and wet waste isolation among others. Solid waste is produced by market area, homes, settlement area, industries and many other locations. We should manage our solid waste and help keep the environment healthy. The Municipalities should also conduct programs that manage solid wastes. Moreover, we should teach ourselves how to manage our waste without scattering all over.
3. **Forest Conservation-** Tree planting, Afforestation and reforestation help in conserve environment. The forests which are responsible for tapping absorbing a enormous amount of carbon dioxide from reaching the atmosphere. We know that plants are the most essential sources of food air as well as day to day products use. We should make it our life mission to plant trees as much as possible. Additionally, regulation that protects the forests should be highlighted.
4. **Reducing our Water Consumption-** clean water is valuable and not easily available. Prevent water pollution otherwise, Reduce the number of baths, turn off the taps, use take showers, washing machine, do not discard waste in bodies of fresh water and recycle it. We should conserve clean and fresh water. Avoid to disposal of harmful waste chemical elements waste in the water bodies.
5. **Control Pollution-** We need to adopt environmentally sustainable methos to minimise multiple types of emissions. Pollution control is a term used environmental management. Avoid herbicides, pesticides, insecticides, chemical fertilizers etc. that pollute the environment. We should maintain our cars it is possible as they are primary source of control of air pollution. We should control air pollution it is possible, to conserve the environment
6. **Public Awareness-** A Public awareness and education project most of important strategies for preventing crime. Environmental protection with your friends and family members, Counting on local Television and radio stations

on a major local daily newspaper. So that everyone is made aware of conservation of environment.

Encourage Environmental Conservation

1. **Education-** Environmental conservation requirements to be bigger part of the education system. We should teach our young ones how to conserver of the environment as well as the consequences of not doing so.
2. **Ban Plastics:** Plastics are responsible for a dirtier environment. They ought to be banned and people should learn to either recycle or reuse them or fail to use them at all. People should use cloth bag for daily uses than plastic bag.
3. **Create legislation that Encourages Environmental Conservation:** Governments should come up with legislation that promotes environmental conservation. This should also be done on an international level, run by international activities such as the United Nation with its UN Environment Program.
4. **Promote a Paperless Office :** Digital computing solutions have enabled companies to become more collaborative, streamlined. Form using desktop applications such as Microsoft office and Google drive for coordinating work projects paper and ink are exchanged out for an eco-conservative alternative

Conclusion

All nations must work together to solve environmental threats of a global nature, and those which undermine sustainability at more local levels of consumption and continue to improve the management of their natural resources. where once we thought endangered species were the problem, we now face the loss of entire ecosystems. Each country must play its fair role, based on the principle of mutual benefit and obligation, and according to its relative technical and economic capacities. Promoting the ecological management and conservation of developing countries. Promote education and awareness among governments and the public. Maintaining the diversity of life in the both human managed and natural systems. Everyone in the world depends completely on earth ecosystem and the

services they provide, such as food, water, climate regulation, disease management. So, it is better that care for ecosystem should be taken as one of the major responsibilities of every individual for sustainable living of future generations as well.

References

- Clayton, S., & Myers, G. 2015. Conservation psychology: Understanding and promoting human care for nature (2nd ed.). Hoboken, NJ: Wiley-Blackwell
- Clayton, S., & Saunders, C. D. 2012. Introduction: Environmental and conservation psychology. In S. Clayton & C. D. Saunders (Eds.), The Oxford handbook of environmental and conservation psychology (pp. 1–7). New York, NY: Oxford University Press.
- Doherty, T. J., & Clayton, S. 2011. The psychological impacts of global climate change. American Psychologist, 66, 265.
- Hansen, A.J., T. Spies, F. Swanson, and J. Ohmann. 1991. Conserving biodiversity in managed forests: lessons from natural forests. Bioscience 41:382-392.
- Primack, R.B. 2002. Essentials of Conservation Biology. Third Edition. Sinauer Associates, Sunderland, MA. 698 pp.
- Schultz, P. 2011. Conservation means behavior. Conservation Biology, 25, 1080–1083.
- Swim, J. K., Clayton, S., & Howard, G. S. 2011. Human behavioral contributions to climate change: Psychological and contextual drivers. American Psychologist, 66, 251.
- Tallis, H., Levin, P.S., Ruckelshaus, M., Lester, S.E., McLeod, K.L., Fluharty, D.L. and Halpern, B.S. (2010): The many faces of ecosystem-based management: Making the process work today in real places. Marine Policy 34:340-348.
- Williams, B.K. (2011): Adaptive management of natural resources: framework and issues, Journal of Environmental Management 92: 1346-1353.
- Wuebbles, D. J., Fahey, D. W., Hibbard, K. A., Dokken, D. J., Stewart, B. C., & Maycock, T. K. (Eds.). 2017. Climate science special report: Fourth national climate assessment, Vol. 1. Washington, DC: US Global Change Research Program.

◆ ◆ ◆

19.

Different Types of Pollution: Causes and Treatment

Dr. Divya Raghuvanshi*
Dr. A. K. Vidyarthi**

Introduction

In today's world, rapid urbanization, industrialization, population explosion, rampant exploitation of natural resources has increased our energy consumption, waste generation, and pollution. This results in the production of greenhouse gases which causes an increase in Earth's temperature and eventually causes climate change[1]. Pollution and waste are leading to international public health issues. Environmental pollution causes health issues like prenatal disorders, infant mortality, respiratory disorders, increase in stress, allergies, malignancies, cardiovascular disorders, mental disorders, and various other harmful effects [2,3]. Apart from, short-term health issues, environmental pollutants may pose long-term, chronic, non-communicable diseases like morbidity, mortality, organ failures, cancers, etc. [4,5].

The history of pollution is as old as the time when humans

***Research Scholar, Water Quality Management Division-II, Central Pollution Control Board, Delhi.**

****Additional Director, Water Quality Management Division-II, Central Pollution Control Board, Delhi.**

started living together in one place for a long time. In the initial days of such human settlements, there is enough space for everyone but after some time, the problem of pollution arose when the density of the human population increased and the establishment of permanent human settlements. At the end of the 18th century and the beginning of the 19th century, the industrial revolution leads to rapid economic development which requires large-scale consumption of coal which resulted in the problem of air pollution. Through the 19th century, water and air pollution became a worldwide problem. By the middle of the 20th century, the whole world was aware of the necessity to protect air, water, and land from pollution. In 1962, Rachel Carson wrote a book named 'Silent Spring'. In the book, the author highlighted the attention on irreversible impairing of environment produced by inadequate consumption of pesticides such as DDT and other persistent chemicals that accumulate in the food chain and disturb the ecological balance on large scale. To mitigate the problem of air pollution, many countries had passed major legislation like major pieces of environmental legislation, such as the Clean Air Act (1970) and the Clean Water Act (1972; United States)[6].

Before exploring the aspects of environmental pollution, we should get familiar with the term "Pollution". According to Section 1(13) of the UK Environment Protection Act, 1990, the term pollution refers to: The release (into any environmental medium) from any process of substances that have the potential to cause harm to man or any other living being supported by the environment [7].

Environment Pollution is described as the addition of contaminants into the natural environment that causes detrimental effects to nature, natural resources, and mankind. Any anthropogenic and deleterious negative changes in all the dimensions like chemical, physical and biological characteristics of any component of the ecosystem i.e. air, water, or soil which can cause harmful effects on various forms of life and property is called environmental pollution [8].

An Environmental pollutant is any harmful substance that causes hindrance in the healthy living of any organism. Depending upon the longevity, pollutants can be of two

types: Persistent Pollutants are pollutants that persist in the environment in their original form. It includes pesticides, nuclear wastes, plastics, etc. Another type of pollutant is non-persistent pollutants. It includes such pollutants which easily get breakdown into simplified forms. If the breakdown is catalyzed by some living organisms, then it is called bio-degradable pollutants.

Further, depending upon their origin, pollutants can be classified into two types. Primary Pollutants remain in their original form in which they are added to the environment. Secondary pollutants are formed due to the interaction of primary pollutants among themselves. For eg: Peroxy Acyl Nitrate (PAN) is formed by the interaction of NOx and Hydrocarbons.

Environmental pollution can be caused by natural sources such as volcanic eruptions, the release of methane gas by paddy fields and cattle, the release of carbon monoxide by plants and animals, emission of natural gas, ozone gas, nitrogen oxides, cosmic rays, UV-rays, etc. However, pollution term is attributed to pollutants and contaminants having anthropogenic sources such as industrial activities, vehicular pollution, domestic pollution, agricultural activities, etc.

The human community is leading a mad race of development and territory expansion, in which he is exploiting and threatening the natural resources thus deteriorating the relationship between man and the environment. The degradation in the environment modifies the naturally prevailing conditions and leads to alteration in the biotic and abiotic components. The impacts of the human on the environment can either be direct or intentional impacts or indirect and unintentional impacts. The direct impacts are reversible and premediated because their bad or good impacts are already being figured out and got noticed in a short period. While the indirect impacts cause irreversible, long-lasting effects on the environment as the after-effects are not pre-planned and pre-mediated. The indirect impacts cause a chain of harmful side-effects sometimes degrade the environment to such an extent that it becomes suicidal for human beings.

Before discussing further, we should attempt to pinpoint the root cause of environmental pollution. The first and the main cause of increasing pressure on natural resources is attributed to population growth. With the advancement in the medical field, the mortality rate has decreased thus increasing the population growth at a place. The increasing population requires proportionate exploitation of natural resources to provide day-to-day essential requirements of life. It results in the migration of people and the growth of urban areas, thereby inviting new problems of health, ecology, and human sustenance. The second factor is affluence, which is the material aspects of per capita consumption of goods, and resources. The increasing consumerism for un-essential requirements and luxury inclined lifestyle of today's world is causing misuse or overuse and pollution of resources, thus producing waste matter and energy. The third underlying factor responsible for environmental pollution is the usage of modern technology which depends upon the exploitation of more natural resources to generate synthetic and non-biodegradable substances such as plastics, detergents, fertilizers, fibres, big cars, petrochemical, and other environmentally detrimental industries. The fourth major cause of pollution is deforestation. Forests are invaluable property of a nation as they bring prosperity and welfare to the people. They provide us timber, raw materials for various industries, habitat to many living organisms, most importantly they provide us oxygen and act as a carbon sink of the world. Apart from this, the roots of trees help bind the soil thus eliminating the soil erosion and allowing recharge of groundwater. The forest cover at the global, regional, and local levels has markedly declined. The reason for deforestation is cutting of trees and conversion of forest land into agricultural land, shifting cultivation, forest fires, illegal cutting of trees for timbers, overgrazing, hydropower projects. This resulted in serious consequences like soil erosion, land degradation, floods, droughts, natural disaster like landslides, and threatening of all living beings.

The fifth and the most devastating factor for increasing environmental pollution is industrial development which requires the exploitation of natural resources to meet the ever-increasing demand of today's modern world. The underlying

reason behind havoc created by industrial pollution is deforestation, mining, land degradation, reckless abstraction of groundwater, subsidence of earth surface due to withdrawal of minerals, crude oil, and groundwater, etc. Industries pose a serious threat to the natural environment by producing, solid wastes, wastewater, toxic gases, aerosols, flashes, smokes, etc.

Types of Pollution

Fig.: Types of Pollution [9]

Broadly, there are seven categories of pollution:

S. No.	Category	Major Causes/sources	Major diseases/ symptoms	Pollutants
1.	Air pollution	Fire smoke, dust, fumes,	Asthama, bronchitis, etc.	Photochemical smog, nitrogen dioxide, sulfur dioxide, particulates, carbon monoxide, etc.
2.	Water Pollution	Industrial effluent, Agricultural runoff, domestic sewage, etc.	Noxious odors, poisoning, itching, water-borne diseases, eutrophication, etc.	Organic pollutants, inorganic pollutants, heavy metals, pesticides etc.
3.	Land Pollution	Deforestation, constructions of buildings and roads, mining, agricultural chemicals, disposal of solid wastes etc. etc.	Soil erosion, groundwater contamination, loss of fertile soil, etc.	Heavy metals, pesticides, fertilizers, plastic, construction material etc.
4.	Noise Pollution	Road and buildings construction works, road traffic, industrial operations, airways and trains operations, announcements, musical events, advertisements etc.	Headaches, fatigue, anxiety, hypertension, sleeping disorder, ability to focus, etc.	
5.	Radioactive Pollution	Occurs by activities in mining, handling and processing of radioactive materials, handling and storage of radioactive waste, as well as the use of radioactive reactions to generate energy (nuclear power plants), electronic gadgets, military and aviation radars, satellites, X-Rays and wireless internet etc.	neurological, reproductive, cardiac dysfunctions, cancers and even death	CAESIUM-137, STRONTIUM-90, PLUTONIUM 238, URANIUM-235 etc.
6.	Light Pollution	outdoor artificial light	affect human health, wildlife behavior, and our ability to observe stars and other celestial objects	

7.	Thermal Pollution	Coolant from nuclear power plants and factories	Causes sudden change in temperature, decreases oxygen concentration and affects aquatic ecosystem composition	Kills fishes and other aquatic life

The first and the most lethal pollution type is Air pollution. It is one of the worst curses to have affected India. According to the International Energy Agency (IEA), by 2040 report, about 9 lakh premature deaths are likely to occur in India due to the drastic situation of air pollution in the country. Average life expectancies are likely to go down by about 15 months because of air pollution. According to the rankings of the 2016 Environmental Performance Index, India ranks 141 out of 180 countries in terms of air pollution. Facts say that air pollution caused 1.2 million deaths in India in 2017. According to the 2019 WHO list of the 10 most polluted cities in the world includes 7 in India. The National Clean Air Plan, 2018, is inadequate and needs guidelines for proper implementation. [10].

Air pollution in India is caused by fuelwood and biomass burning, burning of crop residue in agriculture fields on a large scale[11], use of impure fuel, release from vehicles, and traffic overcrowding. India is the third-largest in the emissions of greenhouse gases after China and the United States. The severity of air pollution is so much that life expectancy among Indians on average reduces by 3.4 years while among the residents of Delhi it reduces by almost 6.3 years [12].

Air pollution is determined as the presence of pollutants in the air in substantial quantities for considerable periods. Air pollutants are dispersed particles, hydrocarbons, CO, CO2, NO, NO2, SO3, etc. [13].

The transportation sector is the major contributor to air pollutants in almost every city, but this phenomenon is worse in urban cities. A significant share of vehicular emissions comes from urban cities, such as Delhi, Mumbai, Bengaluru, and Kolkata. Carbon monoxide (CO), NOX, and NMVOCs are the major pollutants (>80%) from vehicular emissions [14]. Other trace emissions include methane (CH4), carbon dioxide (CO_2), oxides of sulphur (SOx), and total suspended particles (TSPs). In an urban environment, road traffic emissions are one of the prime contributors to air pollution. Road dust is a major

contributor to PM emissions. In the Indian context, some of the essential factors of high traffic emissions include the extreme lack of exhaust measures, the highly heterogeneous nature of vehicles, and the poor quality of fuel.

Over the last few decades, India has witnessed large-scale industrialization. This has degraded the air quality in most urban cities. The Central Pollution Control Board (CPCB) has categorized the polluting industries into 17 types, which fall under the small and medium scale [15]. Out of these categories, seven have been marked as 'critical' industries that include iron and steel, sugar, paper, cement, fertilizer, copper, and aluminium. The major pollutants comprise SPM, SOX, NOX, and CO2 emissions. In Delhi, after the court's judgment in 2000, many industries were relocated from urban areas to adjacent rural areas [16]. In Delhi, a major fraction of the pollution load comes from the brick manufacturing industries, which are situated at the outskirts of the city.

Agricultural activities produce emissions, which have the potential to pollute the environment. Ammonia (NH_3) and nitrous oxide (N2O) are the key pollutants released from agricultural activities. The other agricultural emissions include methane emissions from enteric fermentation processes, nitrogen excretions from animal manure, such as CH_4, N_2O, and NH_3, methane emissions from wetlands, and nitrogen emissions from agricultural soils (N_2O, NO_X, and NH_3) due to the addition of fertilizers and other residues to the soil (14). Agricultural processes, such as 'slash and burn' are prime reasons for photochemical smog resulting from the smoke generated during the process. Crop residue burning is another process that results in toxic pollutant emissions. This is how neighbouring cities of Delhi contribute to the agricultural pollution load. This is an example of how external sources contribute to the menace of air pollution in the city [16].

The thermal power plants manufacture around 74% of the total power generated in India (15). According to The Energy and Resources Institute (TERI), the emissions of SO_2, NO_X, and PM increased over 50 times from 1947 to 1997. Thus, there is an urgent need to adopt alternative power sources including green and renewable resources for meeting the energy requirements.

In India, about 80% of municipal solid waste (MSW) is still discarded into open dumping yards and landfills, which leads to various GHG emissions apart from the issues of foul odor and poor water quality at nearby localities. Methane (CH4) is the major pollutant released from landfills and wastewater treatment plants. Ammonia (NH3) is another by-product, which is released from the composting process. The open burning of wastes, including plastic, produces toxic and carcinogenic emissions, which are a grave concern. Households are identified as a major contributor to air pollution in India. The emissions from fossil fuel burning, stoves, or generators come under this sector, thereby affecting the overall air quality. Domestic energy is powered by fuels, such as cooking gas, kerosene, wood, crop wastes, or cow dung cakes (14).

In India, the central and state governments have taken several steps to control air pollution and improve the ambient air quality. Various initiatives, such as the use of compressed natural gas (CNG) as an alternative fuel, the odd-even measures implemented in Delhi, the introduction of Bharat Stage VI vehicle and fuel standards, the Pradhan Mantri Ujjwala Yojana (PMUY), and the National Clean Air Programme (NCAP) are some examples in this endeavour. The CPCB ensures the monitoring and regulation of the NAAQS in the cities, towns, and industrial areas with the cooperation of the respective state pollution control boards (SPCBs). Under these plans, various sector-wise measures have been implemented in the urban cities of India. For the transport sector, for instance, some of these measures include the use of electric vehicles (EVs) as a mode of public transportation, development of cycling infrastructure, use of bioethanol as fuel, and the construction of multi-level cars parking facilities and peripherals to tackle congestion. Within the industrial sector, some of the measures undertaken comprise the implementation of zig-zag technology for the stack emissions from brick kilns, online monitoring of discharges through the Online Continuous Emission Monitoring Systems (OCEMS), and the installation of web cameras in highly polluting industries. To tackle the problem of open burning of garbage and household wastes, door-to-door collection of segregated wastes has been introduced and several compost pits have been established in

urban cities. In the residential sector, the government has set a target of achieving 100% usage of LPG for cooking purposes. Further, to control the concentrations of particulate matter (PM) and dust particles, various steps, such as the green buffer around cities, maintenance of 33% green cover around urban areas, installation of water fountains across the cities have been taken over the years [17,18,19,20].

The second critical type of pollution is water pollution. Water pollution occurs when unwanted materials are discharged into the water body either directly or indirectly, without any adequate treatment, thus making the water unfit for human consumption. It affects the aquatic communities as well as the living beings who depend upon it. According to World Health Organization (WHO), 80% of diseases known to mankind are due to consumption of unhygienic and bad quality of water [21].

Water pollution poses deleterious effects on all the living organisms in the biosphere. In 2015 alone, a study revealed that waterborne illnesses caused 1.8 million deaths worldwide. It can cause contamination of drinking water, thereby causing waterborne illnesses. Eutrophication causes the killing of fishes and other aquatic organisms. Toxic metals dissolved in water can make their way to humans through fish or other aquatic organisms.

Remedial measures to water pollution include avoidance of wastage of water. More stringent laws should be made and implemented for the control of industrial units so that polluted water is not disposed of directly into rivers and lakes. Industrial effluents should be treated chemically before disposing of them in water bodies. Overutilization of pesticides and fertilizers should be avoided. Sewage should be treated before discharging it into water bodies. Throwing of garbage like plastics, wrappers, fecal matter, etc., should be avoided. Cleaning of utensils and clothes, bathing of animals and humans near rivers and lakes should strictly be avoided. Rivers and lakes should be cleaned from time to time [22].

The third type of pollution is land pollution. When solid or liquid waste material is deposited on land causing degradation of topsoil thus reducing the fertility of the land then Land pollution is caused. The probable reasons for land pollution are

improper disposal of liquid or solid or radioactive or hazardous wastes from activities like agriculture, industrial, commercial, domestic, etc. Other activities like littering, mining, application of pesticides, fertilizers, and chemicals for plant growth, resulting in killing the soil biota thus disturbing the food chain and decreasing the soil productivity. For example, the accumulation of DDT (used as a pesticide) in a food chain is discussed by Rachel Carson in her famous book Silent Spring (1962). Also, the misuse of lands like deforestation, land conversion, and desertification are the key factor for land pollution.

The measures suggested for preventing the impacts of land pollution includes the practice of sustainable organic farming instead of using synthetic pesticides, switching to consumption of organic manure from hazardous bio-fertilizers, disposal of all sorts of hazardous solid wastes into secure landfills, spreading public awareness among common people to develop the habit of reducing, reuse and recycle anything [23, 24].

The next type of pollution is noise pollution. Noise is any unwanted sound. A sound that pleases the listeners is music and that which bothers others' peace is noise. At times, what is music for some can be noise for others.

Noise pollution can be categorized into four types: Transport Noise, Occupational /Industrial Noise, Neighbourhood noise, and Recreational Noise. The Ambient noise standards are mentioned in the below table [25]:

S.No.	Area	Day Time	Loge S(A) Night Time
1.	Industrial Area	75	70
2.	Commercial Area	65	55
3.	Residential Area	55	45
4.	Silence Zone	50	40

The effects of noise pollution to human health at different levels are discussed below table (25):

Noise Pollution Level and Its Harmful Effects

Level (in dB)	*Effects*
Upto 23	
30 - 60	Stress, Tension, psychological (illness, heart attack) effects especially at upper range.
60 - 90	Damage to health. Psychological and vegetative (disturbance in stomach-gall function, pains in muscles, high blood pressure, disturbance in sleeping).
60 - 120	Damages to health and otological (ear diseases) effects.
Above 120	Painful effects in long run.

The suggested measures to control the problem of noise pollution include: Prescribing noise limits for vehicular traffic, ban on honking (usage of horns) in certain areas, Creation of silence zones near schools and hospitals, Redesigning buildings to make them noise proof, Reduction of traffic density in residential areas, giving preference to the mass public transport system, minimum use of loudspeakers and amplifiers especially near-silence zones, banning pressure horns in automobiles, etc.

The next type of pollution is Radioactive Pollution. It is defined as the increase in the natural radiation levels caused by human activities. This is referred to as electromagnetic radiation. Examples include visible light, radio waves, microwaves, infrared and ultraviolet lights, X-rays, and gamma-rays. Radioactive pollution may pose a severe threat to the present as well as to the upcoming generation, even when they are present in traces in the environment. Like: genetic mutation, cancer-causing, soil infertility, biomagnification, radiation causes the distortion of cells, leading to permanent damage of the various organs and organ systems; its contact may cause burns, red lesions, and sores; and it may affect all types of living organisms such as plants, animals, aquatic life, etc.

The probable cause of radioactive pollution includes Nuclear Accidents From Nuclear Energy Generation Plants, Like the Fukushima Daiichi nuclear disaster (2011), the Chernobyl disaster (1986), and the Three Mile Island accident (1979) left many dead and even many more affected by the radiation released; The Use of Nuclear Weapons as Weapons of Mass Destruction (WMD) like the use of atom bomb in Hiroshima

and Nagasaki in 1945; mining; spillage of radioactive materials; nuclear waste handling and disposal, etc. Radioactive pollution can be mitigated by the following methods: proper disposal, storage, labeling, and handling of radioactive wastes, usage of alternative sources of energy, banning of nuclear tests and weapons. [26].

The next type of pollution is Light pollution. It is the presence of unwanted, inappropriate, or excessive artificial lighting [27]. Seasonal changes in the natural light condition play a pivotal role in the regulation of many biological processes in organisms. Disruption of this natural condition via the growing loss of darkness as a result of anthropogenic light pollution has been linked to species-wide shifts in behavioural and physiological traits [28]. The consequences of light pollution are getting worse day by day and thus it becomes inevitable to undertake initiatives to address the associated concerns. The suggested control measures to reduce light pollution includes: reduction in the use of decorative lighting during festivals and celebrations, street bulbs should be designed as such that they are covered on the upper side and light is emitting downwards thus eliminating the amount of light getting emitted to the sky. To reduce the artificial light in the night sky, LEDs, compact fluorescents (CFLs), warm-colored bulbs should be used. Switching to LED lighting allows for reduced luminance without compromising visibility. Bringing change in the basic approach towards day-to-day life like switching off unnecessary lights can hugely help in reducing light pollution.

The next type of pollution is Thermal Pollution. It is defined as a sudden increase or decrease in temperature of a natural body of water, which may be ocean, lake, river, or pond by human influence. This normally occurs when a plant or facility takes in water from a natural resource and puts it back with an altered temperature [29].

Control of thermal pollution is imperative to avoid its future lethal effects on receiving aquatic system. To mitigate the effect of chronic thermal discharge into aquatic systems, feasible solutions may be practiced, like cooling ponds, cooling towers, artificial lakes, etc. Cooling ponds indicate the reservoirs which reduce the heat of the water to a considerably

lower temperature. Cooling Towers are made to regulate the temperature of the water and dissolve the recovered waste heat thus on eliminate the issues of pollution. Artificial lakes are artificial bodies of water that supply attainable various to once-through cooling. The warmth of the water is eventually dissipated through vaporization. Also, there are various ways developed for utilizing the liquid waste discharged from power plants into useful heat resources for maximizing the advantages. Along with this, other preventive measures are also being used to control thermal pollution, which includes consumption of less electricity, holding back the hot water for good, plantation of trees on banks of water bodies, Spreading awareness among common people, reduce, recycling, and reutilization of used water, Cogeneration, Suitable arrangements in urban areas [30].

Conclusion

The problems of environmental pollution are of major concern in most developing countries. The reason is that the infrastructures of such countries are not capable enough to maintain database management systems to keep a record of the severity of pollution consequences. Also, the people of low-income countries are more interested in food and shelter than pollution and its detrimental effect on health and the environment. This chapter has given an overview of environmental pollution, its causes and effects, and ways to reduce pollution. Public awareness should be spread regarding the dangers of pollution and all activities that result in degradation of the environment must be discouraged so that remediation of an already affected environment becomes realizable. Following control measures can be followed to control environmental pollution: Eco-friendly, sustainable, and energy-efficient technologies shall be envisaged, alternative sources of energy must be utilized, proper water treatment technologies must be installed and their uninterrupted functioning and compliance should be ensured by local authorities and pollution control boards, the public shall refrain from the consumption of single-use plastics, industries should adopt green technologies and be based on zero liquid discharge, industries shall install Online continuous effluent monitoring systems (OCEMS) and get connected to the servers of pollution control boards to provide

real-time monitoring data, afforestation, social forestry shall be promoted, etc.

Reference

1. A.O. Sunday (2004) On the environmental pollution problem: A review, Journal of Environmental Engineering and Landscape Management, 12:3, 108-113, DOI: 10.1080/16486897.2004.9636828, pp.108-113.
2. Kelishadi R., Mirghaffari N., Poursafa P., and S.S. Gidding, "Lifestyle and environmental factors associated with inflammation, oxidative stress and insulin resistance in children,"Atherosclerosis, vol.203,no1,pp. 311-319,2009.
3. Kelishadi, R. and Poursafa, P., "Air pollution and non-respiratory health hazards for children." Archives of Medical Science, vol.6, no.4, pp. 483-495,2010.
4. Kargarfard, M., Poursafa, P., Rezanejad, S. and F.Mousavinasab, "Effects of exercise in polluted air on the aerobic power, serum lactate level and cell blood count of active individuals" International Journal of Preventive Medicine, vol 2, no. 3, pp.145-150, 2011.
5. Coogan, P.F.; White, L.F.;M. Jereeett et al., "Air pollution and incidence of hypertension and diabetes mellitus in black women living in Los Angeles,'" Circulation, vol.125, no. 6, pp. 767-777,2012.
6. Pollution—Britannica Online Encyclopedia; https://https://www.britannica.com/print/article/468070) (UK Environment Protection Act, 1990, Chapter 43.
7. Environment Pollution: Types, Causes, Effects; BYJU'S Exam Prep (byjusexamprep.com)
8. Environment Pollution: Types, Causes, Effects; BYJU'S Exam Prep (byjusexamprep.com)
9. Pollution: Britannica online encyclopedia
10. Environmental Issues in India Today – BulletinScore
11. http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=79630]
12. Mascarenhas, Anuradha. New Delhi.June 7, 2016. Delhi residents lose 6.3 life years from exposure to PM 2.5: Study. Indian Express
13. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and Health Impacts of Air Pollution: A Review. Front Public Health. 2020 Feb 20;8:14. DOI: 10.3389/fpubh.2020.00014. PMID: 32154200; PMCID: PMC7044178.
14. Gurjar, B.R., J.A. Van Aardenne, J. Lelieveld, and M. Mohan. 2004. Emission estimates and trends (1990–2000) for megacity Delhi and implications. Atmospheric Environment 38 (33): 5663–81
15. Gurjar, B.R., K. Ravindra, and A.S. Nagpure. 2016. Air pollution trends over Indian megacities and their local-to-global implications. Atmospheric Environment 142: 475–95.
16. (Nagpure, A.S., B.R. Gurjar, V. Kumar, and P. Kumar. 2016. Estimation of exhaust and non-exhaust gaseous, particulate matter and air toxic emissions

from on-road vehicles in Delhi. Atmospheric Environment 127: 118–24.

17. Ganguly, T., L.S. Kurinji, and S. Guttikunda. 2020. How Robust Are Urban India's Clean Air Plans? An Assessment of 102 Cities. Details available at https://www.ceew.in/sites/default/files/CEEW%20-%20How%20Robust%20are%20Urban%20India's%20Clean%20Air%20Plans%2016Jun20.pdf
18. Sharma, S., J. Mallik, S. Wilson, M. Sehgal, S. Kumar, S. Dhingra, and S. Pandey. 2018. Measures to control air pollution in urban centers of India: policy and institutional framework. The Energy and Resources Institute (TERI): New Delhi. Details available at http://www.teriin.org/sites/default/files/2018-03/policy-brief-air-pollution-in-urban-centres-of-India.pdf.
19. Sharma, S., I.H. Rehman, V. Ramanathan, K. Balakrishnan, G. Beig, G. Carmichael, B. Croes, S. Dhingra, L. Emberson, D. Ganguly, S. Gulia, O. Gustafsson, R. Harnish, C. Jamir, S. Kumar, M. G. Lawrence, J. Lelieveld, Z. Li, Nathan B. P, N. Ramanathan, T. Ramanathan, N. Shaw, S.N. Tripathi, D. Zaelke, P. Arora, P. 2016. Breathing Cleaner Air: Ten Scalable Solutions for Indian Cities.
20. Gurjar, B. R., Air Pollution in India: Major Issues and Challenges,TERI, April,2021
21. Pawari, M.J. Gawande S. (2015), Groundwater pollution and its consequence, International journal of engineering research and general science, 3(4):773-76.
22. Water Pollution: Sources, Causes, Effects and Prevention (embibe.com).
23. Zerrin Savasan, Chapter: January,2017, Encyclopedia of Big Data, Springer, DOI 10.1007/978-3-319-32001-4_168-1
24. Land Pollution: causes, effects and prevention; www.texasdisposal.com/blog/land-pollution/.
25. Project Report on Noise Pollution (environmentalpollution.in).
26. Radioactive Pollution: Causes, Effects and Solutions to Nuclear Radiation - Conserve Energy Future (conserve-energy-future.com)
27. "Light Pollution". International Dark-Sky Association. Retrieved 2021-06-26.
28. Ahmed A. A. Hussein1,2,3 & Erik Bloem3 & István Fodor4 & El-Sayed Baz1 & Menerva M. Tadros2 & Maha F. M. Soliman1 & Nahla S. El-Shenawy1 & Joris M. Koene3;Slowly seeing the light: an integrative review on ecological light pollution as a potential threat for mollusks; Environmental Science and Pollution Research (2021) 28:5036–5048.
29. Sabhadiya, J.; Thermal Pollution: Definition, Causes, And Effects - Engineering Choice.
30. THERMAL POLLUTION PDF and PPT.

20.

Risk Assessment of BHA and BHT

Dr. Madhumita Bhattacharjee*

Introduction

In the advanced quick life and with the changing way of lifestyle an intake of processed and packaged foods is expanding day by day. When the food is to be stored for a longer period, then the expansion of food additives and preservatives become a fundamental practice. Food additives are added deliberately to different food items specially the processed food to increase its durability and to keep the quality and flavour of the food intact. More than 3000 additives and preservatives may be found in processed foods. Preservatives are the substances which are added to food to restrain the development of microbes. The adding of food preservatives in food items practices date to prehistoric times. As indicated by Kumar and Panneerselvam(2007) the need for food preservation will increase as new food sources are expected to cater for the ever-increasing global human population .Food

***Associate Professor, Department of Botany, Post Graduate Govt. College for Girls, Sector -11, Chandigarh.**

preservatives may be natural or synthetic. In earlier times natural preservatives were often used, but in current food industry natural preservatives are replaced by synthetic preservatives. Synthetic preservatives are most effective for a longer shelf life of food comparative to natural food preservatives ,hence become an integral part of contemporary food industry. These food additives stop or delay the growth of microbes, suppress the reaction when food comes in contact with oxygen or heat. They also prevent the loss of some essential amino-acids and some vitamins and enhance the food flavours and colours, hence preferred over natural food preservatives.

The significant food additives are benzoic acid, nitrites, nitrates and sulphites which are used as antimicrobials, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), ascorbic acid and tocopherols are used as antioxidants. All synthetic food additives are chemical substances and so have been accused of many health hazards ranging from mild headaches to most serious diseases like cancer. A considerable amount of logical information is available ,which links food additive intolerance with various physical and mental disorders, particularly with childhood hyperactivity and hypersensitivity (Feingold, 1973, Smith, 1991). It has been accounted for that certain food additives, especially antimicrobial agents showed genotoxic impact in different test systems (Nagao *et.al.*,1977,Luca *et.al.*,1987, Renc *et.al.*,2001). Safety assessment of food additives is based on the reviews of all existing toxicological data, including observations in humans and in animal assay. Thus the present review has been planned to examine the safety assessment of commonly used food additives namely - butylated hydroxyanisole(BHA) and butylated hydroxytoluene (BHT), which will expose the unfolded truth of these risky food additives before overall population and make them mindful of hurtful impacts of these synthetic compounds.

Toxicological Status of Butylated Hydroxyanisole and Butylated Hydroxytoluene (BHA and BHT)

Butylated hydroxyanisole (BHA) and its related compound butylated hydroxytoluene (BHT) are the phenolic compounds, which are used in food for its antioxidant properties (Aml,

2013) and as preservative both. These are often added to oily food items to maintain their nutrient levels, colour, flavour and odour and so keep them away from become rancid ,when kept for a long period. They are added to packed food, meats, baked goods, cereals, snack foods, beer, animal feed, cosmetics, rubber, medicines and petroleum products etc. Yet there is a ban on the usage of butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), but it is a commonly used food additive in India .

BHA and BHT both have side effects in form of headaches, joint pain, heart palpitations, allergies, and cancer . BHA and BHT both have been associated with many health ailments like child hyperactivity, damage to the lungs, liver, and kidneys and even cancer (Tran, 2013). As indicated by Thakore (2014) BHA can bind to cellular macromolecules, such as proteins and DNA and cause reproductive toxicity and cancer. The treatment of cells with BHT can enhance the susceptibility of rat thymocytes to oxidative stress and also notably increases the population of dead cells on rat thymocytes (Kamemura,2018). Research investigations have shown that BHA and BHT can be carcinogenic at high doses, while BHT at 250 mg/kg/day increases spontaneous neoplasms and tumor-promoting activity (Williams *et. al.,* 1999). BHA can chemically initiate tumours in rats (Whysner, *et.al.;* 1994, Bauer, *et.al.,*2001). Both cancer-causing and anticarcinogenic properties have been accounted for the synthetic antioxidants butylated hydroxyanisole and butylated hydroxytoluene (Botterweck *et.al.*,2000). At low concentration both BHA and BHT can act as chemopreventive agents, but at high concentration they can be carcinogenic (Branen, 1975; Williams *et. al.,* 1999). Another investigation showed that BHA caused forestomach hyperplasia and cytotoxicity (Ito *et. al.,* 1986). At the concentration levels of 1000 ppm, 1500 ppm, 2000 ppm, 2500 ppm these preservatives were investigated on the root tips of *Allium cepa* for 4h,8h and 16 h., and revealed statistically noteworthy inhibition in mitotic index with an increase in concentration of the food preservatives when compared with the control. (Pandey *et.al.*,2014). The International Agency for Research on Cancer (IARC monograph, 1987) classifies BHA as a possible human cancer-causing agent . As per Wada *et.al.*(2004) high proportion

of BHT might impersonate estrogen which is an essential female sex hormone (Schrader and cooke,2000) resulting in adverse reproductive affects. BHT encouraged hepatotoxicity with an increased serum ALT, AST AND GGT levels , when toxicity investigation of butylated hydroxyl toluene (BHT) in rats was done by Panicker *et.al.* (2014). The cytotoxicity and apoptosis-promoting activity of butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) and the combination of BHA and BHT (BHA/BHT) (1:1, molar ratio) were explored, using human promeylocytic leukemia cell lines (HL-60) and human squamous cell carcinoma cell lines (HSC-2) by Saito *et.al.(*2003) and both chemicals were established to be cytotoxic.

Conclusion

On the basis of above discussion it is clear that the food additives which are used in different food and other items regularly and indiscriminately can cause serious health hazards. People must aware about the dangerous effects of these chemicals in food, cosmetics and pharmaceuticals and the steps should be taken to replace the synthetic food additives with natural additives specially the natural preservatives .Natural preservatives offer greater advantages over their artificial counterparts due to their non-toxic nature along with a wide range of health benefits .

References

1. Aml, F. E.(2013) Effects of Butylated Hydroxytoluene and Butylated Hydroxyanisole Against Hepatotoxicity Induced by Carbon Tetrachloride in Rats. World Applied Sciences Journal ,22 (1): 63-69
2. Bauer, A.K., Dwyer-Nield, L.D., Hankin, J.A., Murphy, R.C., Malkinson ,A. M. (2001) The lung tumor promoter, butylated hydroxytoluene (BHT), causes chronic inflammation in promotion-sensitive BALB/cByJ mice but not in promotion-resistant CXB4 mice. Toxicology, 169(1):1-15
3. Botterweck, A.A., Verhagen, H., Goldbohm, R.A., Kleinjans, J., van den Brandt, P.A.(2000) Intake of butylated hydroxyanisole and butylated hydroxytoluene and stomach cancer risk: results from analyses in the Netherlands Cohort Study.Food chem. Toxicol.,38(7): 599-605
4. Branen, A. (1975) Toxicology and biochemistry of butylated
5. hydroxyanisole and butylated hydroxytoluene. Journal of the American Oil Chemists' Society, 52: 59–63
6. Feingold, B.F.(1973) Food additives and child development. Hospital Practice, 8:11-21
7. Ito, N., Hirose, M., Fukushima, S., Tsuda, H., Shirai, T., and Tatematsu, M. (1986) Studies on antioxidants: Their carcinogenic and modifying effects on chemical carcinogenesis. Food and Chemical Toxicology, 24: 1071– 1082
8. Kamemura N. (2018) Butylated hydroxytoluene, a food additive, modulates

membrane potential and increases the susceptibility of rat thymocytes to oxidative stress. Computational toxicology, 6 :32-38

9. Kumar,L. P. and Panneerselvam , N. (2007) Cytogenetic studies of food preservative in Allium Cepa root meristem cells. Facta Universitaties (Medicine And Biology),14(2) : 60 – 63
10. Luca D, Luca V, Cotor F, Raileanu L.(1987) In vivo and in vitro cytogenetic
11. damage induced by Sodium nitrite. Mutation Research, 189: 333–339
12. Nagao M, Honda M, Seino Y, Yahagi T, Kawachi T. (1977) Mutagenicities of protein pyrolates. Cancer Lett.,: 2: 335–339
13. Pandey,H. Vikas Kumar, B.K. Roy (2014) Assessment of genotoxicity of some common food preservatives using Allium cepa L. as a test plant. Toxicology Reports, 1 :300–308
14. Panicker,V. P.,Sisilamma , G,Dhanush, K.B. (2014)Toxicity stusdy of Butylated Hydroxyl Toluene (BHT). World J.Pharmacy and Pharmaceutical Sciences, 3(8) :758-763
15. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans ((1987) Overall Evaluation of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42. Supplement 7 ,International Agency for Research on Cancer, Lyon :59
16. Renc E, Ila HB, Kayraldız A, Topaktas M.(2001) Chromosome aberrations and Sister Chromatid exchanges in cultured human lymphocytes treated with sodium metabisulphite food preservative .Mutat Res/Genet Toxicol Environ Mutagen ,490: 107–112)
17. Saito , M. , Sakagami , H. ,Fujisawa , H. (2003) Cytotoxicity and apoptosis induction by butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT).Anticancer research, 23 (6C):4693-701
18. Schrader, T.J. and Cooke, G. M. (2000) Examination of selected food additives and organochlorine food contaminants for androgenic activity in vitro», Toxicological Sciences, 53, (2): 278-88
19. Smith J.M. (1991) Adverse reactions to food and drug additives. European J. Clin. Nutr.,45(1): 17–21
20. Thakore K.N.(2014) Butylated Hydroxytoluene. Encyclopaedia of toxicology 583-584.
21. Wada, H. et.al., "In vitro estrogenicity of resin composites," Journal of Dental Research, 83(3) :222-6
22. Tran, A. V. (2013) Do BHA and BHT Induce Morphological Changes and DNA Double-Strand Breaks in Schizosaccharomyces pombe?. Scripps Senior Theses. Paper 152.
23. Wada, H. Tarumi,H.,Imazato,S., Narimatsu,M., Ebisu,S. (2004) In vitro estrogenicity of resin composites», Journal of Dental Research 83(3) :222-6
24. Whysner, J., Wang, C. X., Zang, E., Iatropoulos, M. J., and Williams, G. M.(1994) Dose response of promotion by butylated hydroxyanisole in chemically initiated tumours of the rat forestomach. Food and Chemical Toxicology 32: 215–222
25. Williams, G., Iatropoulos, M., and Whysner, J. (1999) Safety Assessment of Butylated Hydroxyanisole and Butylated Hydroxytoluene as Antioxidant Food Additives. Fd Chem Toxicol,37(9-10):1027-38

21.

Sources of Toxic Chemical Waste and Its Hazardous Effect on Environment

Bharat N. Shelke*

Introduction

The environmental pollution and waste management are the major issues for the developing countries. The urbanisation, industrialisation and technological development are the main cause for environmental hazards. The routine activity of humankind has great impact on environment. An enormous increase in population and its massive requirement ultimately affects on environmental resources. There are several environmental issues viz. air pollution, water pollution, solid waste, e-waste, ozone depletion, deforestation, and global warming. The environmental pollution is increasing day by day. Air pollution and water pollution are significantly responsible for health issues of living organism. Non-biodegradable and non- recycled waste directly discarded into the environment. Due to the various industrial chemical processes and greenhouse effect, the toxic gases like

***Department of Chemistry, M.V.P. Samaj's Arts, Science and Commerce College, Ozar (Mig) Nashik, Maharashtra, India.**

CO_2, Methane and CFC evolved in to the environment which is responsible for ozone layer depletion. Now a day, all the organisation working on environmental issues and its impact due to its harmful effects on living things.

The toxic waste materials like solid waste and e-waste are less hazardous compared to liquid waste derived from chemical industry. Some of the toxic waste chemicals in the form of solution are directly discarded into the environment. These chemicals even in trace amount are highly dangerous and disturb the aquatic life. Most of the chemicals give colour to the water resources in which it is discarded. The highly soluble chemicals cannot be separated by simple water treatment techniques like filtration, osmosis, co-precipitation etc. The liquid waste contains hazardous chemicals from research laboratories, analysis laboratories as well as school and college laboratories need to be pre-treatment before its disposal into the environment. The contaminated water through toxic chemical may cause adverse effect on living animals and plants. Agrochemical industry, pharmaceutical industry, dyes and pigments, textile, surfactant, plastic and polymer industry releases tonnes of liquid chemical waste into the environment. Many of these industries do not follow the proper mechanism for liquid waste treatment. Chemical industry effluent is the main source of liquid waste which causes negative consequences on environment. The liquid waste contains toxic heavy metals, complex molecule and solvent which have adverse effect on human health.

Sources of Chemical Waste

Agrochemical Industry

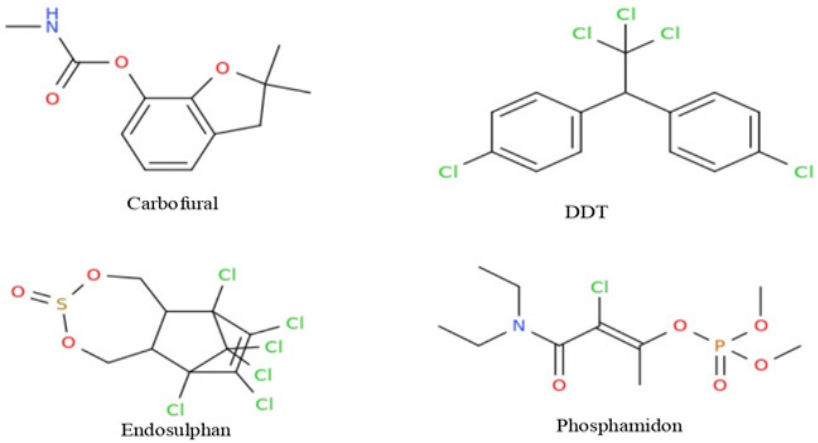
Pesticides: A recent trend to enhance the crop yield and reduces crop maturity time ultimately enforces the use of agrochemicals. It includes pesticides, insecticide, fungicides, herbicides, rodenticides and nematocides. Pesticides and insecticides are mostly used chemicals by the farmer for good productivity. Excess use of agrochemicals causes hazardous effect on environment. From literature it is observed that total 5.2 billion pound of pesticides is annually used in the world. Excess use of pesticide is responsible for health and environmental issues. Pesticide contains organochlorines, organophosphates, carabamates, pyrethroids and neonicitinoids. All these ingredients are highly toxic when it releases into the environment due to formation of metabolites.

Hazardous Effects

1. Direct contact of pesticides to human being causes dizziness, diarrhoea, nausea, vomiting, blindness, Itching and rashes on skin.
2. Excess inhalation of pesticide may cause death.
3. Pesticide affect on nervous system includes memory loss.
4. Accumulation of pesticide affects on reproductive system which influence on birth defect, abortion and infertility.
5. Pesticide also damages lungs, kidneys and liver.
6. Contamination of water due to pesticides is harmful to

aquatic life.

7. Atrazine pesticide has been found very toxic to fish while carbaryl found toxic to amphibian species.
8. Endosulphan and chloropurifos reagent presence in water destroys the aquatic life.
9. The uses of herbicides such as sulphonamide, imidiazolinones and sulphonylurease have negative impact on plant communities.
10. Fungicides and insecticides damage to earthworms which is useful to enhance soil fertility.
11. The growth of nitrogen fixation bacteria is reduced due to heavy dose of fungicides.



Structure of Some Hazardous Agrochemicals

Fertiliser Industry

The crop productivity can be improved by the use of massive amount of fertilisers. Nitrogen, Phosphorus and Potassium (N, P, K) are the main constituent with Fe, Mn and Zn as minor constituents in any type of fertiliser. Excess use of inorganic fertiliser affects on soil fertility and negative impact on environmental ecosystem. In the process of manufacturing of fertiliser, the toxic gases entered into the atmosphere causes air pollution. Nitrogen is the main source of inorganic fertiliser while organic fertiliser derived from animal and plant waste. The added nutrient from fertiliser is used to promote soil

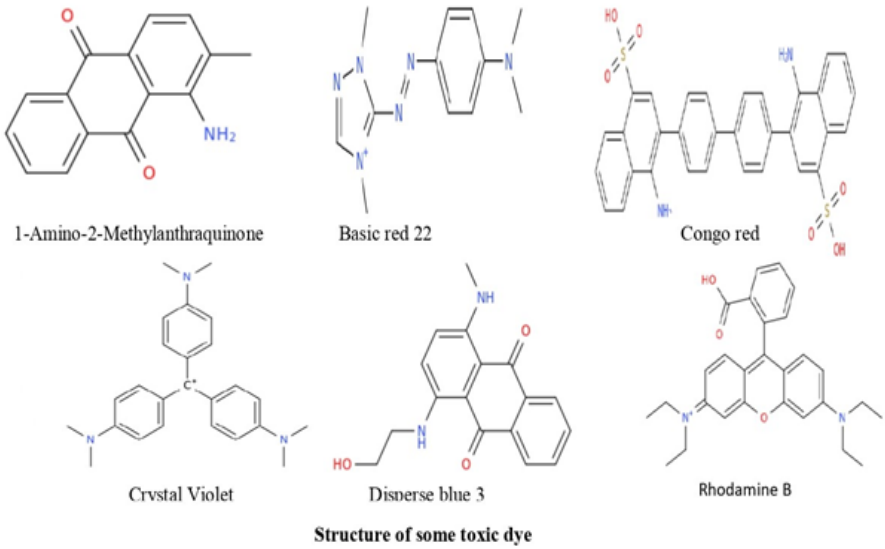
fertility and plant growth.

Hazardous Effect

1. The gases like N_2O and CO_2 released into the environment during the production of nitrogenous fertiliser which causes air pollution.
2. The gases release from fertiliser industry is responsible for Ozone layer depletion.
3. The trace amount of heavy metal presence in triple super phosphate fertiliser enters into the human body through the food chain and causes severe health problems.
4. An excess use of fertiliser diminishes soil acidity and depletion of humus which affect on soil nutrient availability.
5. Chemical fertiliser kills the soil microorganisms which are beneficial for soil fertility.
6. Chemicals from fertiliser contaminate to the water through ponds, rivers and create hazardous health effect on animal body.

Pharmaceutical Industry

For the treatment of different types of diseases and disorders, continuous scientific formulation of drugs, research and development of drug is carried out in pharmaceutical industry. Due to increase in population and its health issue, pharma industry have tremendous demand. There are certain treatment and processes on chemical reagents for the preparation of drug having specific action. A variety of chemicals such as acids, bases, oxidising agents, reducing agents, gases, aromatic compound and solvents are required for formulation. The reaction byproducts, solvent and gases are the main effluent of pharma industry. All these chemicals are very toxic and if it is released into the environment without proper treatment then it causes several hazardous effects on biotic things.



Structure of some toxic dye

Structure of some Pharmaceutical Drugs

Hazardous Effects

1. Toxic gases releases from pharmaceutical industry causes atmospheric pollution like HCN, NH_3, HF, SO_2, NO and CO.
2. For manufacturing of sulphonic chloride derivatives, the raw material sulfonating agent produces acidic gas which causes respiratory diseases.
3. The organic solvents which are easily discarded into the environment like benzene, dichloromethane, chloroform, diethylsulphate and formaldehyde are carcinogenic.
4. Nitrites, diphenyls, trichloroethane affects on cardiovascular system.
5. The presence of lead, toluene, ethylene oxide in industrial effluent damages the reproductive system of human being.
6. Silica, Kaolin, Phthalic anhydride, asbestos attacks on pulmonary system and responsible for pneumonia and asthma.
7. Arsenic, Vanadium and Mercury creates throat infection.
8. Benzyl chloride, acetaldehyde, copper dust forms yellow stain on skin.

Dye Industry

Textile industry utilises tonnes of dyes annually and around 15-20% of dye release into the environment in different forms. Acidic dye, Basic dye, Vat dye, Disperse dye, Direct dye are the types of dyes used for colouring and dyeing purpose. All these dyes are toxic which creates several environmental issues. Dyes are coloured complex organic molecule soluble in water and organic solvents. Many dyes are non-biodegradable having good stability are more harmful to the environment.

Hazardous Effects

1. Dyes in water absorb and reflects sunlight which diminishes photocatalytic activity.
2. The oxygen level in water may decrease due to the presence of dye molecule.
3. Azo dye and nitro dyes are carcinogenic.
4. Dyes are mutagenic causes chromosomal fracture.
5. It attacks on respiratory system which is responsible for respiratory diseases.
6. Basic dyes increases heartbeat causes jaundice, vomiting and cyanosis.
7. Synthetic textile dye gives skin irritation and allergic reactions.
8. Disperse dye causes eye irritation.

References

- Ibro Skenderovic, Becir Kalac, Suad Becirovic, Environmental pollution and waste management, Balkan Journal of Health Science, 2015.Volume 3 (1).
- Isra Mahmood , Sameen Ruqia Imadi , Kanwal Shazadi , Alvina Gul and Khalid Rehman Hakeem, Effects of Pesticides on Environment, Plant, Soil and Microbes, 2016
- Md. Wasim Aktar , Dwaipayan Sengupta , Ashim Chowdhury, Impact of pesticides use in agriculture: their benefits and hazards, Interdisc Toxicol. 2009; Vol. 2(1): 1–12.
- Chanti Babu Patneedi and K. Durga Prasadu, Impact of pharmaceutical wastes on human life and environment, Rasayan J. Chem 2015, Vol. 8 (1), 67-70.
- Susmita Rajbongshi, Yamini Dushyant Shah and Ahsan Ullah Sajib, Pharmaceutical waste management: a review, European Journal of Biomedical and Pharmaceutical Sciences, 2016, Volume 3 (12), 192-206.
- Ahmed E. Al Prol, Study of Environmental Concerns of Dyes and Recent

Textile Effluents Treatment Technology: A Review, Asian Journal of Fisheries and Aquatic Research 2019, 3(2), 1-18,

- OPSIN: Open parser for systematic IUPAC nomenclature

◆ ◆ ◆

22.

Cleaning the River Damodar (India) : Impact of COVID-19 Lockdown on Water Quality and Future Rejuvenation Strategies

Zaheen Hasan*

D.D.Tewari**

Introduction

The outbreak of CORONAVIRUS disease (COVID19) mostly affects the global human health, economic lifeline and sociocultural rhythm. First, the virus was discovered at Wuhan city of China in December2019 and it spreads rapidly from affected person to another unaffected person through sneezes, coughs, etc. Nearly 210 countries of the w orld have been affected up to April 2020 through rapid transmission of COVD19 vir us (Yunus et al. 2020). Yet noperfect remedial medicine or vaccine has been discover ed till now and thus human body gets seriously exaggerated by severe acute respirato ry syndrome (SARS) due to corona virus. On this critical circumstance, world health organization (WHO) suggested to maintain social distancing and mandatory facemask for the people. Most of the countries

***Water Analysis Lab,TM.L.K. (P.G.) College, Balrampur U.P.**

****Associate Professor, Department of Botany, M.L.K.(P.G.) College, Balrampur (U.P.)**

announced sudden 'lockdown' to avoid public transmission as well as break the infection chain. Worldwide, almost all the sectors have been temporarily clogged during lockdown. In India, 'lockdown is started from March 25, 2020, by the order of central Government. All the industries are almostclo sed during this period and thus environment gets unique chance to rid off from huge pollution load released by industries. Though, improvements of environmental quality have been occurred temporarily but it is considered that pollution load was comparativ ely low with respect to pre lockdown period.

Water is one of the very important life supporting components of the environment an d it gives energy to all biotic and abiotic elements of the ecosphere and it maintains the environmental equilibrium. This natural resource has been vehemently polluted by various human activities such as industrialization, urbanization, agricultural practice and over exploitation in normal times. But it is examined that pollution level of aquaticen vironment has been remarkably dropped because of no mixing of industrial waste wat er, solid waste, heavy metals, etc., during lockdown period (Hader et al. 2020). Are cent study on water quality of river Ganga near Kolkata city indicates much higher 1 evel of dissolved oxygen (DO) in lockdown period compared to previous years (Dhar et al.). Another study on Hooghly estuary near Haldia port, West Bengal demonst rates the enrichment of ichthyoplankton species due to no mixing of industrial waste water and crude oil to the water (Mitra et al. 2020). Investigation on bacterial load a S total coliform (TC) on river Ganga at lower course reveals a significant drop of ba cterial community in this river ecosystem because no activity of industrial, tourism or traffic sector in lockdown (Mukherjee et al 2020). The river Ganga (In India) appear s very clear and transparent picture at many places during lockdown period (Mani 2020).

Just like river Ganga, another important river Damodar of Chota Nagpur Plateau regio n is getting huge pollutants from its weil developed industrial and urban catchment. Minerals and coal rich Damodar river basin is highly famous for agriculture and indu strial growth. Meanwhile, the waste effluents, heavy metals, toxic elements from nearb y industries

have been discharged into the river and lowering water quality as well a Sriver ecosystem. Many contemporary researches on water quality of Damodar have been conducted through various modem methods and techniques (Tiwari and Dhar 1994; Basu and Mitra 2002; Tiwari and Abhishek 2005; George et al. 2010; Chatterjee et al. 2010; Banerjee and Gupta 2012; Mukherjee et al. 2012). These relevant studies (physical, chemical or biological assessment) were conducted through popular methods such as water quality index (WOI), pollution load index (PLI), enrichment factor (EF), aseptic techniques (microbial analysis), descriptive statistics, etc. WQI is commonly ap plied by researchers to evaluate the water quality. It was initially developed by Horton (1965) with using 12 common physical, chemical and biological parameters (pH, ele ctrical conductivity, temperature, turbidity, total suspended solids, alkalinity, chloride, ni trate, total phosphate, biological oxygen demand, dissolved oxygen, coliform). But there are some limitations in this method. Similarly, WQI is calculated by giving unequal weightage on the basis of its importance to overall water quality (Pesce and Wunder lin 2000; Liou et al. 2004; Tsegaye et al. 2006. If any parameter of lower concentr ation was assigned by higher weightage, it could lead to wrong interpretation on final results of WQI (Swamee and Tyagi 2000; Juwana et al. 2012) Another two method s for assessing water quality are heavy metal pollution index (HPI) and integrated water quality index (IWQI) and it mainly identifies metal pollution of the water. HPI is also based on weightage method (Mohan et al. 1996). IWQI is a new approach to determine water quality (Mukate et al. 2019). Both of these two methods are followe d highest desirable limit and maximum permissible limit of parameters concentration. On the other hand, BIS (2012) and WHO (2011) generally suggest maximum permissi ble limit with no highest or lowest limit. Therefore, HPI and IWQI methods usually become inappropriate by using BIS and WHO standards (Chaturvedi et al. 2018.

Thus, to avoid the difficulties of weightage and sensitivity of indexing, there has bee n emerged a new concept of water quality analysis, i.e., water pollution index (WPI). It is very flexible index method which deals with large number of parameters as ph ysical, chemical ions, heavy metals or even

microbial components without putting any weightage. For this convenience, there are no needs to calculate of WOI or HPI se parately (Hossain and Patra, 2020).

In the present study, the objective is mainly to evaluate changes of surface water qua lity in respect of physical, chemical and heavy trace metals for some selected industri al effluent discharge sites of river Damodar during lockdown period using WPI method and GIS technology.

Material and Methods

Procedures of Sample Collection and Analysis

Water samples were collected from eleven (11) discharge sites of industrial effluents on both side of river Damodar in prelockdown and lockdown period (December 2019) and again during lockdown period (July 2020) for the evaluation of changes of water quality (Fig. 1). These samples were obtained from 0.5 m depth of surface water w ithin 5 m radius of influence point. Five samples were collected at each site and the se are mixed for bulk amount (1 lit). Sample locations were recorded using portable GPS handler (GARMIN GPS). All samples were preserved in pre-cleaned polyethylene bottles (500 ml) and properly carried to laboratory for analysis.

Physical parameters such as pH and EC were measured in situ by their portable meter (Hanna HI9811-5). TDS was measured as suggested by Hem (1991).

Chemical parameters like cations (Ca^{2}+, Mg^{2}+, K^{+}, Na^{2+}) and anions (F^{-}, Cl^{-},No_3^{-}, So_4 CT,) were estimated by ion chromatography (883 Basic IC plus). Concentration of hea vy metals such as Cd, Zn, Pb, Cu, Ni, and Fe was primarily in concentrated Hco_3 (pH <2) for next analysis. All metals were analyzed by Anodic Stripping Voltammetry (VA797, Switzerland) with three different pulse analyzer in a Hanging Mercury Drop electrode (3 MKCL). Personal computer (Windows) was used for recorded peak of voltammetric analysis.

Calculation of water pollution index (WPI) Around 17 parameters were analyzed by water pollution index (WPI) method and it is a new approach of water quality analysis. Applying standard permissible limits of WHO (2011), different

parameters have been analyzed. Similarly, WPI of river Damod ar has been used following the steps (Hossain and Patra (2020)

At first. PL_i (Pollution Load) of each parameter was calculated as following:

PLi=1+(Ci-SiSi)PLI=1+(C-SiSi) (1)

where, Ci means measured concentration of *i*th parameter, S*i*, means standard limit of permissible for *i*th parameter. Hossain and Patra (2020) suggest a different formula fo I calculation of PLi for pH by following

PLi=Ci-7Sia-7Pi=Ci-7Sia-7 (2)

where, pH concentration is <7, there S*ia* would be minimum permissible limit of pH, i.e., 6.5. If, pH concentration is >7 then Sib would be minimum permissible limit of pH, i.e., 8.5 apply ing following equation:

PLI=Ci-7S^{ib}-7PLI=Ci-7Sib-7 (3)

Overall WPI were calculated by summation of al values of PL*i* of *n* parameter and finally divided by *n* (no. of parameters). The WPI values were classified based on n number of parameter into four categories (Table-1).

WPI=1n$\sum^{ni}$=1PL^{i}

Table :1

Classfication of WPI

WPI value	**Category**
<0.5	Excellent water
0.5–0.75	Good water
0.75–1	Moderately polluted water
>1	Highly polluted water

All WPI values of prelockdown and during lockdown were interpolated using inverse distance weightag e method (IDW) in GIS platform for showing spatial distribution of water quality on river Damodar.

Difference between water quality of prelockdown and lockdown period were analyzed by descriptive sta tistics, Pearson's correlation analysis, and 7" test using SPSS 16 software.

Result and Discussion

Hydrochemistry of Water Samples of River Damodar

Descriptive statistics and correlation matrix of water samples has been presented for prelockdown period

(Tables 2 and 3 and during lockdown period (Table 4). In prelockdown period pH ranged from 7.04 to 8.21. During lockdown very low mixing of liquid effluents from industries helps to decrease pH 1 evel of river water and it ranged from 6.12 to 7.72 TDS and EC are directly related to each other a s increasing of dissolved solids rises electrical conductivity power of water body. In prelockdown perio d. TDS was very high due to high amount of mixing of waste materials to the river bed which is in creased solubility of soil in the water. TDS in prelockdown ranged from 665.6 to 806.4 mg/l and fro m 480 to 563.2 mg/l during lockdown period. EC ranged from 1040 to 1260 S/cm in prelockdown p eriod and from 750 to 880 uS/cm during lockdown period. All values of these physical parameters we re higher than their standard limit of permissible according to WHO (2011) guidelines in prelockdown Session and lower in lockdown session.

Table 2

Descriptive Statistics of Parameters in Prelockdown and During Lockdown Period

	Prelockdown	During lockdown		WHO guidelines (2011)	
	Range	Mean ± *SD*	Range	Mean ± *SD*	
pH	7.04–8.21	7.45 ± 0.37	6.12–7.72	6.92 ± 0.48	6.5–8.5
TDS (mg/l)	665.6–806.4	740.65 ± 50.23	480–563.2	524.85 ± 26.29	500
EC (µg/l)	1040–1260	1157.27 ± 78.49	750–880	820.09 ± 41.09	750
Ca^{2+} (mg/l)	94–194	131.09±34.13	50–79	64.81±9.48	75
Mg^{2+} (mg/l)	50–85	70.36±11.00	22–32	27±3	50
Na^{2+} (mg/l)	430–560	500±42.66	76–120	95.09±12.12	200
K^{+} (mg/l)	210–380	278.18±59.96	57–99	81.45±12.71	200
So_4^{2-} (mg/l)	300–410	358.18±41.18	70–170	127.27±34.37	250
Cl^{-} (mg/l)	290–480	407.27±65.12	170—220	198.18±17.21	250
No_3^{-} (mg/l)	75–110	86.45±9.59	21–47	35.18±8.53	45
F^{-} (mg/l)	1.6–2.2	1.96±0.18	0.14–1.11	0.71±0.34	1.5
Zn^{2+} (µg/l)	3200–4700	3984.54±628.03	1200–1840	1593.63±201.90	3000
Cd^{2+}(µg/l)	12.2–19.45	16.20± 2.85	1.2–2.6	2±0.44	3

Pb^{2+} (µg/l)	18–33	26.18±5.23	3.4–7.9	5.80±1.52	10
Cu^{2+} (µg/l)	1600–2700	2343.63±370.60	840–1600	1090.90±281.33	2000
Ni^{2+} (µg/l)	140–230	184.54±33.57	34–65	51.72±9.26	70
Total Fe (µg/l)	1130–1900	1618.81±262.73	120–250	207±45.95	300

Table-3

Correlation Matrix of Prelockdown

pH	TDS	EC	Ca2 +	Mg2 +	Na2 +	K +	So4 −	Cl−	No3−	F−	Zn2 +	Cd2 +	Pb2 +	Cu2 +	Ni2 +	Total Fe	
pH	1																
TDS	0.29	1.00															
EC	0.29	1.00	1.00														
Ca2+	0.69	0.15	0.15	1.00													
Mg2+	0.36	0.56	0.56	0.46	1.00												
Na2+	0.60	0.59	0.59	0.71	0.74	1.00											
K+	0.37	0.59	0.59	0.61	0.47	0.86	1.00										
So4 −	0.56	0.31	0.31	0.61	0.58	0.86	0.71	1.00									
Cl −	0.63	0.50	0.50	0.68	0.77	0.97	0.79	0.89	1.00								
No3−	0.47	0.24	0.24	0.81	0.43	0.80	0.76	0.70	0.74	1.00							
F −	0.39	0.33	0.33	0.63	0.55	0.81	0.72	0.87	0.83	0.78	1.00						
Zn2+	0.68	0.21	0.21	0.77	0.42	0.84	0.76	0.92	0.87	0.79	0.83	1.00					
Cd2+	0.60	0.32	0.32	0.65	0.60	0.91	0.78	0.95	0.94	0.77	0.83	0.95	1.00				
Pb2+	0.60	0.58	0.58	0.65	0.66	0.91	0.87	0.87	0.92	0.65	0.79	0.87	0.91	1.00			
Cu2+	0.50	0.51	0.51	0.67	0.88	0.92	0.72	0.83	0.96	0.70	0.85	0.76	0.86	0.86	1.00		
Ni2+	0.61	0.43	0.43	0.69	0.56	0.94	0.84	0.94	0.93	0.82	0.85	0.92	0.94	0.88	0.82	1.00	
Total Fe	0.48	0.63	0.63	0.63	0.85	0.92	0.77	0.83	0.93	0.68	0.86	0.75	0.84	0.91	0.98	0.83	1.00

Table-4

Correlation Matrix of lockdown period

	pH	TDS	EC	Ca+2	Na2 +	Mg+2	So4−	Cl−	No3−	F−	Zn2 +	Cd2 +	Pb2 +	Pb+	Cu2 +	Ni+2	Fe
pH	1																
TDS	0.47	1.00															
EC	0.47	1.00	1.00														
Ca2+	0.59	0.59	0.59	1.00													
Mg2+	0.31	-0.02	-0.02	-0.06	1.00												
Na2+	0.60	0.32	0.32	0.17	0.74	1.00											
K+	0.53	0.33	0.33	0.40	0.47	0.58	1.00										
So4 −	0.69	0.38	0.38	0.63	0.58	0.54	0.71	1.00									
Cl −	0.63	0.62	0.62	0.62	0.77	0.50	0.79	0.89	1.00								
No3 −	0.62	0.37	0.37	0.41	0.43	0.12	0.76	0.70	0.74	1.00							
F −	0.50	0.42	0.42	0.46	0.55	0.34	0.72	0.87	0.83	0.78	1.00						
Zn2+	0.52	0.34	0.34	0.41	0.42	0.27	0.76	0.92	0.87	0.79	0.83	1.00					
Cd2+	0.60	0.43	0.43	0.48	0.60	0.41	0.78	0.95	0.94	0.77	0.83	0.97	1.00				
Pb2+	0.43	0.35	0.35	0.25	0.66	0.33	0.87	0.87	0.92	0.65	0.79	0.97	0.95	1.00			

Cu2+	0.28	0.02	0.02	-0.017	0.88	0.41	0.72	0.83	0.96	0.70	0.85	0.77	0.71	0.85	1.00		
Ni2+	0.46	0.35	0.35	0.34	0.56	0.66	0.84	0.94	0.93	0.82	0.85	0.97	0.96	0.97	0.80	1.00	
Total Fe	0.59	0.35	0.35	0.61	0.85	0.76	0.77	0.83	0.93	0.68	0.86	0.94	0.93	0.87	0.61	0.88	1.00

Major cations such as Ca^{2+}", Na^{2+}, Mg^{2+}, K^{+} were found very high amount in all sam ples of prelockdown period as guided by WHO (2011). In this period, mean cationc oncentration of river water was in a sequence of Na^{2+}>K^{+}> Ca^{2+} > Mg^{2+} Regular dep ositions of waste effluents from nearby chemical industries are the main cause of hig h mixing of sodium and potassium. In lockdown period temporary stopping of industri al activities effectively decreased level of these chemical ions after few months. In th is period, it was noticed all of these parameters lowered down than their standard li mit (WHO 2011). During lockdown mean value of cations was arranged same as pre lockdown.

Major anions as $S0_4$, Cl, No_3 and F^{-} are very important determinant of water qual ity. In premonsoon session, all parameters were higher than permissible limit. In this session anions were arranged as an order of CI^{-} > $S0_4^{-}$ > No_3^{-} >F^{-}. Effluents from near by cement factory, sponge iron factory are the main factors of high concentration of chloride and sulfate in sample water. During lockdown all of these parameters found very low amount in river water and all of them were in safe limit.

Mean concentration of heavy metals in river water was in the order of Zn^{2+} > Cu^{2+}> Fe> Ni^{2+} > Pb^{2+} > Cd^{2+} in both pre lockdown and lockdown period. Higher concentration of zinc, copper, ferrous indicated higher deposition of solid and liquid materials from nearby iron and steel industries, thermal plant in the bank of river Damodar. Accordi ng to WHO (2011), most of the samples were above permissible limit of concentratio n in this session. During lockdown, no mixing of industrial toxic elements helps to d ecrease the level of heavy metals in river water and indicated their concentration und er permissible limit set by WHO (2011).

Hypothesis testing (T test)

Hypothesis testing was done by T test to understand whether there were any change in individual water quality parameter between prelockdown and lockdown period. Statis tical analysis of T test showed that around 17 parameters indicated their Tvalue grea ter than table value at 0.05% level of significance (Table). Thus, rejection of null hypothesis (H) strongly suggested that there has significantly reduced the concentration of parameters and improvement of water quality at the study area due totemporarily losing of industries.

Table-5

Values of 'T' test for hypothesis Testing

Parameter	*'t'*-value	*P* value (%)
pH	3.105424	0.05
TDS (mg/l)	12.34664	0.05
EC (µg/l)	12.34664	0.05
Ca^{2+} (mg/l)	6.412227	0.05
Mg^{2+} (mg/l)	13.87425	0.05
Na^{2+} (mg/l)	41.18781	0.05
K^{+} (mg/l)	13.30681	0.05
So^{4-} (mg/l)	102.5283	0.05
Cl^{-} (mg/l)	13.78952	0.05
No_3^{-} (mg/l)	30.93489	0.05
F^{-} (mg/l)	17.2788	0.05
Zn^{2+} (mg/l)	17.30211	0.05
Cd^{2+} (mg/l)	19.32441	0.05
Pb^{2+} (mg/l)	17.63277	0.05
Cu^{2+} (mg/l)	13.48275	0.05
Ni^{2+} (mg/l)	17.35355	0.05
Total Fe (mg/l)	21.43122	0.05

Status of Damodar Water Analyzed by Water Pollution Index (WPI)

On the basis of sample collection from 11 discharge points of industrial effluents at different stretches of river Damodar (on prelockdown and lockdown period), WPI have been done using standard permissible limit of, 17 different parameters prescribed by WHO (In prelockdown period, WPI ranged

from 1.59 to 2.46 with mean value of 2.07 (Table) All samples (100%) are indicated the high level of pollution in th is session. Highest WPI value was found in SIO location. Toxic pollutants are directl y discharged into the river and these toxic elements are regularly released from nearb y chemical industry. During lockdown period, closing of all types of heavy industries significantly help to reduce pollution level of river water. Near about three months of industrial inactivity brought no such waste effluents to the river bed. WPI values of t his session showed very noticeably and ranged from 0.52 to 0.78 with mean value of 0.66. In this period, around 90.90% of samples indicated 'good water' type and9.10% samples indicated 'moderately polluted water category.

Table 6

Percentage (%) of Sample Under Different water Pollution Index(WPI) Category

Category				
excellent water	**Good water**	**Moderately polluted water**	**Highly polluted water**	
Prelockdown (% of samples)	0	0	0	100
During lockdown (% of samples)	0	90.90	9.10	0

Future River Rejuvenation Strategies

The COVID19 lockdown gave clear indication about environmental deterioration caused by various anthropogenic actions throughout the year. It is confirmed that lockdown method is a temporary measures to avoid pandemic situation. Regeneration of industrial activities is very crucial to overcome economic distress and maintenance of public liv elihood. As a result, sustainable livelihood should be practiced for the maintenance of the health of the total environment. To rejuvenate the health of the river Damodar, few relevant remedial measures should be taken.

Conclusion

The water quality as well as river ecosystem of Damodar has been deteriorated for la st three to four decades. In the recent years, many applied research on water qualityh ad been conducted and they have brought the reasons behind

the deterioration of wat er quality such as urban sewage and discharge of industrial effluents from the iron a nd steel industries, chemical, cement, tannery industry, thermal power plant. The conte mporary research highlighted that industrial waste effluents are directly thrown into the river water without treatment (Bhattacharyya et al. Sundararanjan and Mohan 2011; Ghosh and Banerjee 2012, Singh et al. 2014; Chatterjee et al. 2010; George eta 2010. Mukherjee et al. 2012). Here, the current study focused that the physical, che mical and heavy metals have been found beyond permissible limit (WHO 2011) at ef fluents discharge sites in the present study. In this study, assessment on difference of water quality between prelockdown and during lockdown of COVID19 was conducted through a new approach, i.e., WPI as suggested by Hossain and Patra, 2020 WPI of prelockdown showed that around 100% samples are of highly polluted. During lockdo wn a significant development has been noticed in river water. WPI of lockdown sho wed that around 90.90% samples are of good and around 9.10% samples are of mod erately polluted. Thus, various awareness programmes should be practiced by local gov erning bodies. From this research work on impact of lockdown to improvement of riv er water quality would be helpful for further management, restoration and spatial treat ment of river water towards the achievement of environmental sustainability.

References

1. Banerjee, U. S., & Gupta, S. (2013). Impact of industrial waste effluents on river Damodar adjacent to Durgapur industrial complex West Bengal India. Environment Monitering and A ssessment.
2. Basu, M., & Mitra, A. K. (2002). Studies on the pollution of river Damodar at Burdwan with special reference to metals COD and pH. Nature Environment and Pollution Technology, 1(4), 397-400.
3. Bhattacharyya, R., Kumar, M., & Kumar, P. P. (2013). Index analysis, graphical and multiva riate statistical approaches for hydrochemical characterisation of Damodar River and its cana system Durgapur West Bengal India. International Research of Journal and Environment Science, 2, 251.
4. BIS. (2012). Indian standards specification for drinking water. BIS, 10500, 2012.
5. Chatterjee, S. K., Bhattacharpee. 1. & Chands. G. (2010). Water quality assessment near an industrial site of Damodar River India. Environmental Monitoring and Assessment.

6. Chaturvedi, A., Bhattacharjee, S.Singh, K & Kumar, V. (2018). A new approach for in dexing groundwater heavy metal pollution Ecological Indicators, 87, 323331
7. Dhar, 1., Biswas, S., Mitra, A Pramanick, P., & Mitra, A. (2020). COVID 19 Lockdown phase: A boon for the River Ganga water quality along the city of Kolkata. N UJSJ Regulatory Studies, 26, 2456-4005
8. George, J., Thakur, S. K T. Ram. L. Gupta, A., & Prasad, S. (2010). Impact of coal in dustries on the quality of Damodar riter water. Toxicological & Environmental Chemistry, 9 209), 1649-1664
9. Ghosh, A. R., & Banerjee. R. (2012). Qualitative Evaluation of the Damodar River water flowing over the coal mines and industrial area. International Journal of Scientific and Resea rch Publications, 2, 10.
10. Hader, D. P. Banaszak A. T., Villafame. V. E Narvarte, M. A., Gonzalez, R. A., & Helbling E. W. (2020). Anthropogenic pollution of aquatic ecosystems: emerging problems with glo bal implications. Science of the Total Environment, 713, 136586.
11. Hem, J. D. (1991). Sturdy and interpretation of the chemical characteristics of natural water: USGS Professional Paper Book 2254 263). Jodhpur: Scientific Publishers.
12. Horton, R. K. (1965). An index number system Pollution Control Federation, 37(3), 300-305 for rating water quality. Journal of Water
13. Hossain, M., & Patra, P. K. (2020). Water pollution index: A new integrated approach to rank water quality. Ecological Indicators, 217, 206668.
14. Juwana, I., Muttil. N., & Perera, B.J. C. (2012). Indicator based water sustainability assessment-a reviews Science of the Total Environment, 438, 357371.
15. Liou, S. M., Lo, S. L., & Wang, S. H. (2004). A generalized water quality index for Taiwan. Environmental Monitoring and Assessment. 90(1-3), 35-52.
16. Mani, K.S., (2020). The Lockdown Cleaned the Ganga More than Namami Gange Ever Did. [WWW Document].
17. Mitra, A., Pramanick, P., Zaman, S. METSA (2020). Impact of COVID19 Lockdown on the Ichthyoplankton COLERity in and around Haldia Port-cum
18. Industrial complex. NUJS Journal of Regulatory Studies, 57-61. 18. Mohan, S. V., Nithila, P., & Reddy, S. (1996). Estimation of heavy metals in drinking water and development of heavy metal pollution index. Journal of Environmental Science, 316 2), 283-289.
19. Mukherjee, D., Dora, S. L., & Tiwary, R. K. (2012). Evaluation of water quality index ford rinking purposes in the case of Damodar River, Jharkhand and West Bengal Region India.
20. Journal of Bioremedical and Biosiegretantton. 310). 2155-6199.
21. Mukherjee, P., Pramanick, P., Zam . S. & Mitra, A. (2020). ECO restoration of River Gsanga water quality during COVID19 lockdown period using total coliforia (IC) as proxy. NUJS Journal of Regulatory Studies 56,2456-4605.
22. Pese S. F., & Wunderlin, D. A. (2000). Use of water quality indices to verify

the impact of Córdoba City (Argentina) on Suqua Rier. Water Research, 34(11), 2915-2926.560.

23. Singh, A., Deo, B., & Singh, S.P. (2014). Risk analysis on the use of Damodar River water for drinking purposes. International Journal of Current Engineering and Technology, 4(1),
24. Sundararajan, M., & Mohan, A. (2011). A study on the impact of vahvashery effluents along Damodar river stretch in Dhanbad district, Jharkhand, India. International Journal of En gineering and Management Science, 214, 135
25. Swamee, P. K., & Tyagi, A. (2000). Describing water quality with aggregate index. Journal of Emironmental Engineering, 126(5), 451-455
26. TiwaryAbhishek, R K. (2005). Impact of coal washeries 2 water quality of Damodar River in Jharia walfield. Indian J Environment protection, 25. 518522.
27. Tiwary, R. K, & Dhar, B. B. (1994). Environmental pollution from coal mining activities in Damodar River Basin India. Mire Water and the Environment, 13, 1-10.
28. Tsegaye, T., Sheppard, D., Islam, K R, Tadesse, W., Atalay, A, & Marzen, L. (2006). Development of chemical index asameasure of in-stream water quality response to landuse and land cover changes. Water, Air, and Soil pollution, 174(1-4), 161-179.
29. WHO. (2011). Guidelines for drinking water quality (4th ed.). Geneva: World Health Organization Yunus, A. P. Masago, Y., & Hisoka, Y. (2020). COVID19 and surface water qualty Improved lake water quality during the lockdown. Science of the Total Environment, 731. 139012.

◆ ◆ ◆