

Environmental Issues : Risk, Management And Sustainable Development

Proceedings of International Webinar

Held on 28th & 29th January, 2022

Organized by

**Science Stream, Bijni College
Bijni**

In Collaboration with

***Aaranyak* Assam**



Published by

PUBLICATION CELL, BIJNI COLLEGE, BIJNI

Organising Committee

Chief Patron



Dr. Birhash Giri Basumatary
Principal, Bijni College, Bijni

Joint Convenor



Dr. Sewali Pathak
HOD, Zoology Department
Bijni College, Bijni
Assam, India



Jayshri Narzary
HOD, Physics Department
Bijni College, Bijni
Assam, India



Lily Devi
HOD, Botany Department
Bijni College, Bijni
Assam, India



Swapna Saha
HOD, Chemistry Department
Bijni College, Bijni
Assam, India



Mahizur Rahman
HOD, Mathematics Department
Bijni College, Bijni
Assam, India



Dr. Ashoke Kumar Das
Assistant Professor,
Department of Botany,
Abhayapury College, Aaranyak

IQAC OFFICE COPY

SPRINGER

Environmental Issues : Risk, Management And Sustainable Development

Proceedings of International Webinar
Held on 28th & 29th January, 2022



Organized by
Science Stream, Bijni College, Bijni

In Collaboration with
Aaranyak Assam

Published by
Publication Cell,
Bijni College, Bijni.

This is the Proceedings of two-day International Webinar on *Environmental Issues: Risk, Management and Sustainable Development* conducted on 28th & 29th January, 2022 by Science Stream, Bijni College, Bijni. In Collaboration with Aaranyak. This is a compilation of the papers presented in the webinar by the participants. This compilation is edited by Dr. Sewali Pathak.

EDITORIAL BOARD

Chief Patron:

Dr. Birhash Giri Basumatary, Principal
Bijni College, Bijni

Chief Editor:

Dr. Sewali Pathak, Assistant Professor
Department of Zoology, Bijni College, Bijni.

Editor :

Dr. Anindita Chakravarty
Syed Jawahar Hussain
Swapna Saha
Dr. Jabin Chandra Ray
Dr. Prasanta Das
Jayshri Narzary

Date of Publication : 28-06-2022

Published by : Publication Cell, Bijni College, Bijni

Price : 250/-

ISBN : 978-81-951163-1-7

Printed at Vicky Communication & Associates
(A Unit of Byatikram Group)

Vivekananda Path, H. No. 19, G.S. Road, Ulubari, Guwahati 781 007

Ph : +91 94350 10632 / 95085 73672

Email: vcaghy99@gmail.com

OFFICE OF THE PRINCIPAL :: BIJNI COLLEGE

বিজনি মহাবিদ্যালয়ৰ অধ্যক্ষৰ কাৰ্যালয়
গোৱাৰুনি মাৰুখ' :: বিজনি সোলোঁসালিমা



Dr. Birhash Giri Basumatary
Principal
Bijni College, Bijni

Website: www.bijnicollege.ac.in
Email : bijnicollege@gmail.com
P.O. Bijni, Dist. Chirang (BTAD) Assam
Pin- 783390
Phone- 03668-295025

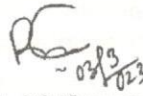
MESSAGE FROM THE PRINCIPAL, BIJNI COLLEGE, BIJNI



I am very glad to know that the Faculties of Science, Bijni College have jointly organized an International Webinar on "Environmental Issues: Risk, Management and Sustainable Development" to be held on 28th & 29th January, 2022. On this occasion, the organizing team plans to publish the proceedings with the precious contributions from scholars and participants from different parts of the globe. It will represent the spirit of the webinar reflecting and representing the concerns, thoughts and efforts in various fields of environmental issues. This will go a long way in augmenting united efforts of the people concerned in creating a knowledge base for the humanity.

I wish this publication a grand success.

Place: Bijni
Date: 03.03.2023


(Dr. Birhash Giri Basumatary)
Principal,
Bijni College, Bijni

Aaranyak

A Society for Biodiversity Conservation

13, Tayab Ali Byelane
Bishnu Rabha Path
Beltola Tiniali-Bhetapara link Road
P.O. Beltola, Guwahati, Assam, India - 781028
Info@aaranyak.org
Telefax: 0361-2230250

Ref: AA/SG_CEO/1A-22-23/36

Date: 11 March 2023

Message

I am very much delighted that the Bijni College is bring out an important publication based on the deliberations made during the International webinar on "Environmental Issues: Risk, Management And Sustainable Development" held on 28-29 January 2022. Documentation is an important part of sharing knowledges and lesson learnt from academic institutions.

Aaranyak, a Scientific and Industrial Research Organisation (SIRO), recognised by the Department of Scientific and Industrial Research, Ministry of Science and technology, Govt. of India, was pleased to be a collaborator for the above mentioned international webinar with Bijni College. The webinar includes a wide range of key topics related to environment and some case studies from western Assam.

I am convinced that the proceedings of this webinar in a published format shall help disseminate knowledges further to wider audiences and likely to attract new and budding researchers to put their energy to undertake applied research that could offer wide ranges of solutions to diverse environmental challenges and crisis that our planet earth is currently facing.

I wish Bijni College continued success in their endeavour in years to come.



Bibhab Kumar Talukdar, PhD
Secretary General and Chief Executive Officer
Aaranyak
Email: ceo@aaranyak.org; Mobile: +91 94351 13139

FROM THE DESK OF EDITORIAL BOARD

It is a great pleasure and also a great achievement for Science Stream, Bijni College to organize an International Webinar on "Environmental Issues: Risk, Management and Sustainable Development" in collaboration with NGO Aaranyak, Assam. The success of this programme has been made possible by the kind and active co-operation of the resource persons from different fields, **Dr. Arup Kumar Misra**(India), **Dr. Dipak Nath** (India), **Dr. Hilloljyoti Singha** (India), **Dr. Bibhab Kumar Talukdar** (USA) and the paper presenters and participants. We welcome and congratulate all the above personalities.

It has been well recognized that environmental issues like global warming, ozone layer depletion, acid rain, marine pollution, hazards and loss of biodiversity are not merely of regional or national issues but are of global dimension and hence must be tackled with joint international efforts and co-operation. Our current practices and lifestyle will have to be re-thought and re-laid if we want to stop further environmental erosion and climatic calamities. We must find solutions that would enable sustainability of our current lifestyle without further degradation and deterioration of our environment and life respectively. It is time for us to brain-storm, work together and chart new courses of action that will save our planet from global environmental disaster. The paper presenters have come together to present their ideas to save our environment and ensuring wellbeing for our future generations and giving them chance to enjoy many mysteries and beauties that the planet offers. We are elated not only to organize this webinar as we may together make efforts to find the solutions to different complex environmental issues but also by publishing the scholarly papers in this proceeding for benefit of all.

With Best Wishes

CONCEPT NOTE

Environmental issues are much more related to human directly or indirectly. Mankind is always driving the environmental gradients changing with the geological timescale and providing the earth a new dimension. In the same time, the earth is under threat with the intervention of human deeds which destroying the beauty of nature, habitats, different kinds of flora and fauna, endangering wildlife and even gene pool of future generations. Humans cannot deny the impacts of own interventions on environment, several adverse factors which changing the behaviour itself replying us in a special manner. Researchers are doing on specific issues of environment such as pollution, climate change, deforestation, exploitation, loss of biodiversity, ecological crisis, habitat destruction, human-animal conflict, wildlife crime, policy and management. It is the high time to bring back our nature in a sustainable way without compromising and need eco-restoration to ensure ecological security of life on the planet earth. It is an appeal to all human beings to create attitude in favour of our environment with greater coordination and integration to establish the mankind again. Keeping this view, an approach is made to identify the environmental issues and its' solution in this present international webinar.

Sub Themes

1. Ecological Restoration and Eco Transportation
2. Pollution: Causes and Remediation
3. Disasters and Hazards
4. Waste Management
5. Global Warming and Climate Change
6. Biodiversity Degradation and Sustainable Development

CONTENTS

Title	Author	Pg. No.
1. The Initiative of Volunteering Organization to Protect the Environment: A case study of Pranam Narmada YuvaSangh	Nidhi Singh Rathour	9
2. Deepor Beel: Biodiversity, Degradation and Conservation	Dr. Shashwati Nath	18
3. Factors affecting the health of wetland: A case study of Chandakhhal wetland, Dhubri district, Assam, India	Dr. Samuel Sheikh and Dr. Mrigen Goswami	27
4. Ground Water Pollution: Causes and Remediation	Swapna Saha	38
5. Global Warming in the Twenty-First Century: Its Causes, Impacts and Solutions	Dr. Jabin Chandra Ray and Lily Devi	49
6. Forest degradation: impact of rural population pressure: A case study on Bezara Development Block in Kamrup district, Assam	Dr. Bhanu Hazarika	62
7. Hazard and Disaster: A Comprehensive Study	Sanjita Ray	77
8. The Impact of Solar Waste Recycling and its influence on the Environment and Health Care	Dipak Bhattacharyya	82
9. Pollution: Causes and Remediation	Mahizur Rahman	96
10. Causes and Control of Air Pollution	Dr. Prasanta Das	102
11. Environmental Consciousness in Gandhian Philosophy	Dr. Reepa Sarmah	109
12. Literature and Environmental Concerns	Dr. Arup Sarkar	115

Title	Author	Pg. No.
13. Environmental Ethics and sustainability	Dr. Sulabh Chandra Das	120
14. Indoor House Pollution and its effect on Children	Dr. Nilima Dutta	132
15. Forests: The stabilizing force for climate	Dr. Anindita Chakravarty	138
16. Global Warming and Climate Change	Syed Jawahar Hussain	146
17. Problem in Managing Waste in North East India	Dr. Apu Guha Thakurta	150
18. An assessment on habitat diversity in relation to flora and fauna with their conservation strategy in the Chirang District of Assam, India	Dr. Sewali Pathak	161
19. Importance of Sedges (cyperaceae) in wetland ecosystem restoration	Beauty Queen Goyari and Maratha Brahma	170
20. A study on the role played by Earthworms in Waste Management: Vermicomposting	Lipika Dey Dutta	177
21. Management of Flood in Assam through Community Participation	Jayshri Narzary	185
22. Environment and Human Relationship	Bibha Talukdar	191

The Initiative of Volunteering Organization to Protect the Environment: A case study of Pranam Narmada Yuva Sangh

Nidhi Singh Rathour, Vikas Chandel, and Santoshi Singh Rathour

Indira Gandhi National Tribal University, Amarkantak,
Madhya Pradesh
nidhisinghrw@gmail.com, igntu.vc.@gmail.com,
santoshisinghrathour@gmail.com

Abstract

Environment plays a prominent role for every living being. Without the environment, an individual cannot imagine life is possible. It is said that the environment is our second mother who nurtured us without any expectation, but what we did? The worst activity is done by human beings to full fill the greed, creating the critical issue in front of all critters. Governments of different countries have made acts and policies to reduce unethical practices towards the environment at the national and international levels. Previously environmental protection movements have been done by many individuals, communities, and organizations. However, ecological issues are enduring actions. The current study mainly focused on volunteering organizations' role in environmental protection through various initiatives throughout the nation. For this, investigators have adopted the case study method and collected primary data from one actively working volunteering

organization of Madhya Pradesh, called Pranam Narmada Yuva Sangh (PRANYUS). This organization makes efforts to remove immoral practices towards the environment and have taken initiatives like – Selfie with My plant campaign, Save Tree movement (Bicycle rally), Save the forest from fire, Right to forest land under FRA 2006, Narmada Swachhta Abhiyan, organic farming, etc. These efforts are made a success by the volunteers, who actually belong from different states of India. The organization continuously works to make people aware and connect their emotions with the environment. Initiatives of this organization are interesting and successful and also impacted positively among all age groups.

Keywords: Volunteering organization, Initiatives, Environment Protection, PRANYUS.

Introduction

Environment plays a prominent role for every living being. Without the environment, an individual cannot imagine life is possible. It is said that the environment is our second mother who nurtured us without any expectation, but what we did? We are taking more and more from our environment and returning the worst things. Rapid use of environmental stuff in the wrong way by human beings creates critical issues in front of all critters. To resolve these issues created by human beings, many acts like The Environment (Protection) Act, 1986; Forest (Conservation) Act, 1980; Wildlife Protection Act, 1972; Water (Preservation and Control of Pollution) Act, 1974; Air (Prevention and control of pollution) Act, 1981; The Indian Forest Act, 1927; National Green Tribunal Act, 2010 and policies like The National Forest Policy, 1952 and 1988; National Environmental Policy, 2006 have been made by the governments of different countries at a national and international level. Previously environmental protection movements/Social movements have been done by many individuals, communities, and organisations like the Bishnoi movement was started by Sombaji about 1700 AD in contrast to deforestation. Later, Amrita

Devi took action on this movement, and 363 individuals were killed in a protest.

Then Chipko Movement in 1973, the movement was started to stop the illegal cutting of trees in the Himalayan region of Uttarakhand. In the Chipko movement, Sundarlal Bahuguna and Chandi Prasad Bhatt were the heads of the movement; the most crucial characteristic of the movement was the participation of women. In 1983, Appiko Movement was started in Karnataka for reforestation and accomplishment, restoration, and utilization of the forest appropriately. The Silent Valley Movement, Jungle Bachao Andolan, Narmada Bachao Movement, Tehri Dam Conflict, etc. However, ecological issues are enduring. Still, Different volunteering organizations are working to resolve these problems and working as supporting agents/units for the government laws and rules made to protect the environment. Volunteering organizations play a crucial role in the present scenario, connecting masses, especially youth, with their new ideas for environmental protection. India is estimated to have approximately 2 million NGOs in 2009. Here is the list of Some NGOs working in the field of environment protection, Assam Science Society, Bombay Natural History Society, Center for Environmental Education (CEE), Center for Science and Environment (CSE), CPR Environmental Education Center, Kerla Sastra Sahitya Parisad, Kalpvriksha, Worldwide fund for nature, Foundation for Revitalization of Local Health Traditions (FRLHT).

Role of volunteering organization towards Environment protection in India

Organizations constitute a worldwide network to promote different actions towards environmental protection:

- ◆ Creating awareness among the people on present environmental problems and solutions.
- ◆ Enabling the contribution of several stakeholders in the conversation on environmental problems.
- ◆ Accompanying participatory rural appraisal.

- ◆ Involving themselves to protect human rights to have a clean environment.
- ◆ Protecting the natural resources and delegating the fair use of resources.
- ◆ Statistical information on natural resources, timeline history of villages.
- ◆ Investigating and monitoring environmental quality.
- ◆ Shifting information through bulletins, flyers, articles, audio-visuals, etc.
- ◆ Organizing conferences, lectures, and debates to encourage environmental consciousness.
- ◆ Helping the communities' directorial administrators in the preparation, application, and implementation of plans on environmental protection.

It is essential to know that most volunteering organizations do their work without violence. The present study focused on enthusiastically working volunteering organization PRANYUS. This organization also works towards environmental protection in a non-violent way and for sustainable development.

Methodology

Researchers have adopted the case study method and collected primary data from the organization for the current paper by direct participation and the interview.

Contribution of an organization (PRANYUS) to protect the environment –

Here in this part of the paper, researchers have mentioned about contribution of volunteering organization as their initiatives for environmental protection in brief:

Pranam Narmada Yuva Sangh:

This organization is a non-profit volunteering organization registered under the Madhya Pradesh society registration Act 1937, working in the Maikal hills of Madhya Pradesh since 2014. It is funded by

the students and alumni of the Indira Gandhi National Tribal University Amarkantak. This organization is actively working in the five tribal districts of eastern M.P., namely, Anuppur, Dindori, Mandla, Shahdol and Umariya district. The core working area is tribal development, women empowerment, health, livelihood, education, and the environment. The team has 22 core committee members and more than 150 volunteers from Madhya Pradesh and other states of the country. The organization's objective covers environment protection, including Narmada cleanness and awareness program, tree plantation, promotion of organic farming, and save tree - save life movement, etc. The United Nations organization set the 17 goals and 169 targets for the Sustainable development of the member countries called Sustainable Development Goal (SDG). The SDG focused on overall development with respecting the environment. The PRANYUS organization makes many efforts and continuously works towards environment protection and fulfills the target of SDG.

Save Tree movement (Bicycle rally):

On May 1901, the plant scientist Jagdish Chandra Bose proved that plants are like any other life form; they have feelings as we have. With this concept, the organization raises the voice against the unethical advertisement put on the trees; many advertisement agencies use the iron nails and drop the permanent or temporary posters and banners on the tree, which cause severe harm to the trees. The organization organized a 35km bicycle rally till Amarkantak of Anuppur district, M.P. to save the trees from such an offense and make the rule for advertisement. They also gave a memorandum to the CMOs, SDM, and DM of the district. Environment Protection Act 1986 and National Green Tribunal Act 2010 have many provisions to save the trees from such an offense. It is hugely needed for the proper implementation of these laws.

Save the forest from fire:

The volunteers of the PRANYUS are also deeply involved in protecting the Maikal forest from the fire. They are aware of the villag-

14 Environmental Issues: Risk, Management And Sustainable Development

ers, and in case of fire, they rescue with the team. Forest fire is a severe problem caused every year in the summer; it harms small trees, medicinal and non-medicinal herbs, and tiny insects that are very important for nature. The organization made a village task force (VTF) committee in the villages of Maikal hills; they trained and aware to the villagers about the importance of the forest and used it to save the forest from fire.

Selfie with my plant:

The organization took the initiative on World environment day 2021, called selfie with my plant, to plant 10000 plant saplings in a year, throughout various activity organization almost reached 68.4 percent of the given target till 27 January 2022. Total 6840 plant saplings have been planted by the members, volunteers, and other stockholders at Madhya Pradesh and out of state. The organization promotes the plantation on many occasions like religious and national festivals, birthdays, marriage functions, marriage anniversaries, death anniversaries, etc. They are trying to attach human emotion to plants. Gift a plant is an attractive initiative that promotes the gift of plants to each other. The organization also filed an online form of planted sampling and monitoring every three months where people have to upload the recent photographs.

Sl. No.	Local Name	Scientific name	Plantation no.	Use of plant
1.	Pipal	<i>Ficus religiosa</i>	158	Shady, Medicinal
2.	Mango	<i>Mangifera indica</i>	463	Fruit
3.	Banyan tree	<i>Ficus benghalensis</i>	23	Shady, Medicinal
4.	Neem	<i>Azadirachta indica</i>	106	Medicinal
5.	Guava	<i>Psidium guajava</i>	457	Fruit
6.	Jackfruit	<i>Artocarpus heterophyllus</i>	228	Fruit
7.	Gulmohar	<i>Delonix regia</i>	98	Shady
8.	Pears	<i>Pyrus communis L.</i>	683	Fruit
9.	Saltree	<i>Shorea robusta</i>	312	Timber

Sl. No.	Local Name	Scientific name	Plantation no.	Use of plant
10.	Arjun	<i>Terminalia arjuna</i>	70	Medicinal
11.	Reetha	<i>Sapindus mukorossi</i>	42	Medicinal
12.	Khair	<i>Acacia catechu</i>	16	Timber
13.	Bel	<i>Aegle marmelos</i>	32	Fruit, Medicinal
14.	Mahua	<i>Madhuca longifolia</i>	239	Medicinal
15.	Shisham	<i>Dalbergia sissoo</i>	90	Timber
16.	Jamun	<i>Syzygium cumini</i>	140	Fruit
17.	Aonla	<i>Phyllanthus Emblica</i>	212	Fruit, Medicinal
18.	Karanj	<i>Milletia pinnata</i>	220	Timber
19.	Sandal	<i>Santalum album</i>	91	Medicinal,
20.	Imli	<i>Tamarindus indica</i>	26	Fruit
21.	Sagon	<i>Tectona grandis</i>	48	Timber
22.	Bahera	<i>Terminalia bellirica</i>	98	Medicinal
23.	Harra	<i>Terminalia chebula</i>	127	Medicinal
24.	Sitaphal	<i>Amnonasquamosa</i>	472	Fruit
25.	Bambu	<i>Bambusoideae</i>	545	Timber
26.	Babul	<i>Vachellia nilotica</i>	164	Timber
27.	Others		1680	All types
Total			6840	

Right to forest land under FRA 2006:

According to Forest Right Act 2006, the Government of India provide the right in the forest land to Forest Dwelling Scheduled Tribe (FDST), according to section 2(c) of FRA, to qualify as FDST and be eligible for recognition is that the applicant should ST of that area, primarily resided in forest land prior to 13th December 2005. Later on, many political parties make this political agenda, and unfortunately, it starts to distribute ineligible candidates. Many villagers, including tribal and non-tribal, claim the right on the forestland and receive the landlease. The organizations raise this issue in front of the Forest department and district administration and file a case in NGT to look upon this.

Narmada Swachhta Abhiyan:

As the organization's motto is Pranam Narmada Sewa Sarwada, they started Narmada cleanness program at Amarkantak from 2014. Amarkantak is the origin place of the Narmada River; hence it is an initial point so essential to take care of pollution and sustainability of flow. The volunteers of the organization are regularly cleaning the river, aware the people, and occasionally making the rally and strike for making the strict rule for controlling the pollution.

Organic Farming:

The organization promotes organic farming and provides training to the farmers. The vision behind this is to provide livelihood opportunities and sustainable agriculture. They are aware the people about the harmful impact of chemical fertilizer and pesticides, instead of this vermi compost and tradition or organic methods of pesticide to be used. The team starts mushroom cultivation with the organic process and provides free training to farmers. The organization collaborated with Krishi Vigyan Kendra-IGNTU for better implementation of the project.

Conclusion

From the above study, we can conclude that the Volunteering organization plays a very prominent role in the present scenario and faces many problems. Volunteering organizations work as supporting units of governmental laws and rules towards the environment and connect masses to protect the environment with different initiatives, as discussed in this paper. Government, volunteering organizations, and people collaboration are the imminent need to protect the environment. It can be seen that volunteering organizations connect mainly youth, who plays an excellent role with new ideas towards preserving the environment.

References

- ◆ Vigyan Prasar. <https://vigyanprasar.gov.in/bose-jagdish-chandra/>

- ◆ United Nations, The 2030 Agenda and the Sustainable Development Goals: An opportunity for Latin America and the Caribbean (LC/G.2681-P/Rev.3), Santiago, 2018
Act, Rules, and Guidelines. <https://tribal.nic.in/FRA/data/FRARulesBook.pdf>

Deepor Beel: Biodiversity, Degradation and Conservation

Dr. Shashwati Nath

Assistant Professor Department of Geography
Saraighat College, Changsari, Kamrup, Assam
Email: shashwati71@yahoo.com

Abstract

Deepor Beel is becoming very significant in terms of socio-economic value, ecology, tourism, habitats of numerous aquatic birds, aquatic plants and fish, healthy ecological system, potential natural resources. The Ramsar Convention (1971) places full weightage on the Deepor Beel for special characteristics and this convention brings the Deepor Beel to international status for their uniqueness and places at the vanguard of its conservation and management. This review research paper is totally based on secondary data derived from various sources including books, research papers and reports to know about diverse biodiversity of the Deepor beel wetland along with identifying the impacts of human activities on its ecosystem and measures adopted for the conservation, protection and management of the wetland.

Keywords: Biodiversity, Degradation, Conservation, Ecosystem, Wetlands, Flora-Fauna.

Introduction

Biodiversity means "Biological Diversity" which refers to all varieties of lives such as plants, animals; microorganisms exist together

in a region. In India there are 27 Ramsar site and Deepor beel from the state of Assam are one of them. It is a wet land acts as the life-givingsupport for humans and recognized as the important source of natural resources. Wetlands are generally designated as the world's important productive environment as they ensure availability of different species of plants and animals which are of immense importance to humans. Wetlands are the world's most diverse and efficient ecosystems. "Ecosystem services," are the gift of wetlands for human society ranging from food and biodiversity, water supply, construction materials, erosion and flood control, recharge of ground water and stabilization of climate change. However, most human activities continue to degrade wetlands and transform them to other uses.

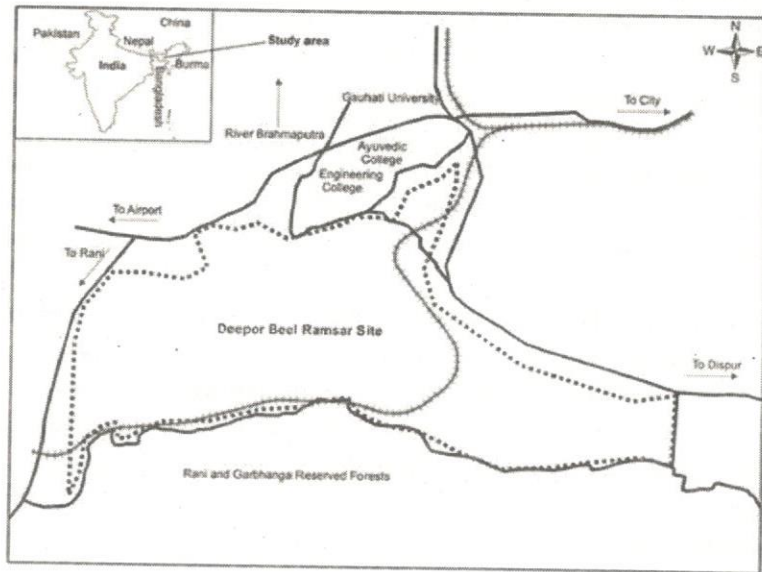
Deepor beel is a large natural wetland having great biological and environmental values. The beel is one of the largest beel in the lower Assam valley of Brahmaputra and a permanent freshwater lake. It is one of the north-eastern region's fifth only Ramsar site of Assam. Deepor beel was designated as a "wetland of international significance" under the 1971 Ramsar Convention on Wetland and was comes under Ramsar site in November, 2002 on the basis of its biological and environmental importance. The beel is endowed with rich flora and fauna. Deepor Beel has also been designated by International Birdlife as one of the Important Bird Area (IBA). The ecosystem of different residential and migratory birds is the centre of attraction for tourists.

Study Area:

Deepor beel is located in Kamrup District of Assam. The Deepor Beel's geographical coordinates are between latitude $91^{\circ} 35' - 91^{\circ} 43'$ E, $26^{\circ} 05' - 26^{\circ} 11'$ N. It is located 10 kmsouthwest of Guwahati City. It is situated at fifty-three meters above Mean Sea Level, with a maximum depth of 4 meters and an average depth of 1 meter. Deepor Beel occupies 41 sq km of land and is known as a large oxbow lake (Chandana, 2018). The major inlets of the beel are the rivers Basishtha Bahini and Mara Bharalu which bring wastewater and rain-

water from the city of Guwahati. The beel's only outlet is Khanajan, located north-east to the main Brahmaputra River. The beel has perennial water holding area which is about 10.1 sq.km.

Map of the study area



Objectives of the study

- 1) Biodiversity of the Deepor Beel along with identifying the impacts of human activities on its ecosystem.
- 2) Measures adopted for the conservation, protection and management of the wetland.

Methodology

The research paper is totally based on secondary data derived from various sources including books, research papers and reports.

Biodiversity of the Deepor Beel and impacts of human activities on its ecosystem

Deepor Beel is a wild life sanctuary endowed with rich flora and fauna. The beel also harbors about 61 species of fish, which are regu-

larly harvested by the local inhabitants for their livelihood and are totally dependent on this beel.

Based on the ecological adaptation of the Deepor Beel, the hydrophytic vegetation of the beel has been classified accordingly. Submerged, emergent and floating vegetation like Giant Water Lily, water hyacinth, aquatic grasses and water lilies are part of the aquatic vegetation during the summer season. The deciduous forests are a dominant type of tree species, the beel also offers other types of flora like medicinal plants and orchids, which are of commercial value. The nymphaeum nuts and flowers as well as ornamental fish and Euryale ferox Giant Water Lily medicinal plants and seeds provide significant revenue on local markets. This wildlife sanctuary is visited by a large number of tourists to enjoy the scenic beauty of the wetland primarily for boating and birding.

The beel is a performing place for migratory birds and some of the highest mass of aquatic birds in Assam, which are available in winter. On the account of wealth of avian fauna, Bird life International has also selected Deepor Beel as one of the Important Bird Area (IBA).

The Government of Assam declared that an area of 414 hectares of the Deepor Beel has been assigned as Bird Sanctuary where natural habitat of varieties of birds are seen. The sanctuary has over 120 species of birds including kingfishers, fishing eagles, adjutant storks, Siberian cranes and abundant varieties of ducks. The largest congregations of aquatic birds can be seen here with a recorded count of about 19,000 water birds in a day. There is also a watch tower on the bank of the beel for bird watching.

The Deepor Beel also has a rich aquatic fauna encompassing of 20 amphibians, 12 lizards, 18 snakes and 6 turtle and tortoise species. Other types of fauna such as the Wild Asian elephants, leopard, jungle cat and the protected barking deer, Chinese porcupine and sambar are recorded.

The ruthless truth about Deepor beel is that due to negligence and mismanagement, its rich ecosystem and biodiversity are gradually losing. Concrete wall built by different groups of people living here, not

only damaging the beel's natural beauty, but also blocking the corridors of wild animal. Growing human settlement, urbanization, road and industrial development on the eastern and north-eastern sides of Deepor beel were listed as major threats to the water body. The periphery deteriorates the water quality of this reservoir due to garbage dumping by the Guwahati Municipal Corporation is also a major problem which has put this wetland under ecological threat. Potential threats include illegal fishing and water fowl hunting stress, pesticides, insecticides and fertilizer pollution, and water hyacinth crassipes from Eichhornia. Inits possible effects, a plan to build a wastewater canal from the city directly to the beel is considered disastrous. Human stresses have led to man-made changes in the Deepor beel that change the ecology of the wetland.

In 1989, the beginning of railway construction through the wetland body was started to expand for the Assam rail network that affect the natural ecosystem of the beel. Currently, the most important threat that needs to be addressed is to reduce anthropogenic pressure on the beel region. Environmental Quality of Deepor Beel is polluted by many human activities and the source of this pollution is of two types, single identifiable source such as a discharge pipe from a factory or sewage plant and other is multiple identifiable sources like excess fertilizers, pesticides-insecticides from agricultural lands or toxic chemicals from urban run off. By using proper water shed management cases, single identifiable source pollution can be managed successfully but multiple identifiable sources of pollution are very difficult to manage and remains as a major problem and affect the environment in a great extent.

Now, many species of flora and fauna of the beel are facing endangered surroundings. The water body is highly infected by many human activities including the depositions of many harmful materials or chemicals. Fishing is the main source of livelihood of the local people; thus, building houses near this wetland through encroachments are also very common. Different human activities, carelessness and negligence of the people, Deepor beel's rich ecosystem and biodiversity is slowly being lost.



A view of Deepor Beel



Migratory Birds of Deepor Beel

Suggestive measures for conservation, protection and management of the Deepor Beel:

During 1989, the then government of Assam proposed a plan for the construction of a railway line across the Deepor Beel, but a group of conservationists appealed to the people of India to support and

participate in the conservation of the beel. The first step was taken by the people of Assam and gave good response and at that time government effectively formed a committee. The committee recommended for shifting the railway line from the middle to the southern periphery of the beel. The dump yard of the Municipality of Guwahati (24 ha) situated in Boragaon is located in Deepor Beel's eastern corner.

In 2008, Guwahati Water-Bodies (Preservation and Conservation) Act was established to preserve, protect, conserve, control and maintain water quality for growth and preservation of Deepor Beel. National Plan for Conservation of Aquatic Ecosystems (NPCA) was launched by

UPA Government in 2013 by merging two erstwhile schemes viz. National Lake Conservation Plan (NLCP) and National Wetlands Conservation Programme (NWCP) to run a single integrated programme for 12th plan.

It can be suggested that more area should be covered under Bird sanctuary which includes highland within it. Other small naturally depressed areas also should be included and proper plantation programme should be initiated to create breeding ground of residential water fowl. Land cutting, brick making factory and industrial development should be stopped within and in the surrounding areas of Deepor beel.

Conclusion

Deepor beel is one of the largest beel in the lower Assam valley of Brahmaputra and a permanent freshwater lake and an important Bird Area. Citizens should be aware of using wetland wisely means sustainable use for the benefit of mankind in a manner consistent with the protection of the environment for current generation and also for coming generation. Strict protection is also required for "Wise Use" (Ministry of Environment & Forests, 2007). To minimize public intervention in the main area of the wetland the Council is promoting development of alternate fishing grounds in the fringe area of the wetland. This will help the fishing community to support their

livelihood and minimize their dependency on the central part of the beel.

In March 2015, the district administration of Kamrup (Metro), the Guwahati Municipal Corporation (GMC) ordered that waste disposal project be moved from Deepor Beel and, in return for this, the GMC stated that work on the Noonmati Solid Waste Management Plant would begin. A number of well-wishing organizations such as Aaranyak, Early Birds, Deepor Beel Ramsar Site Conservation Society also conducted socio-economic programmes proposed at capacity building, drinking water supply, sustainable fisheries, alternative livelihoods, children's education and wetland conservation awareness. Aaranyak, a biodiversity conservation society, has start on socio-economic status assessment scheme, alternative sources of living, fringe villager's awareness programmes, workshops for government officials, and wetland values. A grass-root conservation group, Early Birds, works with people and educates them about healthy living. However, to control the incoming silt from the Rani-Garbhangha hills, gully control

measures have been initiated. A beautiful watchtower with indigenous bamboo technology has been constructed in the bank of the beel. Tree plantation is also being carried out with the help of the local community.

These types of initiatives would require regular support of people from all walks of life such as government organizations, schools, colleges, local communities and individuals by promoting and educating about conservation and management techniques to every local club, villages, etc. In order to prevent from further degradation of the environment, every individual should make efforts on their part to generate awareness and ensure further minimal damage. Many voluntary organizations, government, local people should come up to save the beel. Regular monitoring and sustainable as well as wise use of the resources can lead to healthy surroundings of the Deepor beel.

Bibliography

- 1) Basistha, P. S. (2016). Assessment Of Impact of Urbanisation on

- Deepor Beel Wetland. Guwahati: Assam Science Technology and Environment Council.
- 2) Chandana, D. (2018, Oct-Dec). Abundance and Distribution of Chanda nama (Glass-perchlet) in Deepor Beel, Guwahati, Assam. *International Journal of Scientific Research and Reviews*, 7(4), 533-545.
 - 3) Eliza, K., Khosa, R., & Gosain, A. K. (2018, November). Developing a management plan for Loktak Lake considering Keibul Lamjao National Park and hydropower demand using a data driven modeling approach. *CURRENT SCIENCE*, 115 (9).
 - 4) Mazumder, Chitrini, N.K. Tripathy, T. Tipdech, (2014), "Ecosystem Evaluation (1989-2012) of Ramsar Wetland Deepor Beel using satellite-derived indices." *Environmental Monitoring & Assessment*.
 - 5) Panini, D. (1998). *The Ramsar Convention and National Laws and Policies for Wetlands in India*.
 - 6) Saikia, P.K. (2005). *Qualitative And Quantitative Study of Lower and Higher Organisms and Their Functional Role in The Deepor Beel Ecosystem*. Gauhati university, Department of Zoology. Guwahati: North Eastern Space Applications Centre, Department of Space, Government of India, Umium, Meghalaya, Shillong.
 - 7) Sharma, N., Janauer, G. A., Mondal, M. S., & Oinam, B. (2012). *Assessing Wetland Landscape Dynamics in the Deepor Beel of Brahmaputra*. *Asian Journal of Geo informatics*, 12(1).
 - 8) Solanki, V., & Joshi, A. (2017). *Disappearing Wetland: A Study of Basai Wetlands, Haryana (India)*. *International Journal of Economic Research*, 14(20), 681-691.
 - 9) Solanki, V., & Joshi, A. (2019), "Degradation and Conservation of Indian Ramsar Wetlands: A Study Of Loktak Lake And Deepor Beel", School of Humanities Lovely Professional University Phagwara, Punjab, India, *International Journal "Our Heritage"*.
 - 10) Saikia, P.K. & P.C. bhattacharjee, (1987), "A Study of the Avifauna of Deepor Beel – A Potential Bird Sanctuary in Assam", in *Wetland & Water fowl Conservation in Asia*.

Factors affecting the health of wetland: A case study of Chandakhal wetland, Dhubri District, Assam, India

Dr. Samuel Sheikh

Assistant Professor, Department of Zoology
B.N.College, Dhubri, Assam, India
Email: sheikh2015samuel@gmail.com

Dr. Mrigen Goswami

Retired Professor and Former Head
Department of Zoology, Gauhati University
Guwahati, Assam, India

Abstract

The wetlands of Assam (India) locally known as *Beels*, are characteristically low land areas and shallow depressions of various shapes being water fed by the monsoon rains or flooded by its major river systems and their tributaries through some rivulets as feeder channels. The present study enquires the health of Chandakhal wetland of Dhubri district in Assam, India. It is an investigative study to enquire the presence or absence of some of the key factors that usually have significant concerns on the health of a wetland. Chandakhal wetland is a natural wetland of tubular shape, having perennial water retention character with natural inlet-outlet system connecting the mighty Brahmaputra at one end and the Dhaka *Beel* at the other. The data was collected with the help of interviews with the key informant tradi-

tional fishermen associated with the wetland and subsequently verified by personal observation during the year 2010 to 2013. The present study finds as many as 9 numbers of key factors prevailing in the study area which are mostly of anthropogenic origin leading to the degradation of the wetland health which is a potential threat to Chandakhhal wetland and its bio diversity.

KeyWords: Beel, Chandakhhal, Wetland, Key factors, Anthropogenic

Introduction

India is a land of diverse and distinctive natural wetland types. In Assam, the wetlands may be of tubular, oval, dendritic, oxbow or horse shoe shaped having perennial or seasonal feeder channel from their respective river systems (Deka *et al.*, 2005). The wetlands of Assam, locally known as *Beels*, are characteristically low land areas and shallow depressions of various shapes being water fed by the monsoon rains or flooded by the two major river systems, the Brahmaputra and Barak and their tributaries through some rivulets as feeder channels. Assam has 1,392 numbers of *beels* spread over more than 100,000 ha of which the *beels* of River Barak has water spread area of 8,000 ha and the *beels* associated with the river Brahmaputra and its tributaries is estimated at 92,000 ha area (Sugunan and Bhattacharjya, 2000). According to Malt by (2009), wetlands are many-faceted conjunctions not only between land and water, but between groundwater and surface water, and between ground and surface waters and atmospheric moisture. The wetland ecosystems are used by fishes as a refuge for breeding, feeding and nesting purposes atone or the other stage of their life cycle (Wetzel, 2001) that has lead the wetlands to become potent inland fishery resources as well as breeding grounds for many important riverine fishes. It has been observed by several workers (Mahanta *et al.*, 2003; Deka *et al.*, 2005; Dudgeon *et al.*, 2006; Kar *et al.*, 2006; Sarkar *et al.*, 2008; Baishya and Bordoloi, 2008; Das *et al.*, 2011; Goswami and Kalita, 2012) and documented in various journals and periodicals that the natural wetlands throughout the world are continuously being degraded and many of these are in the verge

of extinction due to various factors, mostly of anthropogenic origins. Barman and Kar(2013) reported a significant correlation between the knowledge levels of wetland users with the community based physical assets and socio-political empowerment. In view of this, the present study was conducted with the aim to enquire the presence or absence of some of the key factors responsible for the degradation of Chandakhhal wetland.

Materials and Methods

The present study is an investigative study in which information regarding the presence or absence of various key factors responsible for degradation of wetlands was gathered from key informants and subsequently the same was verified by personal observation during the years 2010 to 2013.

Description of study area

The present study is concerned with Chandakhhal wetland (Latitude 26°00'00"- 26°02'30"N and Longitude 89°51'30" - 89°55'30" E) of Dhubri district in Assam, India. It is a registered tubular type wetland locally known as Chandakhola *beel* and is located in the western most extremity of the state of Assam, India near the Indo- Bangla international border in the district of Dhubri. The entire wetland is divided into six sampling sites viz., LS1 (Pestirpar), LS2 (Bridge), LS3(Garergaon), LS4 (Fesarhat), LS5 (Bazar) and LS6 (Gaspara) as shown in the map of the wetland (Photograph "A" in Plate 1).

Data collection

Data have been collected through interviews with the heads of the families of 40 (forty) numbers of fulltime Fishermen Households (considered as key informants) inhabiting in two Villages viz., Kachuarkhas Pt. I and Dharmasala by employing an Interview Schedule constructed in the line of the present study. The data comprise the responses regarding the problems faced by the wetland and the presence / absence of some of the key factors affecting the health of the wetland. Subsequently the data so acquired were verified by personal

observations.

Result and Discussion

As depicted in Table 1, the study confronts 9 numbers of key factors prevailing in the study area. Of these, "Subsistence Fishing" is a factor that has been mentioned by as many as 26 numbers of respondents; "Flood and Siltation" being mentioned by 23 respondents; "Encroachment" by 21 respondents; Fish Disease by 17 respondents; "Inlet-Outlet Blockade" and "Weed Infestation" by 12 respondents; "Culture of Alien Fish Species" and "Unplanned construction" by 7 and 6 respondents respectively.

Key Factors	Subsistence fishing	Flood and Siltation	Encroachment	Fish disease	Interfeting	Inlet-Outlet Blockade	Weed infestation	Culture of alien fish species	Unplanned Construction
Number of Respondents	26	23	21	17	16	12	12	07	06

(Table 1: Distribution of respondents mentioning the key factor types prevailing in the wetland)

The key factors so mentioned by the respondents were verified by personal observation and a discussion on those made as follows:

1.1. Subsistence fishing:

The present observation finds a huge population on both the banks of the wetland. There is unabated subsistence fishing by such a huge population going on throughout the wetland. Moreover, there is involvement of community other than the fisher community of the region in part time and seasonal fishing in the present wetland. The condition is a serious lacking in the management of the wetland that

poses a threat of significant loss in terms of fish diversity of the present wetland.

1.2. Flood and Siltation:

Though flood is beneficial for the wetland so far as the fish renewal and auto stocking of the wetland is concerned but it is found that heavy silt is also carried to the wetland by flood leading to its shallowness and upheaval of the basin. Periodic "flood and siltation" results into the discontinuity of the present wetland and formation of numbers of discrete small water bodies indifferent areas of the wetland. The mostly affected areas are Fesarhat (LS4), Dharmasala Bazar (LS5) and Gaspara (LS6) area of the wetland. The siltation leading to loss of water area is shown with the help of "Google Earth (Photograph "B" in Plate 1).

1.3. Encroachment for agriculture:

The wetland is facing huge population pressure and every year, there is shrinkage of water body due to illegal encroachment for paddy cultivation in the shallow shore and silted bed of the wetland during the month of November to February. Such activity is common on both banks throughout the length of the wetland. A dispute has been found prevailing between the fishers and the non-fisher agriculturists on both the banks whose agricultural lands are adjacent to the wetland. This is due to the non-availability of sacrosanct demarcation in some areas between the present wetland and the agricultural lands abounding it. Thus, there is obvious encroaching of the silted shore area of the present wetland for the purpose of agricultural activities. The observation records encroachments in areas like Pestirpar (LS1), Fesarhat (LS4), Dharmasala Bazar (LS5) and Gaspara (LS5) area. "Google Earth" (Photograph "B" in Plate 1) shows the encroachment and agricultural activities in the present wetland.

3.4 Inlet-Outlet channel blockade:

The wetland has apparently both inlet and outlet channels in its two ends. It has been observed during the study that the Inlet and

Outlet remain guarded throughout the year except during the Full Storage Level when the connection of the present wetland with the adjacent Dhaka wetland is established due to rise in water level but the other end i.e., the connection with the Brahmaputra is sealed by way of the sluice gate constructed by the Flood Control Department. The entry of water from River Brahmaputra is restricted by the operation of the sluice gate during the flood season. The lessee of both Chandakhil wetland and Dhaka wetland use to restrict the movement of fishes by constructing bamboo fencing (locally known as "Bana") in the junction of both the wetlands. (Photographs "C" and "D" in Plate 1) represent such an anthropogenic disruption of the connectivity of the present wetland.

3.5 Weed infestation:

The wetland has been found heavily infested with macrophyte like water hyacinth (*Eichhorniacrassipes*) almost throughout the length of the wetland particularly affecting the areas like Pestirpar (LS1), Fesarhat (LS4), Bazar (LS5) and Gaspara (LS6).

3.6 Jute retting:

Jute retting was found in a wide range in the present wetland. The small jute growers inhabiting in both the banks of the wetland use it for retting their jute stems. The retting activity is found in huge numbers in areas of the wetland like Pestirpar (LS1), Bridge (LS2), Garergaon (LS3), Fesarhat (LS4) and Dharmasala (LS5).

3.7 Fish disease:

During the month of December / January it has been observed that most of the commercially important fishes were having ulcerative lesions in different parts of the body including the caudalfins. The mostly observed species being affected by this type of infection are *Wallago attu*, *Mystuscarcio*, *Channa striata*, *Mastacembellusarmatus*, *Nandus nandus* etc. The observation includes deep haemorrhagic ulceration in the tail region of *Wallago attu* (Photograph "E"), head and tailrot in *Mastacembellusarmatus* (Photograph "F"), ulceration on the lateral sides

of *Channa striata* (Photograph "G") and *Nandus nandus* (Photograph "H") in Plate 2.

3.8. Culture of alien fish species in adjacent private ponds:

It has been found that adjacent private ponds of the wetland are used for culture of some exotic fishes, whose culture has been discouraged by the State Fisheries Authority. The fishes like Big

Head carp (*Hypophthalmichthys nobilis*), Thai magur (*Clarias garipienous*) and recently the Pacu (*Piaractus spp.*), locally known as Rupchanda have been taken for culture in the private ponds of the wetland vicinity and area available for sale in the local village markets (Photographs "I", and "J" in Plate-2). These ponds are found to be very adjacent to the present wetland and during the flood period most of such ponds are found engulfed by the spread water thus allowing the free movement of the fishes from the wetland to the private pond and vice versa.

3.9. Unplanned construction

The heavy floods in the year 1988 and 1998 have caused heavy damage to the human habitation in Dhubri district. The Howrarpar and Shilghagri area situated in the south of the wetland have faced devastating erosion by the river Brahmaputra during the floods. It has resulted with the loss of a large land area being engulfed by the river. An embankment cum road was constructed which led to the blockade of the age-old connection of the wetland via Howra drainage (locally known as *Howra Nadi*) with the river Brahmaputra in the southern part of the wetland. Earlier the connectivity provided a significant catchment area along with the scope of huge fish renewal from River Brahmaputra through the channel as noted during the interview with the respondent fishermen. But due to the construction of the embankment, the fish and fishery of the wetland is suffering alot.

Conclusion

It can be concluded that the present wetland is suffering from at least 9 different key factors that have bearings with the condition of the health of the present wetland. All the observed factors present in

the study area are potential threats for the wetland and its bio diversity. Habitat degradation results in loss of breeding ground and many biological species including fish will become threatened and depleted.

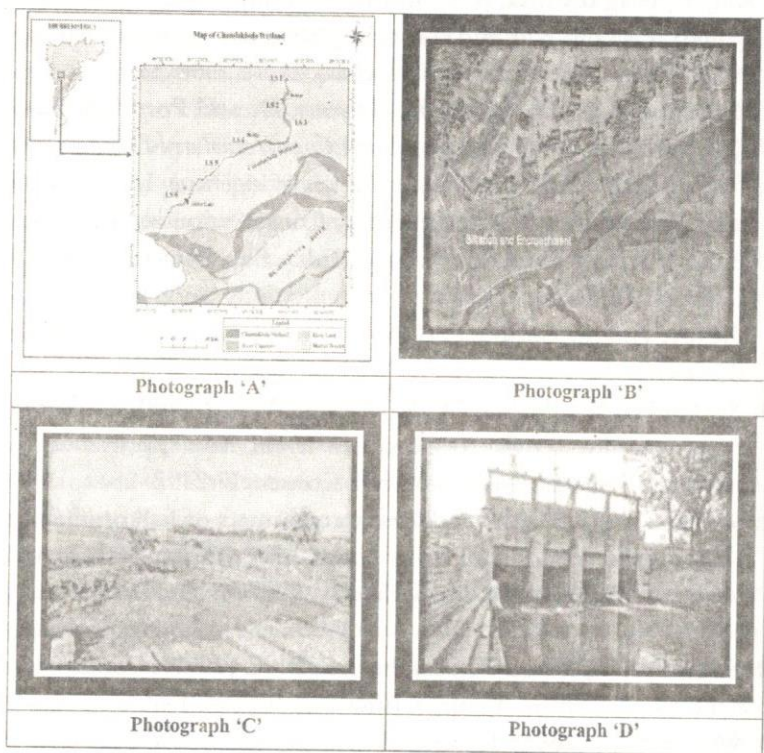
At present, in Assam, the wetlands are leased out to private parties by Assam Fisheries Development Corporation for revenue generation. This type of management approach inspires maximum exploitation of fishery from the wetland by the lessee. The present study shows limited participation by the community of the area. Awareness of local community regarding conservation of wetland ecosystem and biodiversity has become the need of the hour, so that the local community knows about the "Wise Use Concept" of the wetland resources.

Reference

1. **Baishya, A. and Bordoloi, S. (2008).** Effect of anthropogenic Stress on the Production of Fish in the Wetlands of Hajo, Kamrup district, Assam. *Proceedings of Taal 2007: The 12th world Lake Conference.*: 152-155
2. **Barman, R. C. and Kar, D. (2013).** Relationship of community-based physical assets and socio-political empowerment on community-based flood plain wetland fisheries management. *Journal of Academia and Industrial Research.*2(1):27-30.
3. **Das, B., Tripathi, S., Chakraborty, A. And Chakrabarty, K.(2011).** Studies of physico-chemical and microbiological parameters of water samples before and after jute retting. *Journal of Biological Sciences.* 11(2): 210-215.
4. **Deka, T. K., Goswami, M. M. and Kakati, M. (2005).** Causes of fish depletion – a factor analysis approach. *NAGA, World Fish Centre Newsletter.* 28(1&2): 37-42
5. **Dudgeon, D., Arthington, A.H. ; Gessner, M.O.; Kawabata, Z.; Knowler, D.J.; Leveque, C.; Naiman, R.J.; Richard, A.P.; Soto, D.; Stiassny, M.L.J. and Sullivan, C.A.(2006).** Fresh water biodiversity: Importance, threats, status and conservation challenges. *Biological Res.*, 31, 163-182.
6. **Goswami, C. and Kalita, M. P. (2012).** Ichthyofaunal Diversity

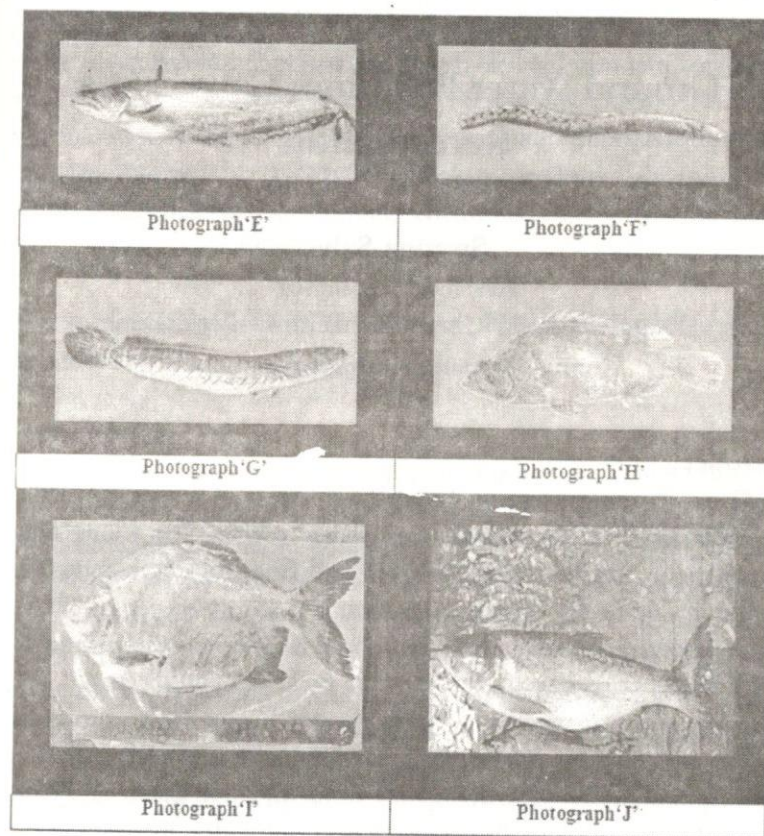
- & Anthropogenic Stress on Deepor Beel: the only Ramsar site in Assam. *Journal of Env. Sc., Toxic. And Food Tech.*2 (1): 54-59
7. **Kar, D., Nagarathna, A.V., Ramachandra, T.V. and Dey, S.C. (2006).** Fish diversity and conservation aspects in an ecosystem in Northeastern India. *Zoos' print journal.* ,21(7): 2308-2315.
 8. **Mahanta, P. C., Tyagi, L. K., Kapoor, D. and Ponniah, A. G. (2003).** *Integration of Fish Biodiversity Conservation and Development of Fisheries in North Eastern Region: Issues and Approach.* In: Participatory Approach for Fish Biodiversity Conservation in North East India. P.C. Mahanta and L. K. Tyagi (Edt.). Pub. Director, NBFGR, Lucknow, India.
 9. **Maltby, E. and Barker, T. (2009).** *The wetlands: Handbook.* Wiley-Blackwell
 10. **Sarkar, U. K., Pathak, A. K., Lakra, W. S. (2008).** Conservation of freshwater fish resources of India: new approaches, assessment and challenges. *Biodivers Conserv*17:2495–2511
 11. **Sheikh, S. (2015).** , Fish diversity and impact of fish production on the socio economy of fisher community of Chandakhola wetland, Dhubri, Assam. Unpublished *Ph.D. Thesis .Gauhati University.* 188pp
 12. **Sugunan, V. V. and Bhattacharjya, B. K. (2000).** Ecology and fisheries of beels in Assam. *CIFRI Bull. No.104:* 1-66
 13. **Wetzel, R.G. (2001).** *Limnology.*3rdEdn. Academic Press New York.
 14. **Google earth**

Plate: 1



Photographs:'A': Map of Study Area. **'B':** Satellite snap showing siltation and encroachment for agriculture (Source: Google Earth). **'C':** Inlet of the wetland being guarded by bamboo fencing. **'D':** Sluice gate guarding the connection with River Brahmaputra.

Plate: 2



Photographs:'E':Diseased *Wallagoattu* with ulcers on lateral and dorsal side of the body. **'F':** Diseased *Mastacembelus armatus* with head and mouth rot. **'G':** Diseased *Channa striata* with ulcers on lateral side of the body. **'H':** Diseased *Nandus nandus* with ulcers on the lateral side of the body. **'I':** Rupchanda (*Piaractus spp.*). **'J':** Big Head Carp (*Hypophthalmichthys nobilis*).

Ground Water Pollution: Causes and Remediation

Swapna Saha

Assistant Professor

Department of Chemistry, Bijni College, Bijni

Email:-swapana24saha@gmail.com

Abstract

Groundwater is an essential natural resource in most places. It makes up about 30% of the world's freshwater reserve. For a long time, groundwater was known to be clean and free from contamination. However due to rapid industrialization and increased use of chemicals, numerous contaminants often find their way into the groundwater. This paper reviewed ground water pollution and discussed possible remediation measures. Groundwater becomes contaminated when anthropogenic or people-created substances are dissolved or mixed in water recharging the aquifer. Contamination also results from an overburden of naturally occurring iron, sulphides, manganese and substances such as arsenic and fluorides. The pollutants usually move within aquifers depending on biological, physical and chemical properties. Processes such as diffusion, dispersion, adsorption and the speed of moving water often facilitates the movement. But in general, the movement of the contaminants within an aquifer is usually slow and as such their concentration tends to be high and, in a form, called a plume. As the plume spreads it might connect with springs and ground wells making them unsafe for human consumption. The significant sources of contamination in groundwater are agricultural chemicals, septic waste, landfills, uncontrolled hazardous waste, atmospheric

pollutants and petroleum products. Contaminated groundwater has detrimental effects on health. It causes typhoid, jaundice, dysentery, diarrhea, tuberculosis and hepatitis. Groundwater remediation is the process that is used to remove pollution from groundwater. Groundwater remediation techniques are mainly divided into two technologies: Ex-Situ Technology and In-Situ Technology. Ex-Situ Technology includes steam stripping, oxygen sparging, bioremediation and carbon adsorption. In-Situ Technology includes air sparging, bioremediation, in-well air stripping, chemical oxidation, thermal treatment and phytoremediation.

Keywords: Groundwater, Contaminants, Pollutants, Anthropogenic, Remediation

Introduction:

Water covers over 70% of the earth surface and is undoubtedly the most precious natural resource that exists on the earth. Without the seemingly invaluable compound comprised of hydrogen and oxygen, life on the earth would be non-existent. Water is a key ingredient supporting food production, sanitation and rural livelihoods as well as ensuring continuity and functioning of ecosystem. Today water resources have been the most exploited natural system since man strode the earth. Pollution of water bodies is increasing steadily due to rapid population growth, industrial proliferations, urbanizations, increasing living standards and wide spheres of human activities.

Ground water, rivers, seas, lakes, ponds and streams are founding it more and more difficult to escape from pollution. Many rivers of the world receive heavy flux of sewage, industrial effluents, domestic and agricultural wastes which consists of substances varying from simple nutrient to highly toxic hazardous chemicals.

The deterioration of the aesthetic and life supporting qualities of natural lakes and estuaries is caused by excessive fertilization due to effluents rich in nitrogen, phosphorus, potassium and organic growth substances. Various flora and fauna are affected and men themselves encounter numerous serious problems in water system. Several natu-

ral impurities which come from atmosphere, catchment areas and the soil are directly added to water. So the water contains several dissolved gases (N_2 , CO_2 , H_2 , Cl_2 , NH_3 , SO_2 , NO_x and H_2S etc.), dissolved mineral salts (Ca, Na, Mg, K, Fe, Mn and Co), suspended matters (sand, clay, silt) and even microbes. Also some of the dumped chemicals that were safely flushed away (e.g. Hg, Cd, As, Pd etc.) are now coming to haunt us.

Even in the most unpolluted geographically clean areas, the rain water consisting of dissolved oxygen, nitrogen, carbon-dioxide, dust and particulates picked up from the atmosphere, adds to the ground water.

Objectives:

1. To study about the causes of ground water pollution.
2. To study the effects of ground water pollution.
3. To study about the remediation of ground water pollution.

Methodology:

The paper is based on secondary data which is collected from various journals, books and internet.

Ground water pollution:

Ground water pollution occurs as a result of the release of pollutants into the ground to natural underground water reservoirs known as aquifers. Once the pollutants released to find their way into ground water, they cause contamination. Today human activities are constantly adding industrial, domestic and agricultural wastes to ground water reservoirs at an alarming rate. Ground water contamination is generally irreversible i.e. once it is contaminated, it is difficult to restore the original water quality of the aquifer.

The pollutants usually move within aquifers depending on biological, physical and chemical properties. Processes such as diffusion, dispersion, adsorption and the speed of moving water often facilitates the movement. But in general, the movement of the contami-

nants within an aquifer is usually slow and as such their concentration tends to be high and, in a form, called a plume. As the plume spreads it might connect with springs and ground wells making them unsafe for human consumption.

Causes of ground water pollution:

Natural sources:

Naturally occurring substances found in the soils and rocks can be dissolved in water causing contamination. These substances are sulphides, iron, radionuclides, fluorides, manganese and arsenic. Arsenic is poisonous in its organic form and it is quite lethal in nature. It gets dissolved in ground water due to the anaerobic conditions produced by organic matter present inside the aquifers. Due to the microbial decomposition of the organic matter, the oxides of iron are released into the ground water aquifers. These iron oxides then react with the arsenic and produce arsenic compounds – arsenite and arsenate, the former is more toxic than the latter.

The compounds of fluoride found in the ground water cause geogenic pollution. These are found in aquifers that lack calcium inside them. The permissible limit of fluoride concentration in ground water is 1.5 mg/L as per WHO guidelines since 1984. Investigations by WHO indicated that 20% of 25,000 boreholes tested in Bangladesh had arsenic concentration exceeding 50 μ g/L. Health problems associated with dental fluorosis may occur when fluoride concentration in ground water exceed 1.5 mg/L. The natural cause of pollution can be tested using the Ground water Assessment Platform (GAP). GAP estimates contamination levels using environmental, geological and topographical data.

Septic waste:

It is essential that septic waste is treated before it is disposed into the ground. Treatment prevents harmful substances from getting into the ground and spreading to the water. Additionally, the septic systems are structured to release the waste into the ground at an ex-

tremely slow rate which is harmless to the environment. However poorly designed septic systems release contaminants such as nitrates, oils, bacteria and household chemicals into the groundwater and make it unfit for human consumption. Poorly maintained septic tanks also result in leaks which cause groundwater contamination. Commercial septic tanks pose even a much bigger threat because they release organic chemicals such as trichloroethane.

Hazardous waste sites:

There are numerous sites around the world where hazardous products such as radioactive components, war chemicals, electronic waste and similar products are disposed. The number of these hazardous waste sites keep growing day by day. In many cases hazardous products' disposal sites are not adequately monitored. The lack of proper monitoring and maintenance of such sites leads to leakage of dangerous substances into the groundwater.

Agricultural chemicals:

Agricultural production has been scaled up in most developed nations. This large-scale production of farm goods means increased use of farm chemicals such as pesticides, herbicides and fertilizers. These chemicals used on farm settle on the ground and when it rains, they mix with the rainwater and seep through the porous ground to reach the underground water. In this way the chemicals pollute the groundwater.

The nutrients, especially nitrates in fertilizers can cause problems for natural habitats and for human health if they are washed off soil into watercourses or, leached through soil into groundwater. The heavy use of nitrogenous fertilizers in cropping systems is the largest contributor to anthropogenic nitrogen in groundwater worldwide.

Petroleum products:

Petroleum storage tanks are either located underground or, above ground. Also, the transportation of petroleum products is mainly done

underground using the pipeline. Leakages from these substances can lead to contamination of water.

Groundwater dissolves many different compounds and most of these substances have the potential to contaminate large quantities of water. For example, one liter of gasoline can contaminate 1000000 liters of groundwater. This problem is particularly severe in the Atlantic Provinces, where there is a high use of groundwater. In many cases, the problem is noticed long after the aquifer is contaminated, for example when consumers start tasting or, smelling gasoline.

Landfills:

Landfills are the places where our garbage is taken to be buried. Landfills are supposed to have protective bottom layer to prevent contaminants from getting into the water. However if there is no layer or, it is cracked, contaminants from the landfills (car battery acid, paint, oil, household chemicals and medical products) can make their way down into the groundwater.

Atmospheric pollutants:

Groundwater is maintained through the hydrological cycle which is the movement of water above, below and on the surface of the earth. As the water moves, it comes into contact with pollutants in the atmosphere such as harmful gases. When it rains, the water carries these contaminants into the ground and pollutes the groundwater.

Effects of ground water pollution:

Ground water pollution causes irreparable damage to soil, plants and animals including man. Polluted groundwater is the major cause for the spread of epidemics and chronic diseases in man. It causes typhoid, jaundice, dysentery, diarrhea, tuberculosis and hepatitis.

Water contaminated by fibers i.e. asbestos causes fatal diseases like asbestosis and lung cancer. The use of polluted groundwater for irrigating agricultural fields severely damages crop and decreases grain production.

Polluted water acutely affects soil fertility by killing bacteria and soil micro-organisms. Contaminated groundwater increases alkalinity in the soils. Groundwater pollution affects plant metabolism severely and disturbs the whole ecosystem.

Contaminated groundwater may seep into rivers and streams and lead to the loss of marine life which is detrimental to the environment. Another effect is that groundwater pollution leads to less stability in industries relying on groundwater to produce their goods. Therefore the industries in affected areas will have to outsource for water from other regions which may turn out to be expensive. In addition, they may be forced to close down due to the poor quality of water.

Ground water pollution can lead to scarcity of water. A very large percentage of the world's population depends on ground water for their daily use. When pollution occurs on a large scale, the entire consumers in a community are forced to abandon the consumption of the affected water. Alternative water supply has to be sought. This is always a problem as it is not usually easy to find alternative water supply for a large population.

Remediation of groundwater pollution:

Groundwater remediation is the process that is used to remove pollution from groundwater. Pollutants and contaminants can be removed from groundwater by applying various techniques thereby making the groundwater safe for use. Groundwater remediation techniques are mainly divided into two technologies: Ex-Situ Technology and In-Situ Technology.

Ex-Situ Technology involves treatment of groundwater by dewatering the polluted aquifer (pumping out), then treating the water on surface by physical, chemical or biological technology and finally re-injecting the treated water to the aquifer.

In-Situ Technology involves treatment of groundwater within the aquifer (in the sub-surface) by using thermal, chemical and biological treatment technology.

Remediation Techniques:

Ex-Situ Technology:

It involves extraction of groundwater from aquifer, treat above ground and return the treated water to the aquifer. Extraction is done by pumping groundwater from the well or, trench and treat them with a variety of techniques such as:

Steam stripping: In this technique the water is treated by introducing steam which extracts the contaminants from the pumped-out groundwater. The extracted steam along with contaminants can be recovered from the condensate or, treated further by incineration.

Oxygen Sparging: It involves the introduction of oxidizing and reducing agents. Example includes O_3 , H_2O_2 and hypochlorite. These will chemically convert the toxic contaminants to less toxic compounds.

Bioremediation: It involves treatment of pumped out groundwater by air (biodegradation) with careful control of moisture, heat nutrients, oxygen and P^H .

Carbon Adsorption: It involves passing the contaminated pumped up groundwater through activated carbon column in which contaminants gets adsorbed.

In-Situ Technology: It involves treatment of groundwater (in-place) without extracting the water from aquifer. There are several treatment techniques used for in-situ groundwater treatment such as:

Air Sparging: It is the injection of contaminant free air into the sub-surface saturated zone which enables a phase transfer of hydrocarbons from a dissolved state to a vapor phase.

Bioremediation: It involves injection of oxygen to enhance the biodegradation. This treatment also combines injection of degrading bacteria and nutrients into aquifer to stimulate biodegradation.

In-well air stripping: It is the injection of air into a double screened well, lifting the water up the well and forcing it out in upper screen.

Chemical Oxidation: It involves oxidation-reduction reactions that chemically convert hazardous contaminants to fewer toxic compounds. Typical examples of this are cyanide oxidation and dechlorination.

Thermal Treatment: It involves increase in temperature of the source zone to increase the mobility of the pollutants. The mobility facilitates removal of pollutants and can also results in in-situ destruction of contaminants.

Phytoremediation: It involves the use of macroscopic plants to destroy, remove, immobilize and treat contaminants. This process does not use microorganisms.

Conclusion:

Ground water resources are vital for human life and health, societal development and the preservation of the natural ecosystems. Various and multiple sources of ground water pollution have been identified which include a series of both natural and anthropogenic sources. Ground water contamination is a serious global problem. Water scarcity puts lives at risk. Today people must be educated to understand need for wise and restrained use of the earth's resources, water being the most vital. Education for protecting the aquatic environment is the need of the hour. Governments should start educating the people through television, films and documentaries about the need to stop the pollution of major rivers. Health hazard programs should be given wide publicity in public sector through television, newspaper etc. The programme should include diseases caused by the consumption of polluted water and precautions to be taken.

References:

1. Ahel, M., Mikac, N., Cosovic, B., Prohic, E. and Soukup, V. (1998) The Impact of Contamination from a Municipal Solid Waste Landfill (Zagreb, Croatia) on Underlying Soil. *Water Science & Technology*, 37, 203-210.
2. Boulding, J.R. (1995) *Practical Handbook of Soil, Vadose Zone and Groundwater Contamination; Assessment, Prevention and Remediation*. Leurs Publishers, Boca Raton, FL.
3. Canter, L.W., Knox, R.C. and Fairchild, D.M. (1998) *Ground Water Quality Protection*. Lewis Publishers, Inc., Chelsea, Michigan, 562.
4. Connell, D.W. (1981) *Water Pollution*. University of Queensland Press, Brisbane.
5. Cruz, J.V., Silva, M.O., Dias, M.I. and Prudencio, M.I. (2013) Groundwater Composition and Pollution Due to Agricultural Practices at SeteCidades Volcano (Azores, Portugal). *Applied Geochemistry*, 29, 162-173.
6. Madsen, E.L. (1991) Determining in Situ Biodegradation: Facts and challenges. *Environmental Science & Technology*, 25, 1663-1673. <https://doi.org/10.1021/es00022a001>
7. Sharma, B.K. and Kaur, H. (1994) *Water Pollution*. First Edition, Goel Publishing House, Meerut.
8. Thayer, A.M. (1991) *Bioremediation: Innovative Technology for Cleaning Up Hazardous Waste*. *Chemical Engineering News*, 69, 24-44.
9. WHO (2011) *Guidelines for Drinking-Water Quality*. 4th Edition, IWA Publishing, London, 564 p. https://www.who.int/water_sanitation_health/publications/2011/dwq_guidelines/

10. Zaporozec, A. and Miller, J.C. (2000) Groundwater Pollution. UNESCO-PHI, Paris, 1-24.

Global Warming in the Twenty- First Century: Its Causes, Impacts and Solutions

Dr. Jabin Chandra Ray &

Lily Devi

Assistant professor
Department of Botany
Bijni College, Bijni

Abstract

Global warming is a big global problem in the twenty first century. The average global temperature in the earth is 15°C. Global warming is the unusually rapid increase in Earth's average surface temperature over the past century primarily due to the greenhouse gases (GHGs) released by people burning fossil fuels. According to National Aeronautics and Space Administration (NASA) and Intergovernmental Panel on Climate Change (IPCC), global temperature has increased by 1.4°F since 1880, CO₂ levels has reached 400.71 Parts per billion. Environmentalists, scientists and researchers are expressing deep concerns about changing in the overall climate of the planet. Urbanization and rapid industrialization have led to deforestation, destruction of forests and uncontrolled burning of fossil fuels produces gases like carbon dioxide (CO₂), nitrous oxide (NO₂), methane (CH₄) and chlorofluorocarbons (CFCs) which lead to global

Warming. A rise in global warming which cause serious ecological effects like- melting of glaciers and ice caps at poles; flooding of coastal areas; increase in sea level; submersion of islands; change in

climate conditions; effects on human health and effects in agriculture. Most people are still unaware of global warming and do not consider it to be a big problem in years to come. Although the scientific community has been aware of the link between greenhouse gases (GHGs) and climate change for many years, world leaders have been slow to react and implement measures to mitigate the risks. Northeast India also in vulnerable position to climate change. The present paper introduces global warming, elaborates its causes, impacts and presents some solutions to solve this burning problem.

Keywords: Global warming, greenhouse gases, climate change, causes, effects and solutions.

Introduction

Global warming is a term widely used to describe a potentially dramatic rise in the annual average global surface temperature of the Earth. Estimates of how big that temperature increase will be range from 1.5°C to 4°C [1]. Now, the world is facing ecological problems like environmental pollution, increase in population, deforestation and energy crisis. An outcome of the atmospheric pollution is warming of the earth's environment. Warming of the earth atmosphere is a serious problem and in twenty-first century this may be a problem of global concern. There is a clear indication that the temperature of the earth has increased slightly during the past 50 years (Fig 1) [2]. Global warming begins when sunlight reaches the Earth. The Earth receives shortwave radiation from the sun (including the visible part of the spectrum), one-third of which is reflected while the rest is absorbed by the atmosphere, ocean, ice, land and biota. The energy absorbed from solar radiation is balanced, in the long term, by outgoing radiation from the Earth and atmosphere. Terrestrial radiation is emitted in the form of long wave infrared energy. The balance between energy absorbed and emitted as long wave infrared radiation can change due to a number of factors: changes in the sun's energy output, slow variations in the Earth's orbit and the greenhouse effect. The green-

house effect is one of the most important factors and is one which humankind has the capacity to change.

Shortwave radiation can pass easily through the atmosphere, whereas long wave terrestrial radiation emitted by the warm surface of the Earth is partially absorbed by a number of trace gases in the atmosphere. These trace gases are *greenhouse gases* (GHGs). The main natural GHGs are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), water vapour (H₂O) and ozone (O₃) in the troposphere and stratosphere.

Thus the *greenhouse effect* arises because the atmosphere is largely transparent to incoming solar radiation, while being quite heavily absorbing to outgoing thermal radiation from the planetary surface and the atmosphere. Since the beginning of the earth's origin, the effect exists as a natural process. But since the 20th century the effect is enhanced by man's activities that are liable to destabilize the natural balance. Different trace gases in the atmosphere contribute to the *greenhouse effect*, but among them the four major gases are carbon dioxide (CO₂), chlorofluorocarbons (CFCs), methane (CH₄) and oxides of nitrogen (NO_x) [3]. According to Intergovernmental Panel on Climate Change (IPCC), carbon dioxide and methane levels have increased by 35% and 148% since the industrial revolution of 1750 [4].

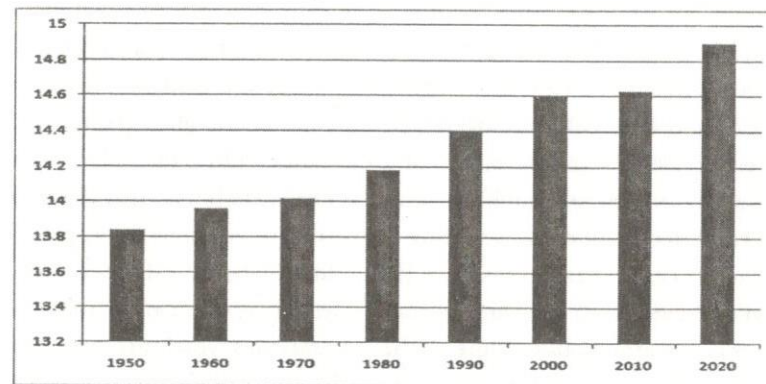


Figure 1: Average temperature of earth recorded in different years (Source: NASA, America)

Greenhouse Effect

The sun is the main source of energy on the earth. The sun is continuously radiating energy in the form of electromagnetic waves into the space. It has been calculated that one part out of two billion parts of total solar energy radiated from the sun reaches the earth because of small size of the earth and very long distance from the sun. The energy reaches to the earth atmosphere by Ultra-violet radiation, visible light (VIBGYOR spectrum) and Infra-red and radio waves.

Cosmic radiations do not reach to the atmosphere of earth. When the solar radiations first fall on the top of atmosphere the harmful ultraviolet radiations are absorbed by the ozone layer in the stratosphere and are prevented from reaching the earth surface. Thus, ozone layer acts as a protective layer in the stratosphere. The visible light and infra-red rays then pass through the carbon dioxide (CO_2) layer in the lower region of the atmosphere (troposphere) and ultimately fall on the earth surface. Since infra-red radiation has heating effect, it warms up the earth, its atmosphere and various objects. A part of infra-red rays falling on the earth surface is reflected back into the outer space. Infra-red radiation coming to earth from the sun are of short wavelength but the infra-red rays reflected from the earth and its various objects are of long wave lengths. The infra-red radiation reflected from the earth cannot escape out from the carbon dioxide layer present in the atmosphere. CO_2 and some other gases like methane, nitrogen oxides and chlorofluorocarbons (CFCs) act as the glass panels of a green house or window panes of a car which allow the solar radiations to pass through and heat the surface of earth but do not allow the heat radiated from earth is surface to pass through thereby trapping it in the process. These gases have the ability to absorb infra-red radiation reflected from the earth surface. Therefore, the blanket of these gases in the atmosphere traps all the infrared rays which produce heat on the earth surface. The heating of earth's atmosphere due to trapped infrared rays reflected from the earth surface is called **Green House Effect** which causes **global warming**[2].

The greenhouse effect, combined with increasing levels of greenhouse gases and the resulting global warming, is expected to have philosophical implication. If global warming continues unrestrained and nothing effective is done to limit this evil, it will cause significant climate change, a rise in sea levels, extreme weather events and other ruthless natural, environmental and social impacts [5].

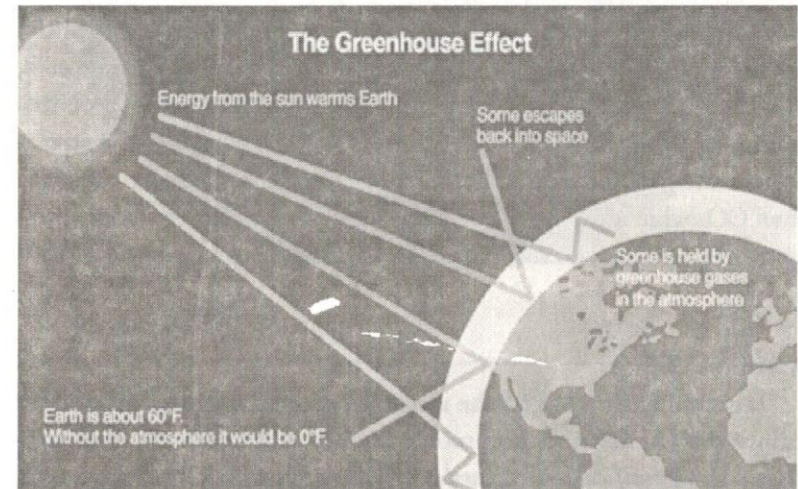


Figure 2: Greenhouse Effect

Greenhouse Gases

The phenomenon that worries the environmental scientists is that due to anthropogenic activities there is an increase in the concentration of the greenhouse gases in the air that absorb infra-red light containing heat and results in the re-radiation of even more of the outgoing thermal infra-red energy, thereby increasing the average surface temperature beyond 15°C [6].

The greenhouse gases present in the troposphere and resulting in an increase in the temperature of air and the earth:

Carbon dioxide (CO_2)

It contributes about 55% to global warming from greenhouse gases produced by human activity. Industrial countries account for

about 76% of annual emissions. The main sources are fossil fuel burning (67%) and deforestation, other forms of land clearing and burning (33%). CO_2 stays in the atmosphere for about 500 years. CO_2 concentration in the atmosphere was 355ppm in 1990 that is increasing at a rate of 1.5 ppm every year. [6].

Chlorofluorocarbons (CFCs):

Moreover, fluorinated gases such as chlorofluorocarbons (CFCs) are chiefly a result of various industrial processes and refrigeration [7, 8]. These are believed to be responsible for 24% of the human contribution to greenhouse gases. CFCs take 10-15 years to reach the stratosphere and generally trap 1500 to 7000 times more heat per molecule than CO_2 while they are in the troposphere. Atmospheric concentration of CFCs is 0.00225 ppm that is increasing at a rate of 0.5% annually.

Methane (CH_4):

It accounts for 18% of the increased greenhouse gases. The third culprit gas is methane, commonly known as natural gas. It is produced as a result of agricultural activities such as livestock digestion, paddy rice farming and use of manure. Methane is also produced due to improper management of waste [7,8]. Methane stays in the atmosphere for 7-10 years. Each methane molecule traps about 25 times as much heat as a CO_2 molecule. Atmospheric concentration of methane is 1.675 ppm and it is increasing at a rate of 1% annually.

Nitrous Oxide (N_2O):

It is responsible for 6% of the human input of greenhouse gases. Besides trapping heat in the troposphere, it also depletes ozone in the stratosphere. Nitrous oxides are generated mainly by fertilizers. Its life span in the troposphere is 140-190 years and it traps about 230 times as much heat per molecule as CO_2 . The atmospheric concentration of N_2O is 0.3 ppm and is increasing at a rate of 0.2% annually [6,7].

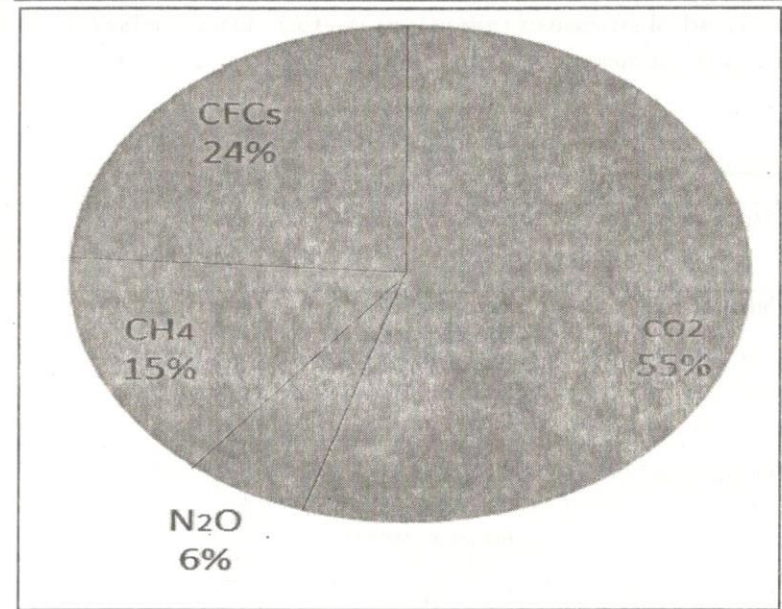


Figure 3: Green house gases and their ratio (%) [2]

These gases are playing their negative part in increasing the havoc of global warming. They are continuously causing an increase in the earth's temperature.

Causes of Global warming

Urbanization and rapid industrialization have led to deforestation, destruction of forests and uncontrolled burning of fossil fuel. Air pollutants like carbon dioxide (CO_2), nitrous oxide (NO_2), methane (CH_4), Chlorofluorocarbons (CFCs) are liberated in the atmosphere. These gases are green house gases as they allow the solar radiation to pass through them but then absorb and reradiate the heat back to the earth, causing green house effect.

When a balance exists between the amount of energy received and the amount of energy reflected from earth back into space, the average temperature of earth remains more or less constant (Average global temperature is 15°C). With the presence of green house gases

and gradual increase of carbon dioxide (CO₂) in atmosphere there is a chance of increase in global temperature[9].

Table1: Sources of green house gases

Green house Gas	Source of discharge	Percentage of discharge
Carbon dioxide (CO ₂)	Burning of fossil fuels	81%
	Destruction of forests	17%
	Cement plants	2%
Methane (CH ₄)	Rice cultivation	30%
	Domestic animals	20%
	Burning of vegetation	17%
	Landfills	12%
	Coal mines	9%
	Natural gases	12%
Nitrogen oxides (N ₂ O)	Burning of fossil fuels	43%
	Use of fertilizers	25%
	Burning of vegetation	25%
	Cultivated land	7%
Chlorofluoro carbons (CFCs)	Industrial activities	100%

Impacts of Global warming

Global increase in temperature of earth will have serious consequences on human society, agriculture, plants and animals. A rise in global temperature by more than two or three degrees may lead to global warming which will cause serious ecological effect: melting of glaciers and ice caps at poles; flooding of coastal areas; increase in sea level; submersion of islands and change in climatic conditions[9].

Melting of glaciers:

Glaciers in the Himalayas are melting at an "exceptional" rate because of global warming; threatening the water supply of millions of people in Asia, according to a study published on 6th December, 2021, by a researcher's team of University of Leeds, UK. The study, published in the Journal Scientific Reports, also shows that Himalayan glaciers are shrinking far more rapidly than glaciers in other parts of the World. The acceleration of melting of Himalayan glaciers has significant implications for hundreds of millions of people

who depend on Asia's river systems (Brahmaputra, Ganges and Indus) for food and energy [10].

Global temperature increase:

It is estimated that the earth's mean temperature will rise between 1.5 to 5.5°C by 2050 if input of greenhouse gases continues to rise at the present rate [6].

Sea-level rise:

Global warming is likely to result in a rise in sea-levels that could threaten many coastal areas around the world. It will also melt much glacier, especially around Greenland. Sea-level changes will complicate life in many coastal regions. A 100 cm rise could submerge 6 per cent of the Netherlands, 17.5 per cent of Bangladesh and many islands. Countries will have to spend huge amounts of money to protect their shorelines, while poor countries may be forced to evacuate low-lying coastal regions. New marshes will also form in many places[2]. In India, the Lakshadweep Island with a maximum height of 4 meters above the sea level may be vulnerable. Life of millions of people will be affected by the sea level rise who has built homes in the deltas of the Ganges, the Nile, the Mekong, the Yangtze and the Mississippi rivers [6].

Human health:

As a result of global warming human populations will be displaced. In a warmer climate people will get more frequently sick. Diseases now found in the warm tropical areas will spread to new regions. Many diseases are transmitted by mosquitoes and other animals when these animals will move into colder regions. Other tropical diseases including dengue fever, yellow fever and encephalitis may spread into new regions. It is also predicted that there will be rising incidence of allergies and respiratory diseases, as warmer air is more charged with pollutants, fungal spores and pollens [...]. Higher temperature and humidity will increase/ aggravate respiratory and skin diseases [6].

Effect on agriculture:

There are different views regarding the effect of global warming on agriculture. It may show positive or negative effect on various types of crops in different regions of the world. Tropical and subtropical regions will be more affected since the average temperature in these regions is already on the higher side. Even a rise of 2°C may be quite harmful to crops. Soil moisture will decrease and evapo-transpiration will increase, which may drastically affect wheat and maize production. Increase in temperature and humidity will increase pest growth like the growth of vectors for various diseases[6].

Climate change:

Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region. Such conditions which average over a long period—at least 30 years. The Intergovernmental Panel on Climate Change (IPCC) in 1990 and 1992 published the best available evidence about past climate change, the green house effect and recent changes in global temperature. It is observed that earth's temperature has changed considerably during the geological times. During the past 10,000 years of the current interglacial period the mean average temperature has fluctuated by 0.5- 1°C over 100 to 200 year period. Small changes in climatic conditions may disturb agriculture that would lead to migration of animals including humans. Climate change upset the hydrological cycle; result in floods and droughts in different regions of the world, cause sea level rise, changes in agriculture productivity, famines and death of humans as well as livestock.

The global change in temperature will not be uniform everywhere and will fluctuate in different regions. By a temperature increase of 1.5 to 4.5°C the global hydrological cycle is expected to intensify by 5 to 10%. Disturbed rainfall will result in some areas becoming wetter and the others drier. Although rainfall may increase, higher temperatures will result in more evapo- transpiration leading to annual water deficit in crop fields[6].

Climate Change and NE

The North Eastern Region of India lies between 22°N and 29°5N latitude and 88° E and 97°30 E longitude and shares international border with Bangladesh, Bhutan, China and Myanmar. The region has two main river basins (the Brahmaputra and Barak), a large dependence of the population on natural resources, and poor infrastructure development. The region is also characterized by diverse climate regimes which are highly dependent on the southwest monsoon (June- September). Over 60% of the crop area is under rain fed agriculture, and so is in areas highly vulnerable to climate variability and climate change [1].

Check on Global Warming

Global warming can be checked by reduction the concentration of CO₂, CH₄, N₂O and CFCs in the atmosphere by adopting the following measures[2, 6]:

- Reducing the use of fossil fuels.
- Cut down the current rate of use of CFCs and fossil fuel.
- Use of alternative energy sources
- Shift to renewable energy resources
- Increase nuclear power plants for electricity production
- Shift from coal to natural gas
- Stabilize population growth
- Efficiently remove CO₂ from smoke
- Plantation of tree at large scale
- Remove atmospheric CO₂ by utilizing photosynthetic algae
- Use of alternative energy sources
- Use of greenhouse gas reduction techniques during the emission.
- If one-third part of the world is covered by the forest then CO₂ will be stabilized

Conclusion

Global warming is a big danger and suitable measures must be taken to undertake this serious problem. This difficulty is not only

causing problem to the human beings but also to animals and plants. Melting of polar ice caps will lead to floods which can cause mayhem everywhere. Rise of sea levels will destroy agricultural and fishing activities. Climate change has remarkable impacts on natural resources, economic activities, food security, health and physical infrastructure. Innovative solutions must be brought forward to end this danger once and forever. India is one of the countries most strongly affected by climatic change.

References

- [1] Houghton, J.T., Meira Filho, L.G., Callander, B.A., Harris, N., Kattenberg, A. and Maskeli, K. (eds) 1996: Climate change 1995: the science of climate change. Cambridge: Cambridge University Press.
- [2] Shukla, R.S. and Chandel, P.S. (2014): A textbook of Plant Ecology. Published by S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi.
- [3] Santra, S.C. (2012): Environmental Science, Published by New Central Book Agency (P) Ltd, Kalkata
- [4] Shahzad, U. (2015): Global Warming: Causes, Effect and Solutions. Durreesamin Journal, Vol.1(4), Uploaded by Umar Shahzad on 05 May, 2017.
- [5] Marc, L. "What is the greenhouse effect", 28 January 2015, <http://www.livescience.com/37743-greenhouse-effect.html>, Accessed 23 May 2015.
- [6] Kaushik, A. and Kaushik, C.P. (2012): Perspectives in Environmental Studies. New Age International (P) Limited, New Delhi

- [7] "Greenhouse gas emissions", <http://www.epa.gov/climatechange/ghgemissions/>, Accessed 23 May 2015.
- [8] "Consequences of greenhouse effect temperature rise", http://www.bgs.ac.uk/discovering_Geology/climateChange/CCS/consequencesOfTemperatureIncrease.html, Accessed 23 May 2015.
- [9] Mita, D.; Guha, J.; Choudhuri, S.K. (2019): Studies in Botany (Vol. Two). Moulik Library, Kolkata.
- [10] Carrivick, J. (2021): "Himalayan glaciers melting at 'exceptional rate' due to warming: Study" published by "The Assam Tribune", page 6; 20 December, 2021.

Forest Degradation: Impact of Rural Population Pressure (A Case study on Bezara development Block in Kamrup District, Assam)

Dr Bhanu Hazarika

Department of Geography, Saraighat College, Changsari
Email: hazarika8.bhanu@gmail.com

Abstract

The role of population pressure on the forest degradation has been much worldwide. Forest plays a vital role in protecting and improving the ecosystem as well as the environment. Forest provides the essential requirements of life to human and other living organism. Rapid increases of human population exert tremendous pressure on land and other resources and bring about a variety of environmental problem in the study area. The total number of populations of Bezara Development Block became more during the period of 1961 to 2011 from 34,072 to 83,860. Similarly, density of population became more from 225km² to 553 km² during the same period. On the other hand, the area of forest cover is 69.05% in 2005-2006 and it decreased to 65.71% during the period of 2011-2012. Over the years, forest cover of this block is decreasing due to the practice of illegal felling of trees, smuggling of forest product and lumbering. Apart from it, large scale forest destruction is going on in the name of Four Lane Highway construction. With this background an attempt is made in this paper to assess the extent of forest cover change in the block using relevant data from both primary and secondary sources. The

study reveals that if the nature and degree of deforestation continues like this, the ecology and ecosystem of the reserved forest will affect greatly losing its rich biodiversity in near future. It is thus the high time to do something effectively to address such as crucial problem of the region.

Keywords: Forest degradation, Ecosystem, Biodiversity

Introduction

Population growth of an ever-increasing rate is a major factor and is fast losing the capacity of earth to support life. The experiences of deforestation, loss of biodiversity, soil erosion, atmospheric pollution, floods and droughts are living examples of the world at stake. Human action by itself has endangered the environment. With the increase of population and growth of industrialization, infrastructural development activities, the dependency of human beings on the forest resources and forest land has increased manifold which in turn results in the destruction of the virgin green blanket. Today due to increasing population the interaction with forest is becoming more and more intense leading to loss of many important resources. The rural population of the Bezara Development Block in Kamrup district became more than double during the period 1961 to 2011 from 34,072 to 83,860. At the same time, the density of population in the study region increased proportionately from 225 km² in 1961 to 553 km² in 2011. To develop him and his surrounding, man directly or indirectly depends on nature. But the long process of development brings in over exploitation of nature and in turn destruction thereof. Along with human resources, land, water and vegetation are the three important natural resources necessary for sustainable growth. Increased population leads to overuse of natural resources, endangering the welfare of future generation.

The increasing population pressure and density of population reduced the per capita availability of forest land over the time. It was 35.33% in 2001 and was reduced to 34.21% in 2011 in Assam. Similarly, the forest area of Bezara Development Block was 69.05% in 2005-06 and was reduced to 65.71% in 2011-12. Now due to increasing population and huge gap between demand and supply, for-

ests have been ruthlessly exploited to meet the increasing demand of fuel, fodder and timber. Depletion of natural forest-based resources is increasing at a rapid rate due to poverty, low agricultural productivity, urbanization and industrialization.

In the study region of the Bezara Development Block in Kamrup district, such developmental activities mainly infrastructural development and high demand for forest resources continue the destruction and degradation of forest cover. The forest area has been shrinking as a result of land cleared for construction of new urban areas, industrial plants, roads, educational institutions and health care centre etc. There are ten selected sample villages near the reserved forest of the study region where 40.29% of the tribal people depend on forest resources. Their main source of income is agriculture and allied activities. In this reserved forest, people are enjoying direct as well as indirect benefits from the forests in case of getting fuel, fodder, shelter, food, vegetables, fruits, etc. Deforestation is the result of rampant planning and non-precautionary action on the part of human being. Hence, in the light of ever-increasing demand, concept of multiple use of land with multiple tree species has become immensely important.

Study Region

The Bezara Development Block is located in the north eastern part of Kamrup district of Assam (Fig.1.1). It is a geographical area having micro physiographical, cultural, historical and economic bases. The area extends latitudinally from 26°10' North to 26°22' North and longitudinally from 91°39'04" East to 91°49'50" East. It covers an area of 138 km² with a total population of 83,860 (2011 census) distributed over 57 villages. At present it consists of 7 gaonpanchayats like Agdala, Bezara, Mandakata, Dhopatari, Saraighat, Rudreswar and Lachitgarh and 3 mouzas, viz SilaSundariGhopa, Bar Bongsar and part of Pub Bangsar mauza. The area is bounded on the east by the river Barnadi, on the west by the Madartala and Pub Bangsar mauzas, on the south by the river Brahmaputra and on the north by the Karara mouza.

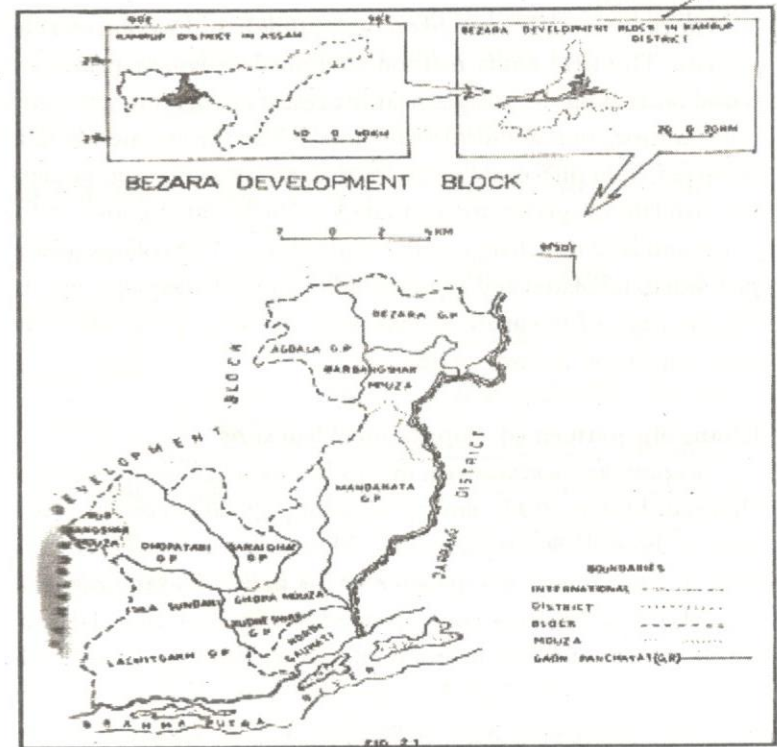


Fig 1

Objectives

The paper is based on the following objectives:

- To analyse the population trend and population density in the Bezara Development Block in Kamrup district of Assam during 1961 to 2011.
- To analyse the reserved forest areas of Bezara Development Block in Kamrup district during 2005-06 to 2011-12.
- To identify the impact of human and infrastructural development on forest cover.
- To find out some probable measures to reduce the rate of deforestation.

Methodology

The present study is based on both primary and secondary sources of data. The field study method is applied to collect primary data based on visiting the villages near the reserved forest to generate relevant information about the situation. While the secondary data are collected from different books, journal, reports, internet, newspaper etc. Satellite imageries are also taken to highlight the loss of forest cover and land use change in the study region. The collected data are processed, tabulated and represented by graphs, diagrams and maps. On the basis of the analysis made with the help of the above methods, conclusion is made on the topic.

Changing pattern of Population Structure

The population scenario in the study region has been tremendously changed. During 2011 census, the total population of the study region is about 83,860 representing .31% of the Assam's total population. In 1961, the total population of the Bezara Development Block was 34,072 which have gone up to 83,860 in 2011 (table 1.1). In the whole district of Kamrup (rural), it was 6,99,243 in 1961, which increased to 1,517,202 in 2011. Similarly, the state of Assam as a whole the rural population was 10,056,041 in 1961 which increased to 26,770,730 in 2011. Population increased in these areas due to both the natural growth as well as legal and illegal migration. On the other hand, major section of the people lives in below poverty lines who are mostly agricultural people. The birth rate is high among the peasant communities due to early marriage, low level of female literacy, religious beliefs, etc. More people mean more inhabited land (increasing population density) and more inhabited land means depleting the natural resources like forest land, agricultural land, water, etc. and misusing the energy sources. Population pressure has led to encroachment of forest land due to increase need of infrastructural development. This have been adversely affected the environment required to live in.

Table 1
Trend of rural population growth in Bezara Development Block, Assam (1961 – 2011)

Study area/District/State	Total Population				
	1961	1971	1991	2001	2011
Bezara Development Block	34,072	49,106	67,361	80,369	83,860
Kamrup (Rural) District	6,99,243	9,56,265	13,44,856	16,14,107	15,17,202*
Assam (Rural)	1,00,56,041	1,33,35,930	1,99,26,527	2,32,16,288	2,67,70,730

*Note: Due to creation of Baksa district.

Source - Census of India for 1961, 1971, 1991, 2001 & 2011

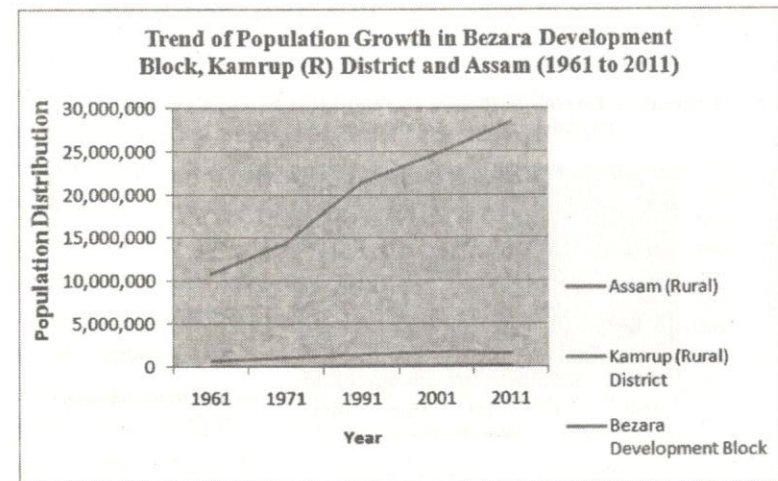


Fig-2

Changing pattern of Population Density

Density depends on many natural and human factors, such as, soil, rainfall, climate, economic resources, and the stage of economic growth and so on. Since, these factors differ in many places, the density will also differ. There is a wide variation in distribution and density of population throughout the Bezara Development Block of Kamrup district.

Table 2
Density of Population in Bezara Development Block, Kamrup District, Assam, (1961 -2011)

Study region/ District/ State	Population Density (per km ²)				
	1961	1971	1991	2001	2011
Bezara Development Block	225	324	445	530	553
Kamrup District	171	234	329	377	436
Assam	130	172	257	340	397

Source: Census of India, 1961, 1971, 1991, 2001 & 2011

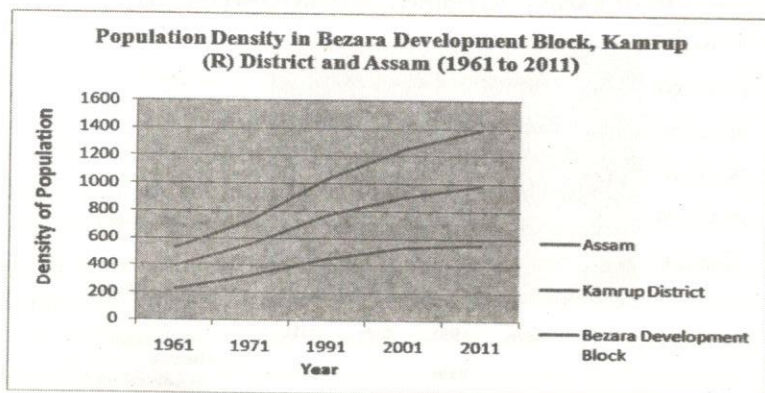


Fig 3

The variation in physical condition, distance from the urban centres or industrial centres, degree of transport accessibility and economic advancement are largely responsible for population distribution in the area. Better transport and communication facilities combined with the on-going process of urbanization and industrialization are largely associated with high concentration of population in Bezara Development Block. During 2011 census, the density of population in this part of the district was found to be 553 km² against 225 km² in 1961, while the corresponding densities of Kamrup (rural) averages were 436 and 171 and that of the state average were 397 and 130 respectively. It is further seen that the density of population in the study areas of Bezara Development Block is consistently higher than that of the district and the state averages.

Human impact on Forest Cover

Forest plays a vital role in protecting and improving the ecosystem as well as the environment. These forests facilitate the conservation of ecological balances, bio-diversity, enhance the quality of environment by checking soil erosion, water cycle, act as a carbon sink which balances the carbon dioxide and oxygen in the atmosphere and facilitate in reduction of the greenhouse gases effect. Nature has endowed Assam with a rich potential for the development of forest. Assam occupies a significant place in wildlife map of the country for her rich and rare birds and animal species. Forest department sources disclose that as much as 55% of the forest area loss in Assam has been caused by filling of trees, 25% for encroachment and 20% for shifting cultivation. On the other hand there was 18,060 sq. km of area under reserved forest in Assam in 2003 which came down to 13,869 sq km of in 2007 indicating a loss of 2184 sq km of the reserved forest area in few years period. On account of deforestation, tempering with nature, uncontrolled grazing in the catchment areas and soil erosion, floods have become a recurring phenomenon in many parts of the region and Assam. Due to rapid growth of population there has been an increasing pressure of man on the limited forest lands.

The data on forest cover reveals some contradictory trend (table 1.3). Data from the IRS Liss III, Images shows in the study region of Bezara Development Block 2005-06 to 2011-12. There are some popular forests reserved found in the study region are as in the following list.

Table 3

Name of the Blocks	2005-2006 (Area in Km ²)				2011-2012 (Area in Km ²)			
	P.C. of Forest area	P.C. of Stone Quarrying	P.C. of Built-up Mining & Industrial	P.C. of Built-up Rural inhabitant	P.C. of Forest area	P.C. of Stone Quarrying	P.C. of Built-up Mining & Industrial	P.C. of Built-up Rural inhabitant
Agyathuri	7.57	2.10	29.49	5.6	7.30	3.79	35.94	7.40
Bamuni Pahar	2.21	5.99	70.51	10.43	1.88	13.33	92.63	11.36
Dirgheswari	30.80	40.41	-	49.28	29.04	61.04	-	61.70
Malong Pahar	0.54	0.70	-	3.35	0.51	0.94	-	3.61
Manik Nagar	0.90	-	-	8.53	0.88	-	-	8.70
Natowanacha	14.82	4.12	-	5.26	14.34	6.36	-	8.01
Sila	12.21	15.62	-	5.30	11.76	18.33	-	9.31
Total area (in Km ²)	49.84	55.73	72.46	61.62	47.43	74.95	93.17	77.81

P.C of Reserved Forest in Bezara Development Block (2005-06 to 2011-12)

Source: IRS Liss III, Images (2005-06 and 2011-12)

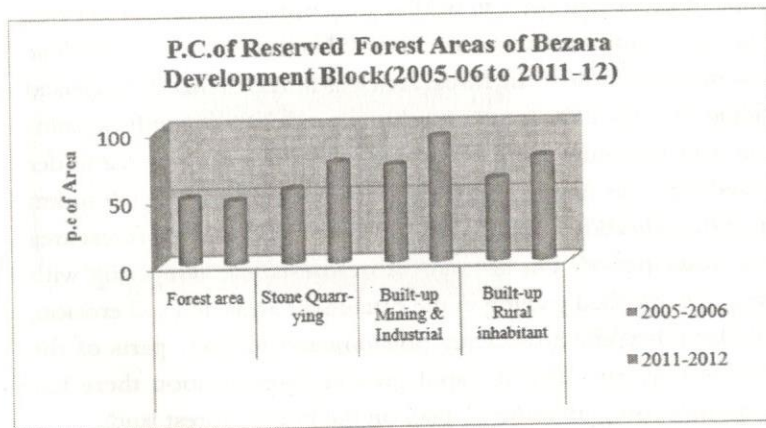


Fig 4.

- Agyathuri Reserved Forest
- Bamuni Pahar Reserved Forest
- Dirgheswari Reserved Forest
- Malong Pahar Reserved Forest
- Manik Nagar Reserved Forest
- Natowanacha Reserved Forest and
- Sila Reserved Forest.

The GIS data on the land cover classes of these mention forests indicate a significant increase in the area under stone quarrying, built up mining and industrial and built up rural inhabitant. Most of the reserved forest areas since 2005-06 onwards to 2011-12 reveal a declining trend. The forest cover area is not only decreasing but also quality of forest is deteriorating and dense forests are becoming open forest or scrub. The area of the forest cover is 49.84 % in 2005-06 and it decreased to 47.43 % during the period of 2011-12. Due to increase in population pressure in that region, the forest cover is rapidly decreasing from the entire region. The increasing population pressure and density of population reflect the per capita availability of forest land is decreasing in the Bezara Development Block; it is found that the area under forest land is decreasing and on the other hand stone quarrying, mining and industries are increasing year by year. Moreover, one of the major factors affecting forest cover is the best place to accommodate the growing pressure of additional human population in the study region. As a result, the growing population is gradually widening in the forest cover area.

The tribal villages near the forest areas, most of the rural people depend on forest based natural resources. Hence, forest-based resources have been providing them motherhood affection. They are getting and enjoying direct and indirect benefits from forest based natural resources in case of getting fuel, fodder, shelter, food, minor forest product, etc. Most of the families do not have the land or resources to grow their own fuel wood trees etc. Some of the landless migrants are given to priority for their settlement in the forest

areas. Thus, the rapid growing population pressure is the main causes of deforestation in the study region.

Infrastructure Development Impact on Forest covers

From ancient time to present time, to meet the demand of population explosion, deforestation has been increased at a faster rate in Bezara Development Block. History tells that the first depletion of natural forest resources was started in the study region since Chinese Invasion (1962). During this period, Defence made so many camps in the different forest areas (mainly in Natowanacha and Dirgheswari reserved forest) in the study region. Now-a-days, it has been noticed that the Govt. of Assam has taken various developmental programmes like construction of foreland (Black Topped Surface roads), urban areas, industrial unit plants, educational institution and health care centers etc. There are lots of infrastructural development is taking place at a very faster rate since last two- three years. The network of modern road transport causes degradation of environment throughout its tracts along with the change of land use. In the construction of Black Topped Surface roads causes land use change by occupying land of different types (agricultural land, built-up land, forest land, etc.) permanently for right of way (ROW).

On the other hand, stone quarrying and mining are increasing year by year in the study region. These also lead to decrease the forest cover area. These developmental activities are carried out through cutting of tree cover. In addition to above, forest area is being used for opening up new industrial units, building, commercial and residential purposes in order to accommodate expanding urban areas. In general, deforestation leads to massive soil and land erosion in Barnadi, Puthimari tributaries, Kalajal sub tributaries and the river Brahmaputra which flow through the heart of the Guwahati city. In fact deforestation has important bearing on human health habitation and livelihood, all of which culminating in to environmental issues adversely affecting the human society and pausing a trend to development of future generation. Hence, deforestation has many effects on the earth sur-

face. The chief effects of it are soil erosion, disruption of water cycle, loss of bio diversity, flood, climate change etc.

Remedial Measures

The remedial measures may be disseminating encouraging active participation of all for the conservation process. The remedial measures may be taken is follows:

- In the rural areas, the family welfare programmes should be initiated honestly and sincerely.
- To meet the demand of fuel, fodder and timber for increasing population, implementation of horticulture or agro- forestry system in the study region is needed.
- Infrastructural development is compulsory, so the forest department has undertaken some plantation programme in the degraded areas of the region.
- The inhabitants should be encouraged to carry out wildlife and ecosystem conservation.
- Proper environmental education should be imparted to the people so that the people can appreciate the importance of sustainable environment.
- Programmes should be organized to create awareness about harmful effects of burning of fuel wood on health. Interactive workshop to promote the usages of bio-gas plants, LPG and pressure cookers are also equally important.

Conclusion

The present paper tried to explain that growing population pressure is a vital factor and can be regarded root cause for affecting the forest cover area in Bezara Development Block. Along with population pressure, population density is also increasing putting additional pressure on forest to accommodate habitation and also collecting food, fuel, fodder, shelter, etc. This has adverse effect on the quality of forest, changing dense forest into open forest or scrub. Economic growth is important to meet the demand of increase population but

- reference to India, **Demography of India**, Vol-37, No-1, Journal of the Indian Association for the Study of population. pp.63-76.
- Mallik, R.M (2000): Sustainable Management of Non-Timber Forest Producers in Orissa: Some Issues and Options; **Indian Journal of Agricultural Economics**, Vol 51;No.1, pp.84-97.
- Rai, R.K (2004): Deforestation and its Impact on Environment with special reference to Assam; **Hill Geographer**, Vol xx, No 1& 2, A journal of The Geographical Society of North East Hill University. pp 8-13
- Saikia, A. (2008): Forest fragmentation in North- East India, (ed), **North - East India, Geo-Environmental issues**, EBH Publishers (India), Guwahati. pp. 227-232.
- Sarma , K (2001): Forest (ed), **Geography of Assam**, Rajesh Publication, New Delhi.
- Sengar, R.S and Choudhury,R(2012): Environmental Protection: Important tips for the development of agro forestry; **Kurukshetra**, A journal on Rural Development, Vol60,No 8; pp.22-25
- Sexana, H.M. (2004): **Environmental Geography**, Rawat Publication, Jaipur. pp 68-76
- Sinha,B.K & Choudhury,(2008): **Environment, Pollution and Health Hazards**, APH Publishing Corporation, New Delhi.

Hazard and Disaster – a comprehensive study

Sanjita Ray

Assistant Professor

Department of Physics, Bijni College

Email: sanjitaray14@gmail.com

Abstract

Hazard is the process, which has the potentiality to cause mass damage and harm to the normal environment when unfurled in a large scale. Disaster is hazard transformed into havoc due to various factors, either manmade or natural. Disaster is the event that occurs suddenly and causes harm to the normal life where it occurs. Example: say, earthquake- it is only hazard when it does not cause any kinds of loss but if it causes harm to the normal situation then it is the disaster situation. This paper explores details into the multiple facets and contributory factors that can turn a hazard into a disaster combined with the eventual consequences. Also, I look into the several international, national, regional, local administrative interventions, policies and framework for hazard and disaster management along with the Disaster Management Act 2005 which brought about a paradigm shift in India disaster management scenario. Furthermore, I glimpse inside the disaster management cycle and risk reduction measures, which in turn can isolate a hazard from disastrous eruption. Hence, the aim of this paper is to understand the basics of hazard and disaster and what can be done, not only at Governmental level but also at community and individual level to ensure a better resilient socio-economic and environmental system of our society in order to curb the menace

of disaster and effective management of hazard. The greater perspective remains to build a sustainable development strategy.

Key words: Hazard, Disaster paradigm, menace.

Objectives:

1. To understand the Disasters and Hazard with Indian management system.
2. To get knowledge how to take precautions in this crucial time and help others if possible.

Introduction

Potential to do damage, harm of mankind is the Hazard and when it happens in a area where people live and causes destruction then it is called Disaster. Disaster may be -Man made and natural. Man made disaster have an element of human intent, negligence or error involving a failure of man made system. Example – Bhopal gas tragedy (2nd. And 3rd. December 1984). It is a man-made disaster. It is considered as one of the World worst industrial disaster. Natural disaster - say Flood. But whatever may be disaster we have to manage it if possible.

Discussion

The world has seen many disasters and hazard- some are man made (wars, nuclear accidents, oil spills, fire etc.) and some are natural (tsunami, earthquake, flood etc.) In 2014 in a journal named Risk Analysis, Michael Siegrist and Bernadette Sutherland said that generally people are more angered and frustrated by a disaster that are man made than the natural one and so, the researchers predicted that man made disasters are more severe than natural ones. They checked the ratings of survey's respondents of chemical plant explosion releasing sulphur dioxide causing death of 15 people and a natural volcano that released the same gas causing death. The main cause may be our mindset up. We think the natural force is uncontrollable and so the natural disaster is seen as inevitable and it is a bit easier for us to reconcile to

the losses. But man made disasters are assumed to be preventable and so it is hard to accept the losses caused by it and who starts it is compared with Devil.

Now all disasters are hazard but all hazards are not disasters. When there is harm to life and property of humans, then it is treated as disasters, but today most hazards are turning into disasters due to huge population of world. Human communities have extended in almost every terrain, every environment; so a small scale hazards turn into a disasters.

The word, which quantifies the probability of a hazard turning into a disaster, is Risk. There is a Risk equation-

$$\text{Risk} = \text{Threat} \times \text{Vulnerability} \times \text{Cost}.$$

When the risk enough then a hazard turns into a disaster.

Floods are hazards but when it is in populated area and causes harm to mankind then it is disaster. It usually happens from June to October in North east India we can prepare for it by taking many steps at community and individual level to reduce the damage; so that it does not turn to disaster.

Floods cause due to

1. Long lasting Heavy rain.
2. Construction work that prevent the natural flow of water.
3. Dams, embankments break.

So, we should listen T.V and radio news and loudspeakers for flood warnings, protect our important and valuable documents by wrapping with waterproof papers and keeping it in a dry high place, reserve enough dry food and drinking water, If we have a boat then it should be maintained, prepare bamboo and ropes to make a mezzanine in our house to stay in, protect water supply by covering well and water containers and at last we should know where we can get help if someone of our family is injured. If possible, all of us should have a life jacket if not then we should manage other things that float to hold onto. Example- inner tubes, big empty plastic containers, banana trees. After the flood we should not enter any house or build-

ings that have been flooded unless they are checked by adult and should use mosquito nets when we sleep. We should not use any food that soaked with floodwater and also seek medical help if necessary. But one thing is that at any situation we should not be panic and manage in a cool brain if possible.

The basic principle of disaster management is to reduce the Risk and this can be done by minimizing any of the three variables of the above-mentioned equation. We cannot control the threat, so, we should focus on vulnerability and costs. Generally, the vulnerability is under human control. For example- if the area is prone to earthquake, then by making (incorporating) earthquake resistance building we can reduce the vulnerability. Cost is also under our control but as it is a consequence of our development, in most cases we cannot minimize it. Hazard is a part of our life, of our planet. We cannot get rid of it, but we may try to prevent it to be a disaster with not only in Governmental level but also at community and individual level.

For efficient management of disasters and other matters related to it, an Act was passed by Government of India on 23rd. December 2005. It has 11 chapters and 79 sections. Under this act there are 5 governing bodies that act to ensure an effective response in the time of disaster.

1. National Disaster Management Authority.
2. National Executive Authority.
3. State Disaster Management Authority.
4. District Disaster Management Authority.
5. National Disaster Response Force

Conclusion

Hazards and Disasters are the part of life. We have to manage it and should work for sustainable development and so, we should not be panic at the time of disaster (though it is very hard), and should do what the situations permit.

Reference

1. www.google.com/amp/s/eco-intelligent.com

2. <https://byjus.com>
3. An introduction to disaster preparedness for primary school children by Gioi Thieu ve, phongnguathamhoa, cho hoc sinhtieu hoc

The impact of solar waste recycling and its influence on the environment and health care.

Dipak Bhattacharyya

Department of Chemistry

Bijni College, Assam

Email: bhattacharyya.dipak1505@gmail.com

Abstract

The increase of waste generated by the business, as well as the expansion of the renewable energy industry, with solar energy resources playing a vital role, is a cause for concern. Installed solar capacity now exceeds 500 GW globally, with capacity expected to reach 5000 GW by 2050. With an estimated lifespan of 25 years, this incredible growth is likely to produce significant solar waste of up to 15%. While recent solar research has concentrated on boosting efficiency, little attention has been paid to the disposal of solar panels that have been removed. Recycling is an option, but only a few businesses are capable of doing so efficiently. This article examines and analyses the technology utilised in the field to address this problem while simultaneously ensuring environmental conservation, resource availability, and recycling. By 2050, there will be 60 million tonnes of solar waste if it is not properly recycled. In their opinion, there is a thorough examination of the numerous technical challenges surrounding solar panel waste recycling and recovery, environmental protection, and waste management. The economics of solar power recycling are examined, as well as the impact on health and the environment, as well

as policies, to ensure that the technology is viable and non-toxic for future development.

Keywords: Solar waste management, Waste recycling, Solar panels, circular economy, solid waste

Introduction

India is blessed with tremendous solar energy potential. India receives around 5,000 trillion kWh of solar energy each year, with most portions getting daily radiation of 4–7 kWh m⁻². The major contribution to electricity production is from conventional sources, such as coal and petroleum, which is polluting the environment. Solar energy is a viable option for combating global climate change and fossil fuel pollution (Lakshmi *et al.*, 2019). Photovoltaic (PV) technology may be used to create solar electricity, which is a potential approach for combating climate change. PV modules now have a 25-year lifespan; however, it is also true that PV technology will decline once it reaches the end-of-life stage. PV technology EOL management is a critical issue for cleanenergy technologies (Rathore *et al.*, 2019). In 2012, India had just 1 GW of solar power installed; by 2019, it had grown to 85.9 GW (shown in Figure 1). The Indian government is committed to achieving the Jawaharlal Nehru National Solar Mission's aim of installing 100 GW of solar capacity by 2022. As the number of solar PV panels installed has grown, so has the amount of waste generated when these panels reach the end of their useful lives (EOL). According to an estimate by Suresh *et al.*, (2019), around 200,000 tonnes of solar PV waste would be created by 2030, rising to 1.8 million tonnes by 2050. According to IRENA, this renewable garbage would expand to around 60 million tonnes globally. Most PV panels installed in the last 5–6 years will turn into waste in the coming 20–25 years. It is vital to establish low price recycling technology for rapid commercialization and advancement of the PV industry. Governments should propose an administrative system that would set out various measures to be followed by diverse stakeholders as they cooperate in recycling of waste (D'Adamo *et al.*, 2017). The commer-

cialization of solar waste recycling has begun, but additional work is needed to speed up this recycling technique. Managing EOLPV modules in order to recover valuable materials that may be used to replace fresh ones is a critical step toward achieving sustainability. The goal of this review study is to demonstrate several solutions for recycling solar waste.

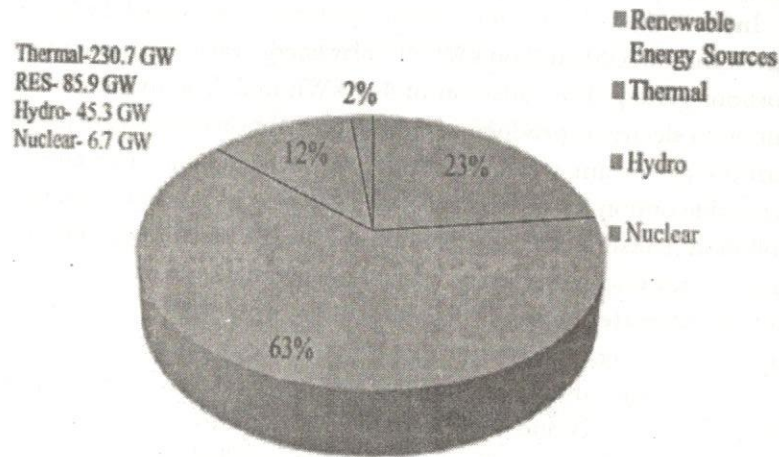


Figure 1. Total installed power capacity in India. RES: renewable energy sources.

Source: MNRE, 2019

Overview of PV module technology

India is unable to manage and handle large volumes of solar waste due to a lack of legislative rules. Various hazardous materials, including as lead and cadmium compounds and polymers are employed in the manufacture of solar panels. According to Suresh *et al.*, (2019), crystalline silicon (c-Si) modules accounted for 90% of Indian PV system installations, with thin film solar modules accounting for the remaining 9–10%. In the worldwide market for utility size PV installations, copper-indium-gallium-selenide (CIGS) solar cell systems from a new technology have a share of barely 1%, whereas cadmium telluride has a share of 6%. The ratio of solar PV waste to new installa-

tions has risen dramatically, as seen in Figure 2. An early loss scenario assumes a greater percentage than a standard loss scenario, as seen in the figure. In a conventional loss scenario, a panel is considered to have 30 years of life with no early attrition, but an early loss scenario considers 'infant,' 'mid-life,' and 'wear-out' failures before the panel reaches 30 years of life. A drastic increase of 60 million tonnes by the end of 2050 is projected in a regular loss scenario, whereas waste is expected to climb to 80 million tonnes by 2050 under an early loss scenario. Preconsumer waste makes up almost all PV waste products, which ranged from 43,000 to 250,000 tonnes globally at the end of 2016.

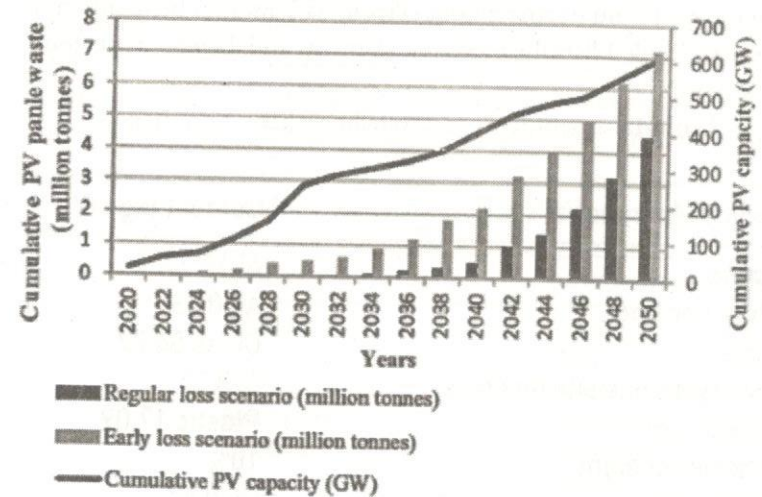


Figure 2. Estimation of cumulative solar PV module waste (million tonnes), 2020–2050.

Source: Chowdhury *et al.*, 2020.

Composition of PV module

The five primary components of the dominating c-Si technology are Front covers, electrical circuits linking solar cells, an envelope with two encapsulant layers shielding solar cells, and a rear cover (back sheet or tempered glass). Copper is utilized in cables and coatings in

PV cell. Glass and aluminium account for 80% of the entire weight of c-Si technology, with lead, copper, and tin accounting for the remaining 20%. Between 2014 and 2030, according to Sicaet *et al.*, (2018), the market share of c-Si solar panels will drop from 80% to 44%. According to, Weckendet *et al.*, (2016); Xu *et al.*, (2018) are two of the few writers who have reported on the market share of different types of solar panels. In 2014, silicon-based c-Si panels dominated the market, accounting for over 90% of the total. Various categories, such as thin film, accounted for just 9% of the market, with other variants (e.g. dye sensitized, organic hybrids) accounting for the remaining 1%. All varieties of PV panels have aluminium and glass as main components (Sicaet *et al.*, 2018). Indium and germanium are uncommon metals found in amorphous silicon, with indium being the most abundant. Table 1 lists the recyclable elements and their contents found in PV panels.

Table 1. Constituents of crystalline silicon solar panels.

Recyclable material	Content (kg kWp ⁻¹)
Frame	Al 12.77
Silver bar line	Ag 0.03
Glass	Glass 54.72
Polycrystalline silicon chips	Si 3.10
Background	Plastic 17.09
Adhesive sealant	10%
Tinned wire	Cu 0.45

Environmental impact of PV materials

It is true that solar-powered energy generation produces no noise, pollution, or greenhouse gas emissions. However, the PV industry, on the other hand, is linked to the usage of hazardous and poisonous chemical compounds. The manufacturing process is responsible for such as sulfuric acid, hydrogen fluoride, hydrochloric acid and nitric acid. Traditional silicon PV technology consists of fewer toxic mate-

rials than thin film PV technology. These materials need to be disposed of carefully in order to prevent dangerous environmental and health problems. Table 2 lists various hazardous materials used throughout the PV industry. The use of thin film PV technology necessitates the use of a few semiconductor materials; however, the component ingredients vary depending on the type of cell to be created. Chemicals and solvents like hydrochloric acid, nitric acid, hydrogen fluoride, acetone and ethanol are used for cleaning wafers and removing impurities during the fabrication process. About 37% of this waste is discharged to offsite treatment facilities while 35% of waste is expelled as diluted acid solutions to treatment plants. 0.8% of wastes are reported to be dumped into surface water (Nkuissiet *et al.*, 2020). Lead leaching can cause reduced development and reproduction in plants and animals, as well as biodiversity loss and a variety of other health problems. PV panel back sheets and encapsulants are made of polymer fractions made of fluorinated and cross-linked polymers that cannot be recycled.

Table 2. Hazardous materials used in PV manufacturing

Type of cell	Material used	Critical issues if disposed of improperly
GaAs	Arsenic (As)	Poisonous, cancer promoting, lung affecting
	Arsine (As H ₃)	Toxic gas, blood, kidney damaging
	Trimethyl gallium	Pyrophoric liquid
	Hydrochloric acid	Corrosive material
	Methane	Flammable gas
	Diborane (as dopant)	Flammable gas
		Pulmonary problem
		Flammable liquid
		Pyrophoric gas, irritant, fire hazard
		Corrosive material
a-Si	Diethylsilane (in deposition)	Toxic and corrosive gas
	Silane (in deposition)	Flammable gas and fire hazard
	Hydrofluoric acid	Poisonous and irritant
	Silicon tetrafluoride (in deposition)	Adverse effect on liver
	Hydrogen	Can cause lung cancer, also affects bones and kidneys
CuSe, InSe	Selenium	
	Tellurium	
	Cadmium	
CdTe		

Uncontrolled burning of this polymer at the incineration stage can result in serious health problems and the discharge of corrosive gases. If this polymer is not properly disposed of, it can harm the ecology. Antimony has great light refracting properties, however when these PV panels are exposed to damp circumstances at the end of their lives, antimony will leach out and have a harmful influence on the environment. Landfilling is a permitted disposal practice in most areas, although it can pollute the land and air and deplete natural resources. The composition of solar modules, waste categorization, and environmental effect of various compositions are shown in Figure 3.

Technologies for solar modules recycling

One major purpose of recycling technologies is to recover valuable components of used solar panels. Although it is technically possible to recycle PV modules. While issues may arise when lesser amounts of solar waste are available. Different types of available recycling processes are physical, thermal and chemical treatment, as shown in Figure 4.

Module and physical separation

This entails separating various damaged panels, but it does not include separating particular elements. By disassembling the panels or modules, junction boxes, embedded wires, and Al frames may be removed. EVA (ethylene vinyl acetate) is a solarcell/module encapsulant and sealer that ensures their reliability and performance (Dias *et al.*, 2018). Various techniques for recycling modules are used. The procedures generally remove the antireflective coatings and surface electrodes. However, the PV cell will degrade as a result of electrode metal migration during the high-temperature procedure. The method is more challenging with Se panels because it takes longer, yet the separation accomplished is only partial. Hydrofluoric acid solutions that remove antireflective characteristics from the surface of polysilicon might be used to restore high purity

silicon. At 500°C and a flow rate of 0.5 L m¹, nitrogen pyrolysis and vacuum decomposition were found to be the most effective in decomposing plastics (Dong, 2009).

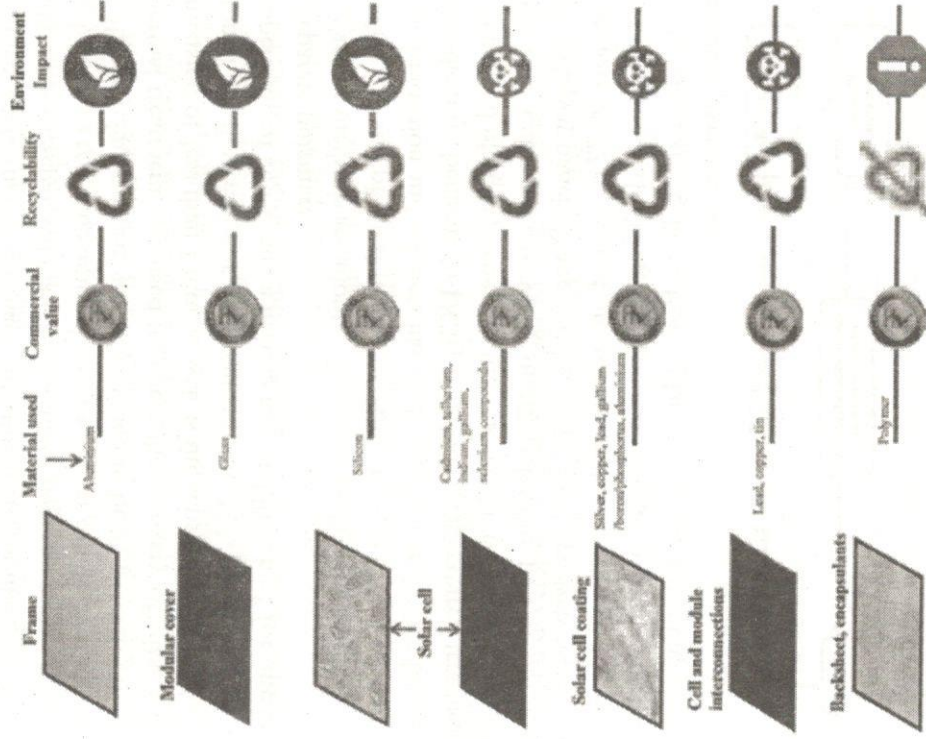


Figure 3. Waste classification of PV modules along with their environmental impact.

Source: Suresh *et al.*, 2019

Thermal & chemical treatments for recycling

There are different kinds of recycling technologies. Thermal treatment involves combustion or burning while chemical treatment involves immersing PV modules in solvents. Components containing

polymers are burned in a furnace but other materials like glass, Si cells and metals are separated manually. Leftover glass and metals removed can be sent to recycling units where new wafers can be created. Overall, the recycling process was determined to be 99 percent efficient. Thermal treatment was used to assess the recovery of glass with a dimension of less than 1 mm, as well as the separation of EVA. The optimal gas flow rate was determined to be 24 L h⁻¹ with a process temperature of 500°C and a heating rate of 450°C h⁻¹ for one hour to separate polymers.

Various methods are adopted for recycling PV panels on the basis of chemical and physical treatment. Kim and Lee (2012) used ultrasonic irradiation and solvents like trichloroethylene (TCE), benzene, and o-dichloro benzene (o-DCB) at various temperatures, irradiation periods, and ultrasonic energies to improve the recovery rate of the EVA layer. During the recycling of the polarizing film of old liquid crystal display panels, Wang and Xu (2016) used pyrolysis technology to remove 99.77 percent of organic materials and get a 98.33 percent yield of acetic acid. Zhang and Xu used nitrogen pyrolysis to recycle plastic, glass, and gallium from solar PV waste, achieving a 100% organic conversion rate.

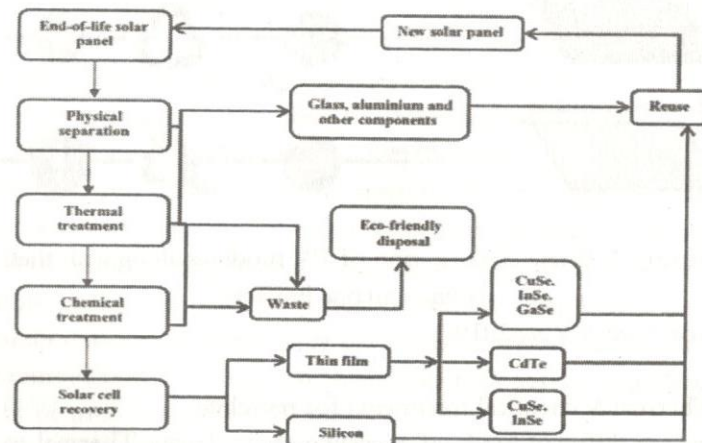


Figure 4. PV recycling methods. Source: Chowdhury *et al.*, 2020.

Optical method for recycling

This involves the separation of the glass structure. After removing the frame and terminal box, the used PV module is placed into optical treatment equipment. Optical therapy, as the name implies, is annealing with a laser or a flash light. Each module takes about one minute to treat. After the treatment is finished, the cover glass and substrate glass are separated. CdTe and CIGS are also treated with an acid such as methanesulfonic acid (CH₄O₃S). Further processing can be used to recover, recycle, and purify metals found in modules. So far, only a few therapies are commercially accessible, while others are still in the laboratory or in study. German firms have a solid track record when it comes to recycling c-Si solar panels.

Indian recycling status

In its instructions, India's Ministry of New and Renewable Energy has urged developers to guarantee that all solar PV modules be disposed of or recycled following their end-of-life stage. Developers must meet WEEE waste (management and handling) requirements, although there is presently no waste disposal system in place. New rules focus on non distributing responsibilities to various manufacturers, distributors and dealers. It should be made mandatory for all consumers to return the product for recycling, only then should consumers be returned their deposit funds. Producers should also create awareness and must ensure that all consumers dispose of e-waste in the right way. Due to low objectives and inadequate execution, India lacks the recycling infrastructure to deal with available e-waste amounts and is underprepared to manage the growing volumes. According to research, just 4% of garbage was recycled between 2015 and 2017; 20% of collection objectives were set, and that number will rise to 70% by 2023. (Suresh *et al.*, 2019).

Advancement of e-waste rules in India

The Indian government must take immediate measures to oversee the solar energy business. It is critical to focus on the preliminary first phase, which emphasizes the adoption of legislation for PV waste

treatment. Private stakeholders and policymakers must work together to ensure the sector's success. To address this developing issue, the following ideas (Suresh *et al.*, 2019) can be implemented:

1. When constructing various components for PV plants, all module makers should bear the EOL stage for panels in mind.
2. Each stakeholder participating in the treatment of these wastes should have their liabilities and obligations outlined.
3. PV waste collection, treatment, and disposal standards are necessary.
4. Conducting polls on recycling treatment might help raise awareness.
5. Only PV recycling infrastructures focused on high-value waste recovery should be pushed.

Life cycle assessment of recycling processes

LCA studies are used to help with environmental product improvements, strategic planning, benchmarking against rival technologies, and political decision-making. Impacts must be assessed throughout the material's life cycle, from extraction through production and manufacture to waste disposal and recycling. For different environmental indicators chosen as most significant for PV power, Stolz and Frischknecht (2016) reported the environmental life cycle evaluation of crystalline silicon (c-Si) and cadmium telluride (CdTe) PV modules. When compared to recycling c-Si PV modules, the environmental effect of producing a 3 kWp (kilowatt peak) household PV system put on a slant roof was significant (maximum 1.1 percent). The treatment of PV panels provides the biggest but still moderate contribution to the indicator for climate change (4.8 percent) in the case of CdTe PV module recycling (Stolz and Frischknecht, 2016). The use of fossil energy resources and respiratory problems induced by air pollution contribute the most to environmental consequences in the life cycle. Copper-indium-selenide (CIS) thin film has the lowest environmental effect of all the other varieties since it utilizes more copper for coating and contact purposes in production. Because of

the significant quantity of cadmium used in coatings, CdTe panels have the most impact. Jungbluth *et al.* (2007) analysed environmental impacts of different systems based on a valuation with Eco-indicator 99. As shown in Figure 5, the highest contribution of environmental impacts in the life cycle is due to the use of fossil energy resources and respiratory effects caused by air emissions of particulate matter (PM) and nitrogen oxides.

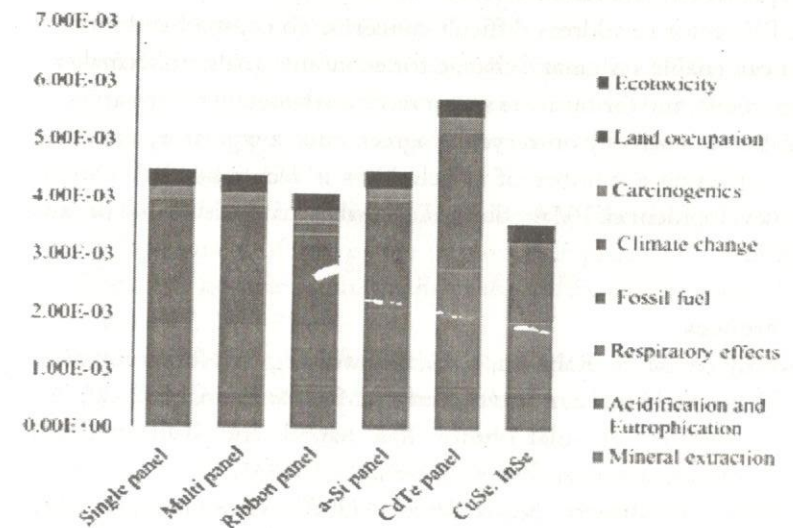


Figure 9. Comparison of different PV technologies by valuation with Eco-indicator 99.

Source: Jungbluth *et al.*, 2007.

Conclusion

Certain dangerous and poisonous chemicals, such as Cd and Pb, are employed in tiny quantities during the fabrication of solar PV modules. To minimize harmful impacts on individuals and the environment, it is critical to monitor and manage these compounds in solar waste that will be present at end of life (after 25 years). As the solar industry grows in prominence, technical advancements in waste management should address proper recycling procedures.

Solar panels are currently recycled in a time-consuming and inefficient manner. Although gallium, indium, and germanium are utilized in the manufacture of PV panels, only the silicon used in the panel terminals may be recycled. Another issue with recycling is the release of solvents, which may be controlled by utilizing an activated carbon fibre adsorption recycling condensation system. This mini-review focused on determining the viability of PV panel waste management and presenting numerous research and development opportunities in the PV sector to address difficult concerns. To comprehend models that can enable systematic change for economic goals, policymakers, institutions, and the business sector must work together. For parties to collaborate correctly on recycling agreements, a regulatory structure encompassing a number of stakeholders is recommended. During the development of PV modules, sustainable materials should be employed.

References

- Chowdhury, M. S., Rahman, K. S., Chowdhury, T., Nuthammachot, N., Techato, K., Akhtaruzzaman, M., ... & Amin, N. (2020). An overview of solar photovoltaic panels' end-of-life material recycling. *Energy Strategy Reviews*, 27, 100431.
- D'Adamo, I., Miliacca, M., & Rosa, P. (2017). Economic feasibility for recycling of waste crystalline silicon photovoltaic modules. *International Journal of Photoenergy*, 2017.
- Dias, P., Schmidt, L., Gomes, L. B., Bettanin, A., Veit, H., & Bernardes, A. M. (2018). Recycling waste crystalline silicon photovoltaic modules by electrostatic separation. *Journal of Sustainable Metallurgy*, 4(2), 176-186.
- Dong, L. (2009). Research on waste crystalline silicon solar panels resource recovery. *China: Southwest Jiaotong University*.
- Jungbluth, N., Dones, R., & Frischknecht, R. (2007). Life cycle assessment of photovoltaics; update of the ecoinvent database. *MRS Online Proceedings Library (OPL)*, 1041.
- Kim, Y., & Lee, J. (2012). Dissolution of ethylene vinyl acetate in crystalline silicon PV modules using ultrasonic irradiation and

- organic solvent. *Solar energy materials and solar cells*, 98, 317-322.
- Lakshmi, G. S., Singh, B., Kamal, A., Sharma, S., & Kumar, V. K. Energy Statistics 2019. twenty sixth issue. *Central Statistics Office, Government of India, New Delhi, India*.
- Nkuissi, H. J. T., Konan, F. K., Hartiti, B., & Ndjaka, J. M. (2020). Toxic materials used in thin film photovoltaics and their impacts on environment. In *Reliability and Ecological Aspects of Photovoltaic Modules*. IntechOpen.
- Rathore, N., Panwar, N. L., Yettou, F., & Gama, A. (2021). A comprehensive review of different types of solar photovoltaic cells and their applications. *International Journal of Ambient Energy*, 42(10), 1200-1217.
- Sica, D., Malandrino, O., Supino, S., Testa, M., & Lucchetti, M. C. (2018). Management of end-of-life photovoltaic panels as a step towards a circular economy. *Renewable and Sustainable Energy Reviews*, 82, 2934-2945.
- Stolz, P., Frischknecht, R., Wambach, K., Sinha, P., & Heath, G. (2016). Life cycle assessment of photovoltaic module recycling. *Swiss Federal Office of Energy SFOE, treeze Ltd*.
- Suresh, S., Singhvi, S., & Rustagi, V. (2019). Managing India's PV module waste. *BRIDGE TO INDIA Energy Private Limited Authors*.
- Wang, R., & Xu, Z. (2016). Pyrolysis characteristics and pyrolysis products separation for recycling organic materials from waste liquid crystal display panels. *Journal of hazardous materials*, 302, 45-56.
- Weckend, S., Wade, A., & Heath, G. A. (2016). *End of life management: solar photovoltaic panels* (No. NREL/TP-6A20-73852). National Renewable Energy Lab.(NREL), Golden, CO (United States).
- Xu, Y., Li, J., Tan, Q., Peters, A. L., & Yang, C. (2018). Global status of recycling waste solar panels: A review. *Waste Management*, 75, 450-458.

Pollution: Causes and Remediation

Mahizur Rahman

Assistant Professor, Department of Mathematics,
Bijni College,
Bijni-783390, Chirang, Assam, India
E-mail: mahizur1957@gmail.com

Abstract

Environment Pollution is a wide-reaching problem and it is likely to influence the health of human populations is great. Man's activities through urbanization, industrialization, mining and exploration are at the forefront of global environmental pollution. The affects of environment pollution in the perspective of air pollution, water pollution, soil waste pollution on human by diseases and problems, animals and plants. Both developed and developing nations share this burden together, though awareness and stricter laws in developed countries have contributed to a larger extent in protecting their environment .Despite the global attention towards pollution, the impact is still being felt due to its severe long-term consequences. This chapter examines the types of pollution and causes and effects of pollution and proffers solutions in combating pollution for sustainable environment and health.

Keywords: Environment Pollution, Air pollution, Water pollution, Soil pollution, Sustainable remedies.

Introduction:

For normal and healthy living a Conducive environment is required by all living beings, including humans, livestock, plants, micro-organisms and the wild life. The significance of environmental factors to the health and well being of human populations is increasingly apparent. Environment pollution is a worldwide problem and its potential to influence the health of human population is great. The favourable unpolluted environment has a specific composition. When this composition gets changed by addition of harmful substances, the environment is called polluted environment and the substances polluting it are called pollutants. Environmental pollution can, therefore, be defined as any undesirable change in the physical, chemical or biological characteristic of any component of the environment (air, water, soil), which can cause harmful effects on various forms of life or property. Environmental pollution could be of various types, i.e. Air Pollution, Water pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear Hazards.

Air Pollution:

The air we breathe is an essential ingredient for our wellbeing and a healthy life. Unfortunately polluted air is common throughout the world. Polluted air contains one, or more, hazardous substance, pollutant, or contaminant that creates a hazard to general health. The main pollutants found in the air we breathe include, particulate matter, PAHs, lead, ground-level ozone, heavy metals, sulphur dioxide, benzene, carbon monoxide and nitrogen dioxide. The natural sources of air pollution are volcanic eruptions, forest fires, sea salt sprays, biological decay, photo chemical oxidation of terpenes, pollen grains of flowers, spores etc. Radioactive minerals present in the earth crust are the sources of radioactivity in the atmosphere. Man made sources include thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc. Thermal power plants have become the major sources for generating electricity in India as a nuclear power plant could not be installed as planned. The main pollutants emitted are fly ash and sulphur di-oxide. Metallurgical plants also con-

sume coal and produce similar pollutants. Fertilizer plants, smelters, textile mills, refineries, chemical industries, paper and pulp mills are other sources of air pollution. The most important indoor air pollutant is radon gas. Radon gas and its radioactive daughters are responsible for a large number of lung cancer deaths each year. Radon can be emitted from building materials like bricks, concrete, tiles etc, which are derived from soil containing radium. Radon is also present in ground water and natural gas and is emitted indoors while using them.

Air pollution can be minimized by the following methods:

- Sitting of industries after proper environmental impact assessment studies.
- Minimize activities which cause pollution like transportation and energy production.
- Modification of process and or modification of equipments.
- Use of appropriate material.
- Using low sulphur coal in industries.
- Vehicular pollution can be checked by regular tune-up of engines, replacement of more polluting old vehicles, installing catalytic converters, by engine modification to have fuel efficient mixtures to reduce CO and hydrocarbon emissions; and slow and cooler burning of fuels to reduce NO_x emission.
- Using mass transport system, bicycles etc.
- Shifting to less polluting fuels.
- Using non-conventional sources of energy.
- Planting more trees
- Reduction of pollution of source.

Water pollution:

The water we drink is essential ingredients for our wellbeing and a healthy life. Unfortunately, polluted water and air are common throughout the world. Polluted water consists of industrial discharged effluents, sewage water, rainwater pollution and polluted by agriculture or households cause damage to human health or the environment. This water pollution affects the health and quality of soils and vegetation. Water pollution is the contamination of water bodies, usually as a

result of human activities, so that it negatively affects its uses. Water bodies include lakes, rivers, oceans, aquifers, reservoirs and groundwater. Water pollution results when contaminants are introduced into these water bodies. Water pollution can also lead to water-borne diseases for people using polluted water for drinking, bathing, washing or irrigation. In fact, the effects of water pollution are said to be the leading cause of death for humans across the globe. The main water pollutants include bacteria, viruses, parasites, fertilisers, pesticides, pharmaceutical products, nitrates, phosphates, plastics, faecal waste and even radioactive substances. These substances don't always change the colour of the water, meaning that they are often invisible pollutants. That's why small amounts of water and aquatic organisms are tested to determine water quality. It is sometimes caused by nature such as when mercury filters from the earth's crust, polluting oceans, rivers, lakes, canals and reservoirs. However, the most common cause of poor-quality water is human activity and its consequences. Water pollution can be reduced by taking the following measures:

- Reduce Carbon dioxide emissions to prevent global warming and acidification of the oceans.
- Reduce the use of chemical pesticides and nutrients on crops.
- Reduce and safely treat waste water so that, as well as not polluting, it can be reused for irrigation and energy production.
- Restrict the use of single-use plastics that end up floating in rivers, lakes and oceans, many as micro plastics.
- Encourage sustainable fishing to ensure the survival of species and avoid depletion of the seas.

Soil Pollution

It refers to anything that causes contamination of soil and degrades the soil quality. It occurs when the pollutants causing the pollution reduce the quality of the soil and convert the soil inhabitable for microorganisms and macro-organisms living in the soil. Soil contamination or soil pollution can occur either because of human activities or because of natural processes. However, mostly it is due to human activities. The soil contamination can occur due the presence of chemi-

cals such as pesticides, herbicides, ammonia, petroleum, hydrocarbons, lead, nitrates, mercury, naphthalene etc. in the excess amount. The primary cause of soil pollution is a lack of awareness in general people. Thus, due to many different human activities such as overuse of pesticides the soil will lose its fertility. Moreover, the presence of excess chemicals will increase the alkalinity or acidity of soil thus degrading the soil quality. Improper management of solid waste is one of the main causes of environmental pollution. Land pollution is one of the major forms of environmental catastrophe our world is facing today. Disposal of plastics, cans and other solid waste falls into the category of soil pollution. Disposal of electrical goods such as batteries causes an adverse effect on soil due to the presence of harmful chemicals. For instance, lithium present in batteries can cause leaching of soil. Regular construction can cause excessive damage to the soil due to the lack of proper drainage and surface run-off. This waste disposed of by human contain chemical waste from residential areas. Moreover, leaking of sewerage system can also affect soil quality and cause soil pollution by changing the chemical composition of the soil.

Soil pollution can be reduced by taking the following measures:

- Recycling of waste before disposal, recycle and reuse products.
- Use of organic fertilizers instead of chemical fertilizers and pesticides.
- Proper maintenance of sewage system, proper disposal method of household and industrial waste.
- Reforestation and afforestation should be promoted.
- Use of correct farming techniques.
- Community education and awareness get the locals involved.

Conclusion

It appears that polluted environment is an global issue and world community would bear worst results more as they already faced. As effective response to pollution is largely based on human appraisal of the problem and pollution control program evolves as a nationwide fixed cost-sharing effort relying upon voluntary participation. Education, research and advocacy are lacking as preventive strategy for pollution in the whole world. Policymakers in developing countries

need to design programs, set standards and take action to mitigate adverse health effects of air pollution. If we can change our lifestyle, attitude and action we surely can prevent our environment from pollution. A small positive step from each individual set a milestone for a community to move that direction and ultimately it will bring the desired results. Unable to restore the purity of our environment we will have endangered our own existence in near future.

References

1. Kaushik, A., & Kaushik, C.P. (2008) Perspectives in environmental studies.
2. Aggarwal. (2010) Environmental studies.
3. Purakayastha, G. (2007) Environmental studies.
4. www.toppr.com
5. www.airowater.com
6. www.researchgate.net

Causes and Control of Air Pollution

Dr. Prasanta Das

Assistant Professor, Department of Mathematics,
Bijni College, Bijni, Chirang, BTR, Assam, India
Email: prasantadsp4@gmail.com

Abstract

At present, air pollution is a global problem. It happens when any harmful gases, dust, smoke and radiations enter into the atmosphere and make it unhealthy for humans, animals and plants to survive in the future. Air pollution threatens the health of humans and other living beings on world. It creates smoke and acid rain, causes cancer and respiratory diseases and reduces the ozone layer atmosphere contributing to the global warming. The World Health Organization estimates that each year 2.4 million people die as a result of air pollution. In the era of technology, air pollution cannot be completely eliminated but can be minimized. The state and central government have adopted a number of laws and regulations for the pollution control specially air pollution. Moreover, we can control it in various ways. This paper highlights the different ways to control air pollution.

Keywords: Air pollution, atmosphere, harmful gases, dust, smoke, acid rain, respiratory diseases, pollution control.

Introduction

Various pollutants create air pollution. A substance which is harmful to humans and the environment is known as an air pollutant. Pollut-

ants are in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are formed and emitted directly from particular sources such as particulates, carbon monoxide, nitrogen dioxide and sulfur dioxide. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact.

Objectives of the Topic

- To identify the Air pollutants
- To investigate the Causes of Air Pollution.
- To study the Effects of Air Pollution.
- To find the measure to Control of Air Pollution.

Methodology

The environment of the world is becoming unhealthy day by day due to various pollution. This study has covered only air pollution. In this study, I have used the descriptive and analytical methods.

Primary Air pollutants include:

- ♦ **Sulphur dioxides (SO₂):** It is a chemical compound produced by volcanoes and burning of coal or oil. Its main danger is its subsequent transformation into sulfuric acid (H₂SO₄) which causes acid rain.
- ♦ **Nitrogen oxides (NO_x):** It includes nitric oxide (NO) and nitrogen dioxide (NO₂). Its main source is motorized vehicles, although fires and volcanoes also emit nitrogen compounds into the atmosphere. It is one of the main causes of smog, also giving rise to acid rain when it is transformed into nitric acid.
- ♦ **Carbon monoxide (CO):** It is produced as a result of incomplete burning of organic matter, which is why one of the main sources of emission is the associated traffic and the burning of fossil fuels. It is a flammable gas that is toxic to people even in small concentrations. It is a precursor of CO₂ and ozone.

- ♦ **Volatile organic compounds (VOC):** It is formed by hydrocarbons in a gaseous state at room temperature. They are toxic substances that give rise to photochemical oxidants such as ozone.
- ♦ **Ammonia (NH₃):** It is a flammable, toxic and burnt gas that has an important emission focus in agricultural activity as a result of the use of fertilizers.

Secondary Air pollutants include:

- ♦ **Particulate:** Particulate pollutant is a microscopic or microscopic liquid and solid particles present in the form of the suspension in the air. Particulate matter can be released from different types of human activities such as vehicle emissions, smoke particles, dust particles, and ash from industries. The size and shape of the particulate matter play a big role in how harmful they are to the atmospheric pollution.
- ♦ **Ground level Ozone (O₃):** It is a component of photochemical smog and secondary harmful air pollutant formed by the action of the sunlight on primary pollutants namely nitrogen oxides (NO_x) from vehicle emissions and industry and volatile organic compounds (VOCs) from vehicles, solvents and industry. It is a colorless and highly irritating gas that forms just above the earth's surface. Short-term exposure to ozone can cause chest pain, coughing and throat irritation, while long term exposure can lead to decreased lung function and cause chronic obstructive pulmonary disease.

Causes of Air Pollution

Causes of air pollution refer to the various locations, activities or factors which are responsible for the releasing of pollutants into the atmosphere. Following are the vital causes of air pollution:

- ♦ **Burning of Fossil Fuels:** The burning of fossil fuels emits a large amount of Sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

- ♦ **Automobiles:** The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases among individuals.
- ♦ **Agricultural Activities:** Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilizers emit harmful chemicals in the atmosphere and contaminate it.
- ♦ **Factories and Industries:** Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons and chemicals. These are released into the air, degrading its quality.
- ♦ **Mining Activities:** In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air, but also deteriorate the health of the workers and people living in the nearby areas.
- ♦ **Domestic Sources:** The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.
- ♦ **Waste in Landfills:** Landfills are land areas in which waste is deposited or buried. These deposited or buried wastes generate methane. Methane is a major greenhouse gas that is highly flammable and very hazardous. E-waste is another grave concern involving a lot of unscientific dismantling such as chemical leaching, burning wires and others.
- ♦ **Natural Events:** There are certain natural events such as volcanoes, forest fires, and dust storms, which are nature-born and cause air pollution.

Effects of Air Pollution

- ♦ **Health Effects:** Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, skin disease, irritation of the eyes, nose, and throat, lung

cancer etc. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing, asthma and aggravation of existing respiratory and cardiac conditions.

- ◆ **Environmental Effects:** Poisonous air pollutants can form acid rain. It can also form dangerous ground level ozone. Moreover, Greenhouse gases increase global warming. These destroy trees, crops, farms, animals and continue to make water bodies harmful to humans and animals that live and depend on water.
- ◆ **Economical Effects:** The effect of air pollution on the economy may be significant. The economy of a country increases when people are healthy, and business that depends on cultivated raw materials and natural resources are running at full efficiency. Air pollution reduces agricultural crop and commercial forest yields by billions of money each year.

Measures to control Air Pollution

It is not easy to control of Air pollution. Therefore, prevention method is the better way of controlling Air pollution. These prevention methods can either come from government or by individual actions. Moreover, use of several control devices can control air pollution in industry or transportation.

Government level prevention

- ◆ Governments throughout the world have already taken action against air pollution by introducing green energy. Some governments are investing in wind energy and solar energy, as well as other renewable energy, to minimize burning of fossil fuels, which cause heavy air pollution.
- ◆ Governments are forcing companies to be more responsible with their manufacturing activities, so that even though they still cause pollution, they are a lot controlled.
- ◆ Governments are also forcing automobile companies to make electric cars, which pollute less than before.

Individual Level Prevention

- ◆ Encourage your family to use the bus, train when traveling. If we all do this, there will be fewer cars on road and less fumes.
- ◆ Use energy (light, water, boiler, kettle and fire woods) wisely. This is because lots of fossil fuels are burned to generate electricity, and so if we can cut down the use, we will also cut down the amount of pollution we create.
- ◆ Recycle and re-use things. This will minimize the dependence of producing new things. Remember manufacturing industries create a lot of pollution, so if we can re-use things like shopping plastic bags, clothing, paper and bottles, it can help.

Control devices

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

- ◆ **Mechanical collectors** (dust cyclones, multi-cyclones)
- ◆ **Electrostatic precipitators:** An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulates such as dust and smoke from the air stream.
- ◆ **Bag houses:** Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust).
- ◆ **Particulate scrubbers:** Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forc-

ing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

Conclusion

Air pollution can be minimized if we can stop using of toxic substances that cause air pollution. This would require the stop of all fossil fuel-burning processes, from industrial manufacturing to home use of air conditioners. However, we have to make strict rules and regulations on industries and power supply manufacturing unit to reduce harmful emissions into the Earth's atmosphere.

References

1. http://en.wikipedia.org/wiki/Air_pollution
2. <http://eschooltoday.com/pollution/air-pollution>
3. http://www.who.int/topics/air_pollution
4. <http://www.nrdc.org/air/>
5. Rao, M.N. & Rao, H.V.N. (2007). *Air Pollution*. Tata McGraw Hill Publishing Co. Ltd.
6. <https://enviraio.com/primary-and-secondary-pollutants-most-dangerous/>

Environmental Consciousness in Gandhian Philosophy

Dr. Reepa Sarmah

Department of Philosophy

Digboi College, Assam.

Email: reepasarmah3@gmail.com

Abstract

Mohandas Karamchand Gandhi, the father of the nation is a well-known human ecologist and environmentalist. Gandhi's views on nature and environment are scattered throughout his writings and speeches. In many occasions, we find evidences of his serious concern about environmental problems and their solutions. Today, we are living in a world where science and technology and development play an important role in changing human destiny. But man's progress and road to development has led to the deterioration of nature. In their quest for fulfilling their needs, men have exploited nature to its maximum. The development status of the world is unsatisfactory and it has given rise to the degradation of environment and reducing the scarce natural resources. In such a dilemma the green thoughts of Mahatma Gandhi give us a new vision to harmonize nature with the needs of people. His views on development, technology, self-sufficiency, village swaraj etc discloses his environmental concern. The present paper is an attempt to present Gandhi as an environmentalist. It also endeavors to see how Gandhi tried to protect the natural environment for the future generation.

Key words: Environment, Gandhi, Philosophy, industrialization,

Introduction

Mohandas Karamchand Gandhi, the father of the Indian nation is a social educator as well as a practical philosopher. He shaped his philosophy on the basis of his own experience. Although Gandhi cannot be considered as an academic philosopher for not formulating any philosophical system or for not having any training in academic philosophy, yet his philosophical ideas always have great importance in realizing the changes in society. Gandhiji is also well known in the society as a human ecologist and environmentalist. But we failed to recognize him as an environmentalist and ecologist because the concept ecology, environment etc. was not in vogue during his life-time, as they are today. The environmental problems have surfaced largely in the post Gandhian era and as such, the concern for environment has assumed importance only in recent years. But, in many occasions, we find evidences of his serious concern about environmental problems and their solutions. His views on nature and environment are scattered throughout his writings and speeches. His views on development, technology, self-sufficiency, village swaraj etc. discloses his environmental concern.

Objective

The objective of the paper is to focus on Gandhi's view on environment and to present him as an environmentalist. It also endeavors to see how Gandhi tried to protect natural environment for the future generation.

Data & Methodology

This paper is based on secondary source of information which is collected from books, journals and other published documents. The methodology that is applied here is descriptive and analytic.

Discussion

Environment means the surrounding or condition in which a person, animal or plant lives or operates. The Cambridge Dictionary defines environment as the condition that you live or work in and the

way that they influence how you feel or how effectively you can work. The literal Meaning of environment is related to the surrounding of an object in nature. In fact, environment may be regarded as everything else. It includes the sky over our head and the earth beneath our feet. It also comprises all other people and any living organism with which we have any connection.

Today, we are in the midst of a great debate over the problem of as how to protect the global environment which is being increasingly threatened by growing pollution, maintenance of ecology and exhaustion on non-renewable resources. We live in a world where science and technology and development play an important role in changing human destiny. But man's progress and road to development has led to the deterioration of nature. In their quest for fulfilling their needs, men have exploited nature to its maximum. The development status of the world is unsatisfactory and it has given rise to the degradation of environment and reducing the scarce natural resources. The threats of ecological balance looms wider than before. In such a dilemma the green thoughts of Mahatma Gandhi give us a new vision to harmonize nature with the needs of people.

Mahatma Gandhi cannot be considered as an environmentalist in the modern sense of the term. Yet some eminent social scientists and some environmentalists also like Ramachandra Guha considered Gandhi as an environmentalist. Gandhi's idea that "nature had enough to satisfy every one's needs, but not to satisfy anybody's greed" became online ethics to modern environmentalists. Through his writings, he has warned the humanity against 'Chimney and Factory Culture', 'Multiplicity of Wants', 'Unconcern attitude of humanity towards nature'. We find that Gandhi was in favour of holistic approach to development to preserve nature and environment. Gandhi repeatedly warns the human being that they will have to realize that a way of life that rapidly depletes the power of earth can only be called violent.

Gandhiji was against mass Industrialization. For him, mass industrialization or large-scale industry leads to the fast depletion of the non-renewable world resources, pollution and problems of ecology. To

eliminate or avoid all the ill-effects of industrialization, Gandhi proposes self-sufficient small industries –cottage industries because according to him, Gram udyug preserved harmony and naturalness. In 'Hind Swaraj' Gandhiji has clearly and emphatically expressed the evils of machinery and Industrialization. According to Gandhi, 'Machinery is like a snake hole which may contain from one to hundred snakes.' Hind Swaraj is one of the thought-provoking words of Gandhiji which he wrote originally in Gujrati on the deck of a ship in November 1909, while returning from London to Cape Town in South Africa. Though Gandhi wrote his book keeping in mind of the Indians, the view presented in this work are not confined to India alone. This book is a severe condemnation of modern civilization and also the dangers inherent in the institutions associated with it. He has written Hind Swaraj more than a century ago in 1909 when very few people talked about environmental problem and hazards.

For Gandhiji cleanliness is the most important element for a healthy environment. It is essential for everyone to learn about cleanliness hygiene sanitation and the various diseases that are caused due to poor hygienic conditions. Mahatma Gandhi offered detailed comments in 'Navajivan' dated 2nd November 1919 on cleanliness and good habits and pointed out its close relationship to good health. He wrote, 'No one should spit or clean his nose on the street. In some cases, the sputum is so harmful that the germs infect others. Those who spit after chewing betel leaves and tobacco have no consideration for the feelings of others. Spittle, mucus from the nose, etc should also be covered with earth.'

Gandhiji emphasized that people of India had to do a lot about cleanliness and sanitation as well as its implementation in the day to day lives. Pointing out our unhygienic habits Gandhi strongly emphasized observing cleanliness in lavatories. Gandhi said, 'Our lavatories bring our civilization in to this credit, they violate the rules of hygiene'. Gandhi learns scavenging in South Africa. His friends there lovingly called him as the great scavenger. Mahatma Gandhi said, 'Everyone must be his own scavenger'. To the students his advice was, 'if you become your own scavenger, you will make your surroundings clean.

It needs no less courage to become an expert scavenger than to win a Victoria Cross'.

Conclusion

Thus, we have seen that although Gandhi has not built up any theory of environmental philosophy or system which strictly falls within the scheme of present environmental science, yet he was deeply concerned about the damages done by modern industrial civilization to the environment which is portrayed in his work Hind Swaraj written in 1909. In fact, Gandhi was concerned with all the problems confronted by humanity. One who scrutinizes Gandhi's speeches and writings will be amazed by the deep eco-consciousness rooted in his philosophy of life.

Gandhian environmental ethics stems from his philosophy of life and his worldview. Although the word ecology appears nowhere in Gandhiji's writings, yet as the Chipko movement, the Narmada Bachao Andolan and is a very different context, the manifesto of the German Green has shown, the impresses of Gandhiji's thinking on ecological movement has been felt widely. Gandhi had bewildering insights and foresights. One is really appalled by his foresightedness so clearly and emphatically expressed in the Hind Swaraj almost a century ago in 1909 when few people talked of environmental problems and hazards.

Gandhi made a relevant appeal to the people of countrymen not be trapped by the allurements of this civilization. As a front leader of the Indian National movement and a visionary and planner of society and political systems of India after independence, he drew a blue print which accordingly rejected the western model on that scientific technological culture.

Gandhi fully understood the primordial relationship of man –nature relationship and his theory and philosophy of life, society and politics are in consonance with it. It is this understanding of sanctity and reverence for the nature and human existence which makes him an environmentalist par excellence. He is not an environmentalist who will analyze the courses and consequences of depletion in the ozone layer.

He is not competent to recommend measures against environmental pollution and safe guards against all kinds of environmental hazards. He believes in remedy rather than cure. He is propounded of a kind of life, culture and society which will never lead to environmental problems.

References

1. Datta, D.M. (1953) *The Philosophy of Mahatma Gandhi*, University of Calcutta
2. Lal Basant Kumar (1973) *Contemporary Indian Philosophy*, Motilal Banarsi das publishers Pvt. Ltd.
3. Sharma Nilima, *Twentieth Century Indian Philosophy* 1999, Bharatiya Vidya Prakasana, Delhi

Literature and Environmental Concerns

Dr. Arup Sarkar

Assistant Professor, Department of English

Bijni College

Email: sarkararup@yahoo.com

Abstract

The present environmental issues and concerns with their dangerous repercussions are real and imminent which has urged different branches of knowledge and departments to hasten their efforts in this critical war to save nature thereby saving the life and existence. Literature with its creative, imaginative and didactic power has always played an important role in this fight. With the recent addition of Ecocriticism as a tool, literature has further expedited its effort in this struggle. Through this research paper the scholar aims to foreground the role of literature in the struggle to save nature and environment in international, national and regional level mainly in the context of literature written in English. The paper also makes an effort to exploit the possibility of an enhanced role of literature in this war of survival.

Keywords: Environment, Nature, Literature, Ecocriticism, Survival.

Introduction

Besides providing aesthetic pleasure, the other, chief objective of literature is certainly imparting knowledge or message through direct or indirect didacticism. It plays a huge role in rectifying character and society. With its visionary motive literature leads the society towards

perfection. The role of literature can be extremely useful and significant in addressing the toughest of the issues. The time and context of recognizing the aforesaid dimension of literature cannot be anymore better than now when the world is confronting the imminent catastrophe invited by the present level of environmental degradation and ecological imbalance. In fact, in tackling the issue of environmental degradation, literature has always played an important role since the times of 'Vedas'. This paper makes a humble effort to identify the contribution of literature and foreground further possibilities in this regard.

Literature in ancient times presented many mythological stories with natural forces and phenomenon like fire, air, water, sun, moon etc. personified as deities. Such presentation of nature helped in creating a social response of both fear and respect towards nature. Talking about English literature, the writers of the romantic revival particularly initiated the movement in favour of the necessity of preservation of nature and environment while condemning the onslaught of industrialization. Poets like William Wordsworth, S. T. Coleridge, John Keats, Lord Byron and P. B. Shelley highly glorified nature in their writings. Their pathetic view of nature helped the cause of protecting environment. They expressed utter disappointment and concern against the manner of deforestation at the advent of industrialization allied with its consumerist culture. The same anxiety was equally shared and continued by many Victorian and modern English and American writers like Mathew Arnold, Thomas Hardy, John Ruskin, Walt Whitman, Robert Frost etc. However, this approach of literature appeared in an organized way since 1970's with the introduction of the critical theory called 'Ecocriticism'. The term and definition of Ecocriticism was introduced by William Ruckert in 1978 in his essay 'Literature and Ecology: An Experiment in Ecocriticism'. In the year 1996 Cheryll Glotfelty defined the term as the study of relationship between literature and physical environment (Sankyan & Sigraha, 2017). Ecocriticism studies not only the representation of environment in literature but also analyses the contribution of literature in understanding and solving the environmental crisis (Upstone, 2017).

The literature from India doesn't lag behind in the context of its role and contribution in addressing the environmental issues. Being a country with such high level of natural as well as environmental diversity and richness, the recent degradation of environment is certainly of great loss for the country. The realization of the same has always been present amongst the writers from India. Therefore, love and anxiety for nature frequently finds expression in the literature from the country. In the ancient classics, it appeared in the form of worship and glorification of nature. Personification of nature as Gods and Goddesses followed by high glorification of pastoral life was common in the classical writings by the greats like Kalidasa. The trend continues even in the recent centuries as well led by none other than the national poet R.N. Tagore who envisioned and established Shantiniketan in the lap of nature, away from modernity and urbanity. His worry for the degradation of nature at the onslaught of human aggression finds expression in many of his creations like 'Rakta Karabi' and 'The Tame Bird was in a Cage' (Mishra, 2016). Similar concern for environment continues to dominate the writings of many Indian writers till date. The names of Anita Desai, Kamala Markandaya, Arundhati Roy, Kiran Desai and Amitav Ghosh are some amongst many prominent ones in this league.

Being a region with a high level of biodiversity and natural enrichment North East India has been highly affected due to the present environmental crisis. With its majority of tribal inhabitants and their nature dependent culture and economy, the region is at high level of risk and vulnerability with the ongoing ecological imbalance and environmental degradation. Therefore, love for nature and anxiety against the atrocity on nature always found expression in the literature from North East. In this context, Temsula Ao, Easterine Kire, Monalisa Changkija, Mamang Dai, Rabin S. Ngangon, Mitra Phukan etc. leads the list.

The above discussion leads us to the conclusion that literature has always been playing a significant role in addressing the issues of environmental degradation. However, it is high time to accelerate the contribution of literature in this direction even more and exploit the reach

and power of influencing human minds to modify their attitude to nature. Nature has already started reacting in ferocious way in the forms of unexpected destructive floods, tsunamis, earthquakes, landslides, draughts, unpredictable and extreme weather conditions, global warming etc. Almost the entire chunk of responsibility and blame for the same is already attached to the unethical consumerist lifestyle of human beings. In this context, literature should infuse its reformist agenda by imparting necessary moral to modify our approach, attitude and relation with nature. Literature, with its huge reach, acceptability and influence, should play a constructive role more frequently than ever before in sensitizing people regarding the impending calamity. Literature can best sell hope and fear. The stories, poems and other literary genres with all their informative value and emotional appeal should go a long way in upgrading our relation with nature by infusing the sense of responsibility in every human being. Through literature the ancient practices like animistic culture and religion should be glorified and glamourized. Literature can best revive the beauty of such ancient pastoral world order when nature ruled over human. Human-centric social structure should be done away with bringing a balance by initiating nature and environment centric world order. Literature can certainly play a constructive role in this regard.

Conclusion

In conclusion, it can safely be assumed that literature is certainly a very strong and effective tool that might be extremely useful in fighting the imminent war to save nature and environment. With all its creative, imaginative and didactic powers literature should be utilized alongside other branches of knowledge and departments in this war to avoid certain calamity. The emergence of Ecocriticism is a right step in right time. Along with this, more such environment centric theories and practice should emerge. Therefore, the responsibility of the greater roles of literature in this context lies both with the writers and poets as it equally lies with other branches and departments to join hands with literature to boast the effectiveness of this struggle.

Works Cited

- Malik, R.S. & Batra, Jagadish. A New Approach to Literary Theory and Criticism. New Delhi: ATLANTIC Publishers & Distributors (p) Lmtd.2019.
- Mishra, Sandip Kumar. Ecocriticism: A Study of Environmental Issues in Literature. *BRICS Journal of Educational Research*, 6(4).2016. <https://www.researchgate.net//> Accessed Jan.14, 2022.
- Nayar, Pramod K. Contemporary Literary and Cultural Theory. Noida: Pearson. 2010. Print.
- Sankyan, Neeraj & Sigroha, Suman. An Ecocritical Reading of Poetry from India's Northeast. *Ikehtilaf*, Journal of Critical Humanities and Social Studies Issue 1- Fall 2017. <http://identityanddifference.org//> Accessed Jan.14,2022.
- Upstone, Sara. Literary Theory: A Complete Introduction. Great Britain: John Murray Learning. 2017.print.

Environmental Ethics and Sustainability

Dr. Sulabh Chandra Das

Assistant Professor, Department of Philosophy
Bijni College, Bijni
E-mail: sdasbc@gmail.com

Abstract

Environmental ethics studies the values and principles involved in combating environmental problems such as pollution, loss of species and habitats, and climate change. Environmental ethics is quite important because it serves as the moral ground to protect our planet's environment and continuously fix the environmental degradation that we have caused over the years. Through environmental ethics, we are being reminded of our environmental responsibilities and our ecological consciousness is being awakened. Without environmental ethics, people would continue to degrade and destroy our planet and live life as if they are not dependent on nature. But with the ecological consciousness provided by environmental ethics, we can lead towards a sustainable future, an ecological balance, and the enrichment of our environment's diversity. While humans are the most dominant and superior beings in nature, we are also expected to be the most responsible for keeping our environment, or planet, habitable and clean. That is where the importance of environmental ethics comes in. With the moral grounds and values that environmental ethics provides, humans are responsibly using nature and not in a way that results in resource degradation and destruction. A sustainable ethic is an environmental ethic by which people treat the earth as if its resources are

limited. This ethic assumes that the earth's resources are not unlimited and that humans must use and conserve resources in a manner that allows their continued use in the future. The present paper is an attempt to highlight the ethical approach towards the sustainability.

Keywords: Ethics, climate change, environment, diversity, degradation, sustainable.

Introduction:

Environmental ethics is a sub-discipline of philosophy that deals with the ethics problems surrounding environment protection. It aims to provide ethics justification and more motivation for the cause of global environmental protection. Environmental ethics is the study of ethical relationships between human beings and the natural environment, including the nonhuman individuals that constitute it. Ethics are our moral principles or values which a human being in his personal and professional life must adhere to and sustainability is exercising control over our needs, balancing today's needs with consideration for our future. Sustainability can't exist without ethical values as any person who is ethical will definitely be disciplined towards his needs and will have consideration for his future generation. This means that sustainable values are the subset of the ethical values or vice versa. Ethical values are the values that should be adopted in order to ensure the sustainable development. Any person who walks on a path of sustainability must be having moral attitude towards his nature and resources and vice versa.

Global warming, global climate change, deforestation, pollution, resource degradation, and the threat of extinction are a few of the issues from which our planet is suffering. Environmental ethics is a key feature of environmental studies that establishes the relationship between humans and the earth. With environmental ethics, you can ensure that you are doing your part to keep the environment safe and protected. Every time a tree is cut down to make a home or other resources are used; we are using natural resources that are becoming more and more sparse to find. It is essential that you do your part to

keep the environment protected and free from danger. It is not as difficult to do as you may think, so long as you're willing to make a few simple and easy changes. With the rapid increase in the world's population, the consumption of natural resources has increased several times. This has degraded our planet's ability to provide the services we humans need. The consumption of resources is going at a faster rate than they can naturally replenish. Environmental ethics builds on scientific understanding by bringing human values, moral principles, and improved decision-making into conversation with science.

There are several distinctive features of environmental ethics that desire our alternation. First, environmental ethics is extended traditional ethics mainly concerns intra-human duties especially duties among contemporaries. Environmental ethics extends the scope of ethical concerns beyond one's community and nature to include not only the people everywhere but also animal and the whole of nature – the biosphere both now and beyond the imminent future to include future generation. Second, environmental ethics is inter-disciplinary. There are many overlapping concerns and area of concerns among environmental policies, environmental economics, and environmental science and so on. The distinctive perspective of discipline provides important inspiration for environmental ethics and the latter offers value foundation for these disciplines. Third, environmental ethics is plural from the moment it was born, environmental ethics has been area in which different ideas and perspective compete with each other. Anthropocentrism, animal liberation/right theory and a host of others all provide unique and, in some sense, reasonable ethical justification for environmental protection. The basic ideas of the environmental ethics also find support from and are embodied in various well establish cultural tradition.

Fourth, environmental ethics is global ecology crisis is a global issue. Environmental pollution does not respect natural boundaries. No country can deal with the alone. All of the above seem to make us see that environmental ethics is a fullest extension of human ethics. It calls on us to think and act locally as well as globally.

Objectives of the study

- To discuss about the concept of environmental ethics.
- To analyse the concept of sustainability.
- To understand about the ethical approach towards the sustainability.

Methodology

The study is based on the secondary information collected from related sources. The secondary data are collected from different sources like books, journals, internet, etc. Apart from this, the analytical and descriptive methods are used in this study.

Concept of Sustainability

Sustainability is considered to be quite a complex topic. People with many different backgrounds and viewpoints must collaborate in order to come up with solutions to grand challenges plaguing the world today. Using ethics to help solve sustainability problems is one way to ensure that all of these voices are heard, including ones that may be more difficult to take into account, such as those of plants, animals, and future generations. Ethics can be applied within the three pillars of sustainability – social, environmental, and economic – and used to make sure that no view is overlooked. When it comes to directly relating ethics to sustainability challenges, a rational mindset and the use of systems thinking are useful strategies to ensure that the collaborative effort will take everyone's needs into account.

In sustainability, a common topic is how connected the world is and how actions in one place can impact communities across the globe. With a goal of sustainability being to provide for current and future societies while preserving the environment that we depend on, taking an ethical approach benefits all stakeholders. In the past, ethics haven't always been considered when making sustainable development. This is typically seen in cases of budget issues and instances where certain groups aren't represented. As sustainability has gained a more ethical approach, many philosophers have considered the value of offering all beings some level of moral consideration, whether they are living or non-living organisms. Thus, Sustainable develop-

ment is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Environmental ethics

With environmental ethics, humans are being humbled and reminded of their main responsibilities to nature. With the capacity of humans, the misbalances that are occurring in the environment can be fixed by some minor or major actions. Through environmental ethics, humans are considerate of not only themselves but also plants, animals, and every object in nature. Every object in nature has its own purpose and use, neglecting its uses for humans. With that being said, it is just right to be a responsible consumer as humans do not have the right to destroy nature's richness and diversity. Instead of polluting our environment, degrading our resources, and destroying our planet, environmental ethics leads humans to act accordingly for the welfare of all in our environment and nature. The plan here is that human, inhabitant and their world, earth live, organism and how environmental ethics are important to them.

Human

Human are helped or hurt by the condition of their environment. Hold that an action is right that produces the greatest good for the greatest number of people. Ethics arises to protect various goods within our culture, the historically has been its principal area. As philosophers frequently model this ethics is a feature of the human.

Inhabitant and their world

Inhabitant need to be healthy, health however, is not simply a matter of biology from the skin in. environmental health ethics from the skin out is equally important more than desire quality or natural given-air, soil, water functioning eco-system, hydrologic cycle and so on.

Environmental Ethics and Its Principles

There are several approaches or principles to determine how we are to value our environment. It is such a huge field, and it is so vast that it is difficult for one principle to cover all the ground. Many theories have emerged over the years, and each one has stressed various principles of environmental ethics. The list below states all the principles that have been predominantly found in those theories.

Anthropocentrism

It suggests that human beings are the most important beings. All other living beings are only accessories that would assist in their survival. Now, there are two further divisions of anthropocentrism. They are weak anthropocentrism and strong anthropocentrism. While weak anthropocentrism believes that human beings are the centre because it is only through their perspective that environmental situations can be interpreted. Strong anthropocentrism, however, believes that human beings are at the centre because they rightfully deserve to be there. Peter Vardy made this distinction.

Non-Anthropocentrism

As opposed to anthropocentrism and non-anthropocentrism, this principle gives value to every object, every animal in nature. It is a principle that believes in everything that sustains itself in nature.

Psychocentrism

Psychocentrism is the principle that believes that human beings hold more value in the environment since their mental capacities are better developed and far more complex than any other element in the environment.

Biocentrism

It is a term that holds not only an ecological but also a political value. It is a philosophy that imparts importance to all living beings. In terms of environmental ethics, biocentrism is the principle that ensures the proper balance of ecology on the planet.

Speciesism

The principle of speciesism justifies the superiority of the human race. Thus, it also justifies the exploitation and maltreatment of animals by humankind.

Moral Considerability

This, too, is an important principle of environmental ethics. *Intrinsic* value is added to every being, which makes us consider being moral. Moral considerable towards a being means that we agree that all our interactions whatsoever with the being is bound by moral laws.

Instrumental Value

The instrumental value is the value imparted to a being as long as it can serve us with resources.

Intrinsic Value

Intrinsic value is the value attached to a being just for itself and not only for its resourcefulness.

Aesthetic Value

Aesthetic value is imparted to a being by virtue of its looks or its beauty.

Animal Liberation or Animal Right

As is evident from its name, animal liberation or rights tries to secure animal life and ensure their welfare by enforcing certain laws.

Ethics in Sustainability

Ethics in sustainability is a crucial piece of sustainable development. A goal of ethical sustainability is to think of how humans ought to live while also considering their connections with other humans, the natural world, and future generations. Without these considerations, certain groups may feel marginalized or that they are not being treated fairly. Although a large part of ethics centers around the treatment of people, it is also important to discuss the considerations

towards nature. The idea of providing a better future for the generations to come revolves around conserving the natural areas that we have today and protecting areas for the future. This relates to the welfare of non-human nature which includes many factors that make life possible. These factors range from clean water and air to biodiversity and species health, which, if not considered during sustainable development, could yield serious negative impacts. In order to make changes that benefit all parties involved, it is sometimes necessary to choose the route that is less desirable or more difficult. Although it may take more time or funding to make improvements that align with ethical practices, in the long run, the impact will be more positive and will do more for the greater good.

Ethics is important to consider when solving grand challenges in sustainability because it takes the needs and rights of a variety of groups into account. It also recognizes the significance of current as well as future human needs. Having access to a wealth of natural resources, as well as ensuring general well-being for all, is a moral right not only for present-day human populations, but also for future generations. When decision-makers use ethical approaches to solve sustainability problems, they consider how their actions can have effects on the environment, economy, and humankind in general – now and in the future. This aspect of time is important to keep in mind because the decisions made today, whether helpful or detrimental, can have significant impacts on the lives of those living in the future. Applying principles of ethics to sustainability challenges also promotes a holistic worldview that takes many different values into account.

Ethics in sustainability aims to restructure how most humans consider nature, even though it can be difficult to change preconceived notions and deeply-rooted mindsets. Currently, some view nature as separate from human life, existing solely for human benefits. However, humans need to understand how the environment is deeply connected to their lives and that animals, plants, minerals, and other parts of nature should not only be used to benefit humans.

Ethics Applied to the three Pillars of Sustainability

Sustainability is commonly broken up into three pillars: environmental, social, and economic. These three pillars contain subcategories that help better define whether a sustainability challenge is an environmental one, economic and so on. Ethics can be applied within all three pillars of sustainability and should be present during the collaborative decision-making processes. The need for ethics in sustainability is important to consider during these processes and when analysing all possible stakeholders in an issue. There is a need to conserve ethical values when coming up with a solution and the input from all stakeholders considering the types of challenges or implications that may come out of a potential solution.

Social ethics in sustainability focuses on the actions, attitudes, beliefs, cultural traditions, and decisions that an individual makes. Ethics within the social sector can be associated with making choices or decisions that line up with an entire group's identity. It is important to note that social ethics is not separated from sustainability as a whole, rather it provides an ethical foundation on which a group can make sustainable decisions in a way that considers equity, fairness, justice, equality, inclusiveness, and cultural differences. Sustainable challenges that require an ethical social foundation consider the social costs, benefits, and values of a decision.

Economic ethics can be closely attributed with social ethics as many ethical economic decisions are based off the social consequences or costs associated with that economic activity or decision. Moral foundations within an economic ethic consider questions such as the efficiency, productivity, and security of a product. It correlates with social sustainability as it considers issues like whether a product has been produced in an environment that provides fair wages and fair working conditions, and if the product has favored one social class over another. It also considers the resources that are used in producing a good and how they are used, and whether that resource may have been exploited in a way that is socially unjust. The role of economic

ethics in sustainability is to ensure that goods are produced in a way that can be attributed to the larger concept and goals of sustainability. An ethical economy is not dependent on growth or material consumption in an age where there are finite resources.

Environmental ethics focuses on the value of non-human nature, or the living and non-living qualities within nature. Living qualities can be seen as animals, plants, and other types of species that live in nature and non-living can consider qualities like the welfare of forests, water, and conservation of broader landscapes. Environmental ethics considers what actions are right and wrong in natural environments. Challenges that could be considered within this type of ethics are the preservation of biodiversity, clean water and air, and the value of non-human life. Environmental ethics argues whether humans have a right to the non-human nature of the earth, saying that the two should coexist.

While humans are the most dominant and superior beings in nature, we are also expected to be the most responsible for keeping our environment, or planet, habitable and clean. That is where the importance of environmental ethics comes in. With environmental ethics, humans are being humbled and reminded of their main responsibilities to nature. With the capacity of humans, the imbalances that are occurring in the environment can be fixed by some minor or major actions. With the moral grounds and values that environmental ethics provides, humans are responsibly using nature and not in a way that results in resource degradation and destruction. Thus, environmental ethics is a safeguard against cruelty to all creatures. It helps maintain ecological balance and provides a peaceful and beautiful living environment. Instead of polluting our environment, degrading our resources, and destroying our planet, environmental ethics leads humans to act accordingly for the welfare of all in our environment and nature.

Sustainability and environmental issues make up a significant aspect of human life, so understanding the importance of environmental ethics can benefit both humans and the environment. At its core,

environmental ethics can be defined as the philosophic study that examines the ethical relationship of humans and the environment. The philosophy also explores the moral relationship humans have with Earth, animals, and plants. Environmentalists, sustainability specialists, and other experts seek to understand whether humans have an ethical responsibility to take care of the environment, and if so, to what extent?

While the discipline of environmental ethics examines the ethical obligations humans have to Earth, human values also play an important role. If people don't place any value on the environment, they'll not likely get involved with movements such as conservation and preservation. It's only when people understand and care about matters such as water and air pollution or the destruction of ecosystems that they'll make an effort to understand and implement environmental ethics.

Conclusion

Environmental ethics is an ethics that studies the relationships between human beings and the environment. Humans is a part of society as well as other creatures, which includes plants and animals. From my opinion, the environmental ethic is very important to help us conserve our world and manage our natural resources to meet our increasing needs and wants. Through the chapter of environmental ethics, conservation values and rational, I found out that there are many of environmental ethics that we should practice it in our daily life to keep the sustainability of the world. These ethics is built on a scientific understanding by bringing humans values, moral principles, and improved decision making into conservation with science.

The idea of ethics within sustainability is one that is vastly understudied. As sustainability continues to be an emerging discipline, it is only natural that subdisciplines follow after. One may argue that sustainability in itself is an ethical discipline, but that can often be refuted with the fact that not all ethical values are considered when coming up with solutions to grand challenges like climate change, world hunger, unequal access to education, and much, much more.

Using ethics in sustainability means that humans need to find an objective way to agree on what basic human needs are and whether these will be met for future generations while taking into account moral values across all subsets. This task is not simple by any means, but is instrumental for protecting the lives of current populations as well as the future well-being of other populations and the Earth as a whole. Earth is the planet that is our homes. This home planet is in crisis now. We must carry out our duty therefore to care for it.

References

- Mautner, M. N. *Seeding the universe with life: securing our cosmological future*, Washington D. C.: Legacy Books.2012. Print.
- Redclift, M. *Sustainable Development—Exploring the Contradictions*. London: Routledge, 1989. print.
- Singer, P. *Practical ethics*. Cambridge: Cambridge University Press, 2011. Print.
- Sagoff, M. *The Economy of the Earth: Philosophy, Law and the Environment*. Cambridge, UK: Cambridge University Press, 1988. Print.
- William, C. *Uncommon ground: Rethinking the human place in nature*. New York: W. W. Norton & Co., 2015. Print.
- Zimmerman, M. E. *Contesting Earth's Future: Radical Ecology and Postmodernity*. Berkeley: University of California Press, 1994. Print.

Indoor air pollution and its effects on children: An overview in Kamrup District (rural), Assam

Dr. Nilima Dutta

Assistant Professor, Department of Statistics
Pub Kamrup College, Baihata Chariali
E-mail: nilima.kamrup@gmail.com

Abstract

Indoor house pollution is now recognized as a potential source of health risks. Children are one of the main victims of this exposure due to their spending more time in an indoor rather than outdoor environment. Also, children have a higher resting metabolic rate and higher rate of oxygen consumption per unit body weight than adult, because they are growing rapidly. The effects of indoor air pollution are of special interest in relation to respiratory health and allergic disorders including rising cases of asthma. Common indoor air pollutants are released from dust mites, moulds, fungi, bacteria and pests (cockroaches, mice, rats, etc). There is an urgent need to create awareness among people about the issues and the serious threat it poses to their health and well-being.

Keywords: Pollution, Children

Introduction

Although official efforts to control air pollution have traditionally focused on outdoor air, it is now apparent that elevated contaminant

concentrations are common inside some private and public building. Indoor air pollution is dust, dirt, or gases in the air inside buildings such as our home or workplace that could be harmful to breathe in. Indoor air pollution refers to any contamination of the air within a building. This kind of pollution is now recognised as a potential source of health risks. Children are one of the main victims of this exposure due to their spending more time in an indoor rather than outdoor environment. Also, children have a higher resting metabolic rate and higher rate of oxygen consumption per unit body weight than adult, because they are growing rapidly. The effects of indoor air pollution are of special interest in relation to respiratory health and allergic disorders including rising cases of asthma. Indoor pollution sources that release gases or particles into the air are the primary causes of indoor air quality problems. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emission from indoor sources and by not carrying indoor air pollutants out of the area. Common indoor air pollutants are released from dust mites, moulds, fungi, bacteria and pests (cockroaches, mice, rats, etc). There is an urgent need to create awareness among people about the issues and the serious threat it poses to their health and well-being.

Objectives

Main objective of this study is to analysis how and when indoor air pollution affects the people specially children. Because children spend more time in indoor rather than outdoor environment. Also, children are one of the most vulnerable groups to indoor air pollution.

Methodology: Here I have used both primary and secondary data. I have prepared questionnaire with some important questions relating to indoor air pollution and collect information from some people of Kamrup District(rural) by face-to-face interview method. I have taken help of some secondary data also from respective departments.

Indoor pollutants: Common indoor air pollutants are released from dust mites, mould, fungi, bacteria, pests (cockroaches, mice, rats). Sev-

eral products such as oven cleaners, paints and lacquers, paints strippers, pesticides, mosquito repellents, dry-cleaning fluids etc also release indoor pollutants. Kerosene, though considered as a cleaner, emits some pollutants which trigger asthma and allergy among children.

Second-hand tobacco smoke is more carcinogenic than mainstream smoke as it is a complex inhaled by active smokers as it is a complex mixture of more than 4,000 chemicals, of which more than 40 are identified carcinogens in vapour and particle phases.

The World Health Organization has estimated that 1.5 million premature deaths per year are directly attributed to indoor air pollution from the use of solid fuels. That amounts to more than 4,000 deaths per day, over half of them being children under five years of age. Why are children more vulnerable:

Statistics say that children have carbon monoxide levels similar to those that would result from smoking about seven cigarettes per day. Children are one of the most vulnerable groups to indoor air pollution, as infants and young children have a higher resting metabolic rate and higher rate of oxygen consumption per unit body weight than adults, because they are growing rapidly. Therefore, their adverse exposure to any air pollutant may be greater. In addition to an increased need for oxygen relative to their size, children have narrow airways than adults. Thus, irritation caused by air pollution that would produce only a slight response in an adult, can result in potentially significant obstruction in the airways of a young child.

Indoor air pollution also impacts academic performance of children by lowering their concentration levels and increasing absenteeism due to asthma and allergies. The indoor air pollution weakens lungs and reduces immunity, making children more susceptible to infectious airborne illness like cold and flu. Indoor air pollution also impacts the development of endocrine glands, nervous and immune system of children.

Statistical Methods: Continuous variables, appropriately transformed, when necessary, were statistically compared by Student's *t*-test between the urban and rural areas. Here simple random sampling method is used to select the families for sample and collect the pri-

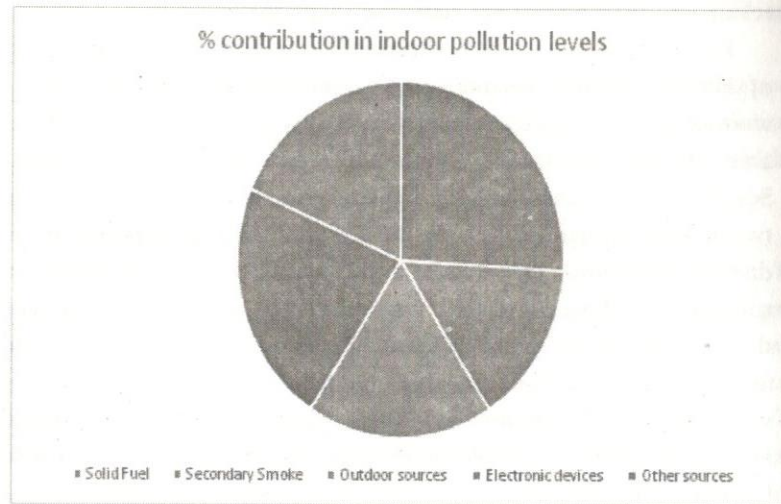
mary data by face-to-face interview method. The frequencies of findings were compared using Chi-square test or Fisher's exact test. The significance of differences in rural and urban areas for measurements during cooking time was calculated using a two-way analysis of variance (ANOVA). Chi-square test is performed to test the dependency of some infections of children on Indoor air pollution. Different results are shown by some statistical diagrams.

Discussion: I have taken around 200 families from the rural areas of Kamrup district for my sample survey. Most (70%) households were under the poverty level. Except the caste (demographical variable) and separate kitchen, all variables were statistically significant. Some Statistical analysis are performed to show the association between some variables with the health problems. It is plausible that distinct differences in the indoor air quality exist between urban and rural areas in Kamrup district since the living environment between these two areas are quite different. In the survey I have found that around 50% of rural people rely on coal and biomass in the form of wood, dung and crop residues for domestic energy. These materials are typically burnt in simple stoves with very incomplete combustion. Consequently, women and children are exposed to high levels of indoor air pollution every day. People of rural areas of Kamrup district are commonly exposed to high levels of household pollution for 3-7 h daily using biomass in their kitchen. There is consistent evidence that indoor air pollution increases the risk of chronic obstructive pulmonary disease and of acute respiratory infections in childhood, the most, the most important cause of death among children. Study also exists of associations with low birth weight, increased infant and perinatal mortality, pulmonary tuberculosis, nasopharyngeal and laryngeal cancer, cataract and specifically in respect of the use of coal, with lung cancer. Indoor air pollution may be responsible for major death in rural areas.

There is a common misconception that air pollution is just limited to cities. We are delusional to identify the rising menace of increasing concentrations of air pollutants as an urban issue. There is no doubt that cities are the principal focal point of air contaminating emissions,

but amidst all the scrutiny of city pollution amasses, there remains a huge question mark on how polluted rural areas are. In my study, I have found the pollution levels from different sources of Indoor house pollution as follows:

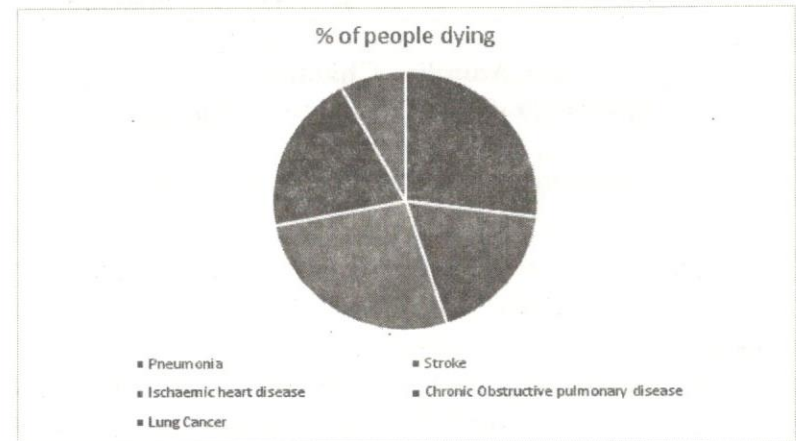
Solid fuel—70%, Secondary smoke—40%, Outdoor sources—50%, Electronic devices—60%, Other sources—50%



Indoor air pollution in rural areas is disproportionately high as compared to urban areas. Most people cook using polluting open fires or simple stoves fuelled by kerosene, biomass (wood, animal dung and crop waste) and coal. A lot of people die prematurely from illness attributable to household air pollution from inefficient cooking practices using pollution stoves paired with solid fuels and kerosene. Household air pollution causes non communicable disease including stroke, heart disease, chronic obstructive pulmonary disease and lung cancer. Close to half of deaths due to pneumonia among children under 5 years of age are caused by particulate matter inhaled from household air pollution.

A lot of people a year die prematurely from illness attributed to the household air pollution caused by the inefficient use of solid fuels and kerosene for cooking. Following are some data-

27% are due to pneumonia
18% are from stroke
27% from ischaemic heart disease
20% from chronic obstructive pulmonary disease
8% from lung cancer



Conclusion

We found the indoor air quality to be lower among urban biomass fuel-users than among rural biomass fuel user in Kamrup district. Indoor air pollution is a major global public health threat requiring greatly increased efforts in the areas of research and policy making. The dependency of the locals on solid fuels for cooking is a risk factor that increases indoor air pollution. Since a vast majority of the population use solid fuels, indoor air pollution is more prominent in rural areas in Kamrup district. Research on its health effects should be strengthened, particularly in relation to tuberculosis and acute lower respiratory infections. A more systematic approach to the development and evaluation of intervention is desirable, with clearer recognition of the interrelationships between poverty and dependence on pollution fuels. There is an important need to create awareness among people about the issue and the serious.

Forests: The stabilizing force for climate

Dr. Anindita Chakravarty

Assistant Professor, Department of Zoology,
Bijni College, Bijni
Email: anindita.chakravarty548@gmail.com

Abstract

Global climate change has become one of the most serious issues of the environment in the 21st Century. Climate change is mainly caused by the anthropogenic emission of greenhouse gases like CO₂. The role of forests in climate change is of two folds- they act as both a cause and a solution for greenhouse gas emissions. About 11% of the total greenhouse gas emission as reported in 2019 was from deforestation and forest degradation. Forest land restoration is one of the most important techniques to minimize the effects of climate change. Approximately 2.6 billion tons of carbon dioxide (one-third of the CO₂) has been released from burning fossil fuels, is absorbed by forests every year. Restoration of forests is, therefore, an essential solution to climate change. Forest regulates ecosystems, protects biodiversity plays an integral part in the carbon cycle, supports livelihoods, and supplies goods and services that can drive sustainable growth. 25% of the world's population depend on the forest for their livelihood and are the poorest people of the world. Restoration of degraded and deforested lands is of utmost importance in addition to the protection of healthy, intact primary forests are the key for mitigating climate change issues. The government, non-government and private sector will to work together with active community par-

ticipation for the conservation of existing forested lands for the safe guard of the world.

Key words: Climate change, Deforestation, Greenhouse gas, Sustainable management.

Introduction

One of the most important environmental concerns of the twenty-first century is climate change. If taken literally, climate change is a long-term modification of the weather. Of course, there have been climatic changes during the previous 650,000 years, with warmer and colder eras. Yet, in contemporary times, climate change is primarily brought on by our activity rather than solely being a natural event. Some of the repercussions of climate change include extreme weather, rising temperatures, and the melting of the polar ice caps. Many statistical factors, including average temperature, average rainfall, frequency of droughts, etc., can be used to measure climate change. The variations in these numbers over the course of years, decades, or even centuries are what is meant by climate change (Jackson & Jerome, 2021). In the modern era, climate change is primarily caused by human activity. The United Nations-led Intergovernmental Panel on Climate Change (IPCC) came to the conclusion that there is a greater than 95% chance that human activity has warmed the earth during the past 50 years. The main greenhouse gases (GHGs) that contribute significantly to global warming and climate change include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (NO₂), and fluorinated gases (such as hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, and nitrogen trifluoride) are the primary greenhouse gases (GHGs) whose excess presence significantly contributes to climate change and global warming. The average global temperature of the Earth is thought to have risen by around 1.8°F as a result of human activity since 1880. Currently, this number is rising 0.36°F every decade. According to the global warming timetable, if the Earth's temperature continues to rise at its current rate, we should hit the 2.7°F level between 2030 and 2052. The burning of fossil fuels, clearing of

grasslands and forests, raising animals for food, industry, and garbage disposal are the top five contributors to greenhouse gas emissions.

Weather patterns may become less predictable due to climate change. According to the UN Meteorological Report, global temperatures rose by 1.8°F (1° C) between 1901 and 2020, and by 2100, they were expected to rise by 5.4°F to 9°F (EHP Report, 2010). In areas where agriculture is a major industry, the unpredictable weather patterns may make it difficult to sustain and develop crops because predictable temperature and precipitation levels can no longer be relied upon. Also, it is linked to other severe weather occurrences like more common and powerful hurricanes, flooding, downpours, and winter storms.

The current study intends to address the role of forests and grasslands in mitigating this serious issue as well as the national action plan for climate change in this scenario of rising global temperatures and anthropogenic climate change. The work is entirely supported by secondary information gathered from print and electronic sources.

Climate change impact

According to a NASA report, some effects of climate change have already been noted.

- i. Ocean warming: The seas have absorbed a large portion of the extra heat; the top 700 metres of the ocean have warmed by 0.302°F since 1969. For instance, coral and shellfish are extremely sensitive to even minute variations in temperature and acidity. Coral reefs are bleached by warm water, and coral structures are weakened by acidity that destroys marine animal shells.
- ii. Since 1993, the pace of sea level rise has increased from 1.7mm/year, which it was for the most of the 20th century. As a result, some nations and towns are in peril, such as the Maldives, which is currently at risk from sea level rise.
- iii. As a result of rising sea levels and an increase in the frequency of natural disasters, more people will unavoidably flee their homes.

- iv. Glaciers are vanishing. The average thickness of 30 well examined glaciers has shrunk by more than 60 feet since 1980 as a result of this rapid melting.
- v. The ice sheets are also shown to be shrinking. Since 1979, the Arctic ice caps' sea ice cover has decreased by around 40%.
- vi. More than 35% of the world's population will experience severe heat waves at least once every five years with a 2°C increase by 2100 (as anticipated by the IPCC). There could be a 3.0-billion-pound drop in fishing catch yields, and some regions' agriculture could completely fail. Several hundred million more of the world's population could face poverty and other climate-related risks (to their health, food security, water supply, livelihood, human security, and economic growth).
- vii. The International Organization for Migration estimates that hundreds of millions of people could be uprooted by 2050 as a result of the effects of global warming.
- viii. Climate change contributes to inequality, and the poor are becoming even destitute. Those who live in densely populated places with insufficient infrastructure, or in countries where the majority of the population depends on natural resources for a living, are particularly exposed to the effects of climate change. Ironically, those who would be most negatively impacted by global warming and climate change are also the least to blame for its causes.
- ix. Humans are more susceptible to conditions such as waterborne illnesses, vector-borne and zoonotic diseases, cancer, cardiovascular diseases, heat-related mortality, asthma, respiratory allergies, and cancer (Portier et al., 2013). According to the WHO, between 2030 and 2050, hunger, malaria, diarrhoea, and heat stress alone are predicted to result in an additional 250 000 fatalities annually. By 2030, it is anticipated that the direct health harm expenses will range from \$2 to \$4 billion USD annually (Patz et al., 2005).

Discussion on mitigation of climate change

Governments can make extensive plans to reduce greenhouse gas emissions and global warming from a global perspective. Many other

solutions are used by nations around the world, such as carbon pricing, in which the government imposes a charge on greenhouse gas emissions or the carbon content of fossil fuels. Governments can use carbon pricing to direct these monies towards reducing climate change. Humans should switch from using fossil fuels to electricity since it can be produced from renewable resources and is a clean energy source with no emissions. One of the biggest sources of GHG emissions is transportation, therefore switching from oil to electricity as a fuel for automobiles could aid in the fight against global warming. Businesses and industries must establish rigorous carbon reduction goals that support the Paris Agreement and the IPCC's 1.5°C target (Briggs & Stallerd, 2022). On a personal level, we need to make our homes more environmentally friendly by removing appliances that create GHG.

How might forests aid in addressing climate change?

The climatic stabilizing power comes from forests. They maintain ecosystem balance, safeguard biodiversity, are essential to the carbon cycle, support livelihoods, and provide commodities and services that can promote sustainable growth. The lungs of the world are forests, jungles, trees, and plants because they provide oxygen for us to breathe and act as a carbon sink for the planet.

The land sector, the second-largest source of GHG emissions after the energy sector, is responsible for around 25% of them globally, with deforestation and forest degradation accounting for about half of these emissions. One of the most crucial ways to combat the consequences of climate change is through the protection of forests. 7.6 billion tons of CO₂ were produced during combustion, is absorbed by forests every year (IUCN, 2020). Hence, maintaining and expanding forests is crucial to combating climate change. Stopping the loss and degradation of forest ecosystems and fostering their restoration will contribute to meeting the Paris Agreement's goals of mitigating climate change by nearly one-third by 2030. (2015).

Increasing and maintaining forests is therefore an essential solution to climate change. Halting the loss and degradation of forest ecosys-

tems and promoting their restoration, help to achieve over one-third of the total climate change mitigation goal by 2030, to meet the objectives of the Paris Agreement (2015).

Global Action plan

The IUCN's forest work addresses the role of trees and forests in enhancing climate change resilience in a number of ways:

- Fighting against deforestation and forest degradation in places with significant cultural and biological diversity, like primary forests and World Heritage sites. Restoring forest landscapes improves climate change adaptation and mitigation by preserving the advantages that people and society derive from forests, such as their carbon stocks and economic benefits. a global initiative to restore 350 million hectares of damaged and forest-covered land by 2030 (Bonn Challenge).
- If the 350-million-hectare goal is met, up to 1.7 gigatonnes of carbon dioxide equivalent might be sequestered annually.

National Action Plan:

In order to lessen the negative effects of climate change, the National Action Plan for Climate Change (NAPCC) was introduced in 2008 and aims to reduce CO₂ emissions below those of industrialised nations (Pandve, 2009). National Mission on Sustainable Habitat, National Mission on Sustainable Water, National Mission for Sustaining the Himalayan Ecosystem, Green India Mission, National Mission for Sustainable Agriculture, and National Mission on Strategic Knowledge for Climate Change are the eight missions under NAPCC.

Green India Mission

In response to climate change, India's green cover is being protected, restored, and enhanced via the Green India Mission. The mission's overall goal is to improve the forest cover on an additional 5 hectares while growing the forest cover on 5 million more hectares of land. The mission also aims to increase the provisioning capacity of Indian forests and their ability for carbon sequestration, as well as

to provide livelihoods for 3 million people through activities based in the forest. The programme was initially budgeted for 10 years at 60,000 crores, however it has remained woefully underfunded. The initiative, whose final launch was scheduled for 2015 but was originally scheduled to occur in 2012 due to an investment crunch. The programme also aims to achieve India's Nationally Determined Contribution (NDC) target, which was to sequester 2.5 billion tonnes of "Carbon emissions" by 2020–30. (Down to earth, 2020). Plantations were planned all over the country with extensive plantation drives, but the results are not visible everywhere due to poor execution everywhere. Communities are the real guardian of the forest, thus community- and individual-level tree planting may produce better benefits.

Conclusion

The maintenance of healthy, undamaged primary forests and the restoration of degraded and deforested lands are essential for combating climate change challenges. In order to preserve the world's remaining forested lands, non-governmental organisations, the public sector, and the commercial sector will collaborate actively with the community.

Reference:

- Briggs, H. & Stallerd, E. (2022). COP27: Why is the Paris climate agreement still important? <https://www.bbc.com/news/science-environment-35073297>
- "Green India Mission grossly underfunded: Parliament panel". *DownToEarth*. Retrieved 19 September 2020.
- IUCN Issues brief on Forests and climate change: <https://www.iucn.org/resources/issues-briefs/forests-and-climate-change>. Retrieved on 19th September, 2020.
- Jackson, L & Jerome, L. (2021). Climate change 101: Causes, effects, solutions and facts about the climate crisis. <https://www.joingoodside.com/blog/climate-change-ultimate-guide#>
- Pandve, Harshal T. (2009). "India's National Action Plan on Climate Change". *Indian Journal of Occupational and Environmental Medicine*.

- 13 (1): 17–19. doi:10.4103/0019-5278.50718. PMC 2822162. PMID 20165607.
- Patz, J. A., Campbell-Lendrum, D., Holloway, T., & Foley, J. A. (2005). Impact of regional climate change on human health. *Nature*, 438(7066), 310–317
- Portier, C. J., Tart, K. T., Carter, S. R., Dilworth, C. H., Grambsch, A. E., Gohlke, J., ... & Whung, P. Y. (2013). A human health perspective on climate change: a report outlining the research needs on the human health effects of climate change. *Journal of Current Issues in Globalization*, 6(4), 621.

Global Warming and Climate Change

Syed Jawahar Hussain

Assistant Professor, Physics Department

Bijni College, Bijni

Email: jawaharhussain2@gmail.com

Abstract

Burning of fossil fuels produce greenhouse gases viz. Carbon dioxide, methane, nitrous oxide etc. These greenhouse gases form a cover over our atmosphere. This cover of greenhouse gases blocks the heat waves reflected by the earth surface. So, the excess heat is trapped in our environment causing a rise in temperature on earth. This is called global warming. Global warming poses serious threat to our ecosystem. It causes melting of glaciers & icecaps resulting in rise of sea water level. According to NASA global temperature has increased by 1.4-degree F since 1880. If such global warming continues then major cities in coastal areas will be submerged in water in near future causing a catastrophic situation. So, steps to be taken for optimum use of fossil fuel to control global warming. Deforestation is another cause of global warming. So, deforestation must be stopped. Changing of environmental conditions of a place such as temperature, rainfall etc. over a long period of time is called climate change. Human activities cause such climate change. Deforestation, industrialization & excessive use of fossil fuel causes climate change. Climate change causes extreme weather conditions. Excessive rain, drought, flood, land slide, land degradation, rise of sea level etc. are caused by climate change. Climate change can create threat to human life & habitat as well as for other animals & plants. So, measure should be taken globally to control climate change.

Keywords: greenhouse gas, fossil, glacier, icecap, drought.

Introduction

In the lowest layer of earth's atmosphere i.e., in troposphere heat reflected by earth surface is trapped by some gases which are called greenhouse gases. The phenomenon is called Greenhouse effect which is similar to greenhouses used in horticulture to keep desired heat. Greenhouse effect keeps our planet at an average temperature of 15-degree C. In absence of this effect the average temperature of our planet will fall to -18-degree C. Thus, greenhouse effect keeps our planet warm enough so that life can exist in the planet. The major greenhouse gases are carbon dioxide, ozone, methane, nitrous oxide, chlorofluorocarbons and water vapour, out of which carbon dioxide and water vapour are predominant. Water vapour is controlled by earth's hydrological cycle and carbon dioxide by global carbon cycle.

While the level of water vapour in the atmosphere relatively remaining constant, carbon dioxide level is increasing significantly due to various human activities. The levels of other greenhouse gases viz. Methane, nitrous oxide and chlorofluorocarbons are also increasing due to human activities. Deforestation, industrial emission etc. caused increase in the carbon dioxide level. Due to absorption of more and more infra-red radiations of heat by these gases heat is re-radiated resulting in an increase in global average temperature above 15-degree C. This is called enhanced greenhouse effect which is responsible for increasing average global temperature or global warming.

Greenhouse gas	Contribution to GHE/GW	Source
Carbon dioxide	55%	fossil fuel
CFC	24%	refrigerator, AC
Methane	18%	dead organic matter
Nitrous oxide	6%	nylon products

Impacts of greenhouse effect:

1. Global warming: If concentration of greenhouse gases continue at present rate earth's average temperature will rise be-

tween 1.5 – 5.5 degree C by 2050 causing earth a warmer planet which will lead to catastrophic situations.

2. Rise in sea level: With increasing global temperature sea water will expand, ice caps will melt and coastal regions will be flooded.
3. Effect on human health: Global warming will change the rainfall pattern, thereby effecting the distribution of vector borne diseases like malaria, filariasis, elephantiasis etc.
4. Effect on agriculture: Due to global warming tropical and subtropical regions will be badly affected. Even a rise of 2 degree C may be quite harmful to crops. Increase in temperature and humidity will increase pest growth causing loss of agricultural products.

Climate Change

Average weather conditions of a region over a period of at least 30 years is called climate. We have a relatively stable climate on earth for thousands of years due to which we have practised agriculture and increased in population. A change in climatic condition will disturb agriculture that would lead to migration of animals as well as human. Due to increase in concentration of greenhouse gases in our atmosphere global warming has increased. This will lead to drought or excessive flood in various regions of earth causing loss of crops and other agricultural products. This may cause famine, and loss of human life and livestock. United Nations Intergovernmental Panel on Climate Change (IPCC) in its report has predicted that there will be unequal distribution of water across the globe in future. Glaciers of Himalayas will melt. As a result, size and numbers of lakes will increase. Africa will face water scarcity. Rain dependent agriculture in north America will get a boost. Human activities will contribute to loss of coastal wetlands. Fresh water availability will decrease by 2050.

Conclusion

To check global warming as well as to maintain a sustainable climatic condition of the earth a joint effort by all nations is very

urgent. Agreement should be made to drastically cut down of fossil fuel use as well as that of CFC. Stress should be given to use more and more renewable energy resources. Steps to be taken to plant more trees, adopt sustainable agriculture, trap and use methane as fuel, remove of atmospheric carbon dioxide by utilizing photosynthetic algae etc.

References

Google sources, Environmental Studies (New Age International Publishers)

E-Waste Management Plant in Lower Assam: Prospect and Challenges

Dr. Apu Guha Thakurta

Assistant Proff. Bijni College, Bijni.

E-mail: apuguhathakurta@gmail.com

Abstract

Waste, basically E-waste has become a serious challenge for our mother earth now a days. Electronic waste is emerging as a serious public health and environmental issue in India. India is the third largest electronic waste producer in the world, approximately 2 million tons of e-waste are generated annually, which is an alarming sign for us.

Though it has emerged as a major worldwide problem, in North-East India in particular, it has become more acute due to the lack of any recycling facilities. In the entire North-East region, there is not a single e-waste recycle unit, in spite of this region with a huge number of consumers and users of various electronics gadgets. Presence of a good number of oil-refineries in this region necessitates the downstream industries to process their by-products. But the inexplicable absence of such units has put the entire region into a critical situation. These by-products are either sent to far-off places for necessary recycling or left unattended and causing a serious ecological problem. In this prospect we make an attempt to bring ideas and thoughts from diverse fields of knowledge and expertise to address the problem and search for possible or viable outcomes.

Keywords: Recycling, Non-biodegradable plastic, Industrialisation, Communication.

Introduction

In this paper we are going to focus on such a idea which is important and also interesting in today's scenario. This business idea is not only related to economic or business point of view, but it is also important to our environmental protection and overall, the protection of human life. This sector is Electronic Waste Recycling sector, which is commonly known as E-waste management. I hope this paper may result in creating a conducive environment for people to join in this sector. In this paper I will share some facts, information and findings on prospects and challenges regarding the set up of E-waste management plant in Lower Assam region. The hazardous features of E-waste, the scope to make profit from E-waste, required machinery, estimated cost will be elaborated in this paper. The agencies who provide training on E-waste management sector are also be maintained here.

What is E-waste

Any electronic equipments having circuit operated by AC or DC, when they become useless are called E-waste. The computers, mainframes, servers, monitors, printers, scanners, compact discs (CDs), copiers, calculators, battery cells, cellular phones, fax machines, transceivers, TVs, medical apparatus, iPods, refrigerators, washing machines, and air conditioners are examples of e-waste when they become unfit for their use.

1.1. Why E-waste is hazardous

The E-waste may cause very much harmful to us. The presence of toxic substances like liquid crystal, lithium, mercury, nickel, selenium, polychlorinated biphenyls (PCBs), arsenic, barium, brominates flame retardants, cadmium, chrome, cobalt, copper, and lead make it very hazardous. The presence of highly toxic substances and heavy metals like mercury, lead, beryllium, and cadmium pose a significant threat to the environment even in their minute quantities. Thus, E-waste can pose the huge risk to humans, animals and our environment.

1.2. The time to be alert

The presence of toxic and highly toxic substances in the E-waste has become a great threat to human life. The most worried thing is that, the quantity of E-waste is increasing day by day. After 2002 the rapid development of technology results in the electronic commodities getting upgraded every moment. So literally during the time generation of E-waste is increasing worldwide as well as in India. According to a survey carried out by Central Pollution Control Board, it is estimated that 1.347 lakh Metric Tons E-waste was generated in 2005. The quantities of E-waste generations are increasing day by day. Considering the growth rate of E-waste, it is calculated that India will generate 2 million Metric Tons E-waste by 2025. (Dr. Chatterjee, 26.1.2023) India stands 5th in E-waste generation producing around 1.7 lakh Metric Tons in 2022. (Source: <https://www.statista.com>).

1.3. The time to think

E-waste is not hazardous if it is stored and recycled by scientific methods. Having the presence of toxic substances, the valuable metals like copper, silver, gold, and platinum can be subtracted from e-wastes once they are scientifically processed. But it will become very much harmful in case e-waste is dismantled and processed in an unscientific or crude manner with the rudimentary techniques. In this regard, to recycle E-waste is not just a profitable business, but also a responsible one to take a step to protect the environment and human health. In Tokyo Olympic, the organisers made all the medals from E-waste. From 78985 Tons of E-waste, they subtract 32 KG of Gold, 3500 KG Silver and 2200 KG Bronze. (Source: <https://evreka.co/blog/tokyo-olympic>)

2. E-Waste! Waste (Kachra) or Business opportunity?

The E-waste management is a relatively new business and the phenomenal increase in generation of E-waste is the prospects of this business. From the over mentioned data, it is clear that,

- A. There is a huge amount of E-Waste generated in India every year.
- B. E-Waste is harmful because of the presence of toxic substances.
- C. E-Waste is valuable because of the presence of valuable metals in it.
- D. E-Waste should be recycled in a scientific manner.

Though recycling of E-Waste can become a profitable business opportunity, but unfortunately in India this sector is dominated by informal or unorganised sectors. E-Waste recycling in informal sector by non scientific and primitive methods is harmful and hazardous. In Lower Assam region the E-Waste is totally controlled by 'Kabadiwala'(scrap-dealer) due to the absence of any E-Waste management unit. In comparison to other advanced states of India North Eastern states are lacking any credible organisation or unit in this regard and thus posing a great threat to the environment and health of all living beings.

List of Dismantlers/Recyclers as per the authorisation issued by SPCBc/PCCs under E-Waste (Management) Rules, 2016 (As on 31-01-2023)

Sl. No.	State	Number of Authorised Dismantler/Recycler	Installed capacity Metric Tons per Annum (MTA)
01	Andhra Pradesh	10	44002.5
02	Assam	01	120
03	Chhattisgarh	02	6750
04	Delhi	06	1989
05	Gujarat	40	120130.92
06	Goa	02	153
07	Haryana	42	128837.67
08	Himachal Pradesh	02	1500
09	Jammu & Kashmir	03	705

10	Jharkhand	02	660
11	Karnataka	72	125115.48
12	Kerala	01	1200
13	Maharashtra	140	118031.5
14	Madhya Pradesh	03	13600
15	Orissa	07	9050
16	Punjab	08	10092
17	Rajasthan	27	82007.67
18	Tamil Nadu	42	130636
19	Telangana	23	148115
20	Uttar Pradesh	121	624219.47
21	Uttarakhand	08	153068.06
22	West Bengal	05	2640
		567	1722624.27

(Source: <https://cpcb.nic.in>)

In comparison to other states of India, Assam as well as entire NE region lacks any E-waste recycling unit. There is only one dismantling unit, that collects very few E-waste, segregate and export it to other states for recycling. In NE region the E-waste collection, segregation and exporting – the whole process is controlled by ‘Kabadiwala’(scrap-dealer). The whole sector is controlled by unorganised sector which is hazardous and environmentally unsustainable. They collect the materials through rag-pickers and manually dismantle them only to collect and sell the PCB for profit and littering the land with other hazardous parts or chemicals. So, there is ample scope to set up E-waste management plant.

1. Investment, Machinery & Licensing

The investment will differ according to the per hour recycling capacity of the machines. The capacity of the machinery depends ac-

ording to the availability of raw material. The medium range (200 kg/hour) capacity plant will require the followings –

- Should have minimum area 1500 sq ft – 2000 sq ft. (Production area, finished good storage and admin area. The raw material storage area excluded)
- Project cost: 45 – 55 Lakhs. (Excluding land cost)
- Manpower required: 4 – 6 persons (operator and helper)
- Electricity required: 60 KW

The Indian Government offers the co-fund grant scheme that covers between 25% to 50% of the project costs for the e-waste management facilities and building capacity for e-waste businesses. However, the uptake of this scheme has been very limited. In addition, there is also a shortage of formally approved e-waste recycling centres as presently existing centres operate far below their capacity due to poorly organized supply chains between them and the majority of informal sector collectors of e-waste in India.

1.1. Investment

As it mentioned above the investment will differ according to the capacity of machinery and supply chain of materials. Here are the investment details of over mentioned capacity-based unit, and the cost of required land is not include here –

- Machinery: 20 – 25 Lakhs
- Raw materials (10 Tons): 3 Lakhs
- Infrastructure & Electricity: 10 – 15 Lakhs
- License: 1Lakh
- Working capital: 10 Lakhs

Total: 44 – 54 Lakhs.

1.1.1. Required machinery for set up PCB recycling unit

According to the E-Waste (Management) Rules, 2016 to crush the whole electronic gadget by machine is strictly prohibited. So, the separation of PCB process should be made manually. So, the E-waste recycle is basically recycle of the PCB. The required machineries are –

- a. PCB component dismantle machine
- b. Blank PCB crushing and separating machine
 - i. Belt Conveyer with magnetic separator
 - ii. Hammer crusher machine
 - iii. Round screen machine
 - iv. Wind conveying machine
 - v. Pulse air separator
 - vi. High voltage electrostatic separator
 - vii. Dust collector
- c. Control cabinet.

For the small entrepreneurs or beginners, the first component is more viable as it requires small land holding, investment and minimal manpower, permission or license requirement.

1.2. Licensing

Ministry of Environment and forests, govt. of India is the nodal agency for policy, planning, promoting and coordinating the environmental programme including E-waste management. Before applying for license the E-Waste (Management) Rules, 2016 should be followed, which is adhered to by State Pollution Control Board. For license the followings are required –

- a. Business Registration
- b. GST number

- c. Udhyam registration
- d. NOC from Pollution Control Board
- e. Trade License
- f. EPF & ESIC Registration (optional)
- g. Trademark Registration (optional)

1.3. MSME Loan

Looking at the importance and need of developing the formal E-waste management sector the Government of India has introduced various schemes to provide financial support to set up E-waste recycling plant. MSME loan is one such facility which is now open for any start-up in this sector. The documents required for MSME loan are –

- a. PAN, Aadhar Card and Voter Id
- b. Copy of address proof
- c. ITR of last three years
- d. Bank statements of last six months
- e. Detail Project Report (DPR)

2. Raw materials, Finished product & Market

The raw material is always available in local area. To collect the E-waste the existing informal chain can help, as well as scrap PCB can also be purchased from India Mart. In local market whole E-waste gadgets generally costs Rs. 10.00 (Ten Rupees) per KG, which need segregation manually for picking the PCB.

2.1. Finished Product

After recycling from the PCB three products come out

- i. Metal Powder, which contain more than 85% copper, gold, silver, tin, palladium and other rare element. The market price of metal powder is Rs. 350 – 450 per KG.
- ii. Resin Powder, which is used on plastic and plywood industry. The market price of Resin powder is Rs. 150 per KG.

III. Fibre Powder, which is used as insulation material. The market price of fibre powder is Rs. 95 per KG.

2.2. Market

There is a huge market for these finished products. The recycler can directly contact the buyer or can sell the product through online platform like Trade India, India Mart, Alibaba, Export India etc.

3. Challenges

There is a lack of public awareness about e-waste hazards and harvesting in India, and recycling is, therefore, very low. Most consumers do not know or have less knowledge about the hazardous nature of e-waste components or the rules and regulations regarding its handling and associated penalties for improper disposal. There is also lack of public awareness about e-waste management in India which is mostly done by urban municipal or state government agencies.

Absence of any trained or professional personnel or agencies in the field of the E-waste collection and segregation process in the North East region.

Density/quantity of E-Waste is very low in comparison to more advanced cities or states. As a result, the carrying cost of waste to the recycling plant becomes unviable.

Absence of big users or entrepreneurs using E-products in the region has made the recycling process unfeasible as bulk purchase of the waste is not possible due to lack of industrial environment & associate industry.

4. Further references

The Government of India provides technical and marketing knowledge on E-waste management through some agencies. The intended entrepreneur in this segment can contact with them for further enquiries.

National Institute of Electronics and Information Technology, Gangtok (NIELIT) under the Ministry of Electronics & Informa-

tion Technology, Govt. of India caters to NE states and 6 seats are reserved for Assam in a 5 days training programme.

Centre of Excellence (CoE) on E-waste Management (CEMAT) is another government agency for providing support to set up E-waste recycling plant in India. In case of formal education on E-waste, IIT, Hyderabad offers M Tech. on E-waste management under the guidance of CEMAT.

5. Conclusion

The maximum volume of E-waste recycled in India is in unorganized sector, which engages a significant number of manpower exposing them to various hazards. Recovery of metals from PCBs by primitive means is the most hazardous act. In this field the Government should provide proper education, awareness, and, most importantly, alternative cost-effective technology to provide better means to those who earn the livelihood from this. And it is most significant from the point of view of safe disposal of this waste for a better environment for our present and future on earth. Strict measures should be taken in this regard by the Government which should impose financial penalties on non-compliance or violation of e-waste handling and processing rules.

In India, especially in NE region our approach can be for integrating the unorganized sector into the system by allowing it to concentrate only on collecting, not dismantling, and segregation, which should be entrusted with the organized sector that will be responsible for metal extraction, recycling, and disposal. The blended model will provide both awareness and employment to the maximum and will ensure a healthier environment for all.

References:

- Chatterjee, Dr. S: *Electronic Waste in India*, web. 28 January 2023 <<https://www.meity.gov.in>>
- List of Dismantlers/Recyclers by Central Pollution Control Board*, web. 30 January 2023 <<https://cpcb.nic.in>>

First hand information is collected from various local vendors, online marketing platforms and entrepreneurs regarding e-waste collection, process of segregation, dismantling and disposal as well as pricing.

An assessment on habitat diversity in relation to flora and fauna with their conservation strategy in the Chirang District of Assam, India

Dr. Sewali Pathak

Assistant Professor, Department of Zoology
Bijni College, Bijni, Chirang
E-mail: sewalip@gmail.com

Abstract

Chirang District (26.6539p N, 90.6394p E) is situated on the north bank of river Brahmaputra along the foothills of Indo-Bhutan border near Manas National Park of Assam. Chirang District is an administrative district in the Bodoland Territorial Region of Assam state in the North-East of India. The total land area of the district is 2,029.2sq.km. covering with 454.6sq.km forest area, 101.1sq.km grass land area, 64.9sq.km agriculture cum human settlement area, 57.7sq.km swampy area and 43.3sq.km river/river sand area. The district is with two sub-division namely, Bijni and Kajalgaon. The major rivers Aie, Nangalbhanga, Makra, Champa and part of Manas including their smaller tributaries Bhur, Deosri, Burisuta, Kuklung, Teklai, Langkhar, Kanamakra and Dulani harbor aquatic flora and fauna. Chirang Reserve Forest and Panbari Reserve Forest constitute the territory of several species along with endangered species. The Bishnupur, Kalamati, Kuklung, Runikhata, Amteka are the attractive land masses covering the forest areas embracing many threatened species. Community aggravation, overexploitation and illegal trading are the root causes of declining few threatened species currently. The study empha-

sis on conservation of gene pool of many species in this region. Mass awareness, management policy and administrative intervention would be applicable regarding conservation. The community people must be involved and trained to maintain resources in sustainable manner.

Key words: Habitat Diversity, Flora & Fauna, Conservation strategies, Chirang District

Introduction

Habitat diversity is the range of different habitats in an ecosystem and it also means the number of different habitats that one particular region can provide. For an aquatic habitat, terrestrial habitat and arboreal habitat. Habitat diversity explores the variations in ecosystems within a specific geographic area. In general, the variety of distinct habitats found in an ecosystem or biome is referred to as habitat diversity. A range of forests, deserts, grasslands, oceans, lakes, coral reefs, wetlands, tundra and other biological communities make up habitat diversity. The conservation of species and genetic variety typically follows the preservation of habitat diversity. It deals with the investigation of various biosphere habitats. Characteristics of habitats are the abiotic and biotic factors that influence a plant. Among the abiotic factors are chemical and physical values like light, climate, soil composition, soil consistency, exposition to the sun, etc. The habitat diversity effect states that as habitat area increases, the variability of structures within the habitat is likely to increase and therefore support a greater variety of species. The habitat assessment is defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and condition of the resident aquatic community (Barbour et al., 1996). The relationship between habitat size and species diversity is that the smaller the habitat, the less diversity of species there will be. Greater habitat differentiation means there are more types of habitats in the same amount of geographical area. If there are more types of habitats, this presents a scenario in which one species could diverge into two species through sympatric speciation. The biological potential is limited by the quality

of the physical habitat, forming the template within which biological communities develop (Southwood, 1977). Generally, the biological diversity in rivers and habitat are closely linked (Raven et al. 1998). Example, a large mountain range like the North American Rockies might produce many diverse habitats: forests, rivers, lakes, deserts, and even tundra or polar habitats. There are basically three types of habitats. They

Habitat loss, especially removal of plants and trees which stabilize soil, increases erosion, and reduces the nutrient levels in terrestrial ecosystems. This, in turn, can decrease agricultural productivity. In turn, increasing erosion decreases water quality by increasing sediment and pollutants in rivers and streams. Habitat loss leaves large numbers of species to gradually decline and go extinct. If we are not aware of this "extinction debt" (Tilman et al. 1994) we are prone to underestimate the level of threat to biodiversity (Hanski and Ovaskainen 2002). The three main types of habitat loss are habitat destruction, habitat degradation and habitat fragmentation. The effects of habitat loss echo up the food chain and disrupt the entire ecosystem. Habitat destruction, fragmentation, and modification caused by human-led activities such as industrial and residential development, logging, crop farming, livestock grazing, mining, road and dam building, and pesticide use etc. have taken a risky crash on threatened and endangered wildlife populations at an alarming rate. Habitat fragmentation has a major impact on animal species populations because it deprives species of what they are naturally habituated. This makes the species isolated, reduces the area where they can live, and creates new ecological boundaries.

Urbanization and urban sprawl are major drivers of habitat loss worldwide. In recent time of rapid urban expansion, cities and outlying greenbelts are demanding an unprecedented amount of land and other natural resources and are encroaching on biodiversity hotspots and protected areas. Conservation of habitat ensures the long-term survival of life on the planet. It allows species to thrive in their environments through different techniques and practices depending on the level and type of degradation or destruction.

Chirang District is closely related to the ecological environment of Eastern Himalayan origin. The general assessments of habitat diversity in term of flora and fauna were observed in the different parts of this region. The diversities of fauna and flora of different areas of Chirang District and their conservation strategy were also more specifically studied. Information obtained from various literatures no any earlier reports is available on the studies of habitat diversity and their prospects from the area of this district in particular till now. The assessment of habitat diversity in Chirang District of Assam is an approach in this regard.

Objective

The aim and objectives of the research work is to highlight the habitats diversity of flora and fauna in different parts of this region and illustrate the strategy for their instant conservation. Identify the major reserve forest areas, rivers, streams related to habitat management in the study area. Role of community practice and management to maintain biodiversity in sustainable way.

Methodology

The research works were followed by participatory method. The field visit and community visit were done in randomly selected habitat areas from different parts of the district to collect information. The data were recorded on the preformatted datasheet and the photographs of flora-fauna in various location were done for documentation. The flora and fauna were identified with the help of taxonomic experts and through literature discussion. The landscape of habitats was monitored and listed the total number of flora and fauna from the study area. The location of vegetations, forests, rivers were visualized through satellite map. The data analysis was done following simple statistics to assumed hypothetically.

Result and Discussion

During the study of habitat assessment of flora and fauna, the recorded floral species are wild orchids, medicinal herbs, flowers,

creeper plants, timbers, wild fruits, different varieties of lemon species, lemon grass, spices plants which may consider as the richest floral diversity. The faunal species are mainly annelids, molluscan, crustaceans, arthropods like different aquatic insects, butterflies, termites, spiders including fishes, amphibians, reptiles, birds and few mammals. The major aquatic habitat areas are river Manas, Aie, Champamoti, Deosri, Burisuta, Bordangi, Teklai, Langkhar, Amtika, Kuklung, Agrang, Dulani, Hakoa, Bhur and Nangalbhanga originates from the foothill of Indo-Bhutan border area which are categorized as foothill-streams. Similarly, terrestrial habitat and arboreal habitat areas are like Chirang Reserve Forest and Panbari Reserve Forest that constitute the territory of several species along with endangered species. The Bishnupur, Kalamati, Kuklung, Runikhata, Amteka are the attractive land masses covering the forest areas embracing many threatened species. The enormous diversity of flora and fauna has indicated the suitable habitat environment in this region. The geographic situation and landmass encourage the greatest bioresource and the river-forest contributed richest biodiversity. The landscape areas like Kalamati, Panbari, Kuklung, Runikhata, Amteka under Chirang Forest Division embrace both flora and fauna of which many of them are threatened species. The river Kanamakra flows down through Kalamati Reserved Forest incorporate a special habitat zone of fish diversity. The typical word "Kalamati" is derived from the "black soil" colour of this area, for which the elephant and other soil feeding animals are used to visit frequently.

The physical characterization such as description of stream origin and type, vegetation, substrate, and water quality provide a unique aquatic ecosystem to support fauna and flora. The river tributaries viz., Aie, Manas, Champamoti of river Brahmaputra drainage and sub-tributaries or hill streams, viz., Dulani, Makra, Kanamakra, Langkhar, Teklai, Sukanteklai, Mara manas, Agrang, Buriaie, Nangalbhanga, Hakowa, Hingula, Burisuta, Lopani, Dholpani, Borsuti, Deosri, Bardangi, Kuklung, Rejajali, Jiasura, Sukanjan, Garawa, Hatisar and Bhur contribute enormous diversity of fish fauna in the Chirang District. They are the fast-moving torrential streams with grayish to

blackish bedrock. The substrates components are sand, gravel, pebble, cobble, boulder, and silt & clay. The composition of these substrates varies from upland to down. The upland substrates level of these streams mostly dominated by cobble and boulder, whereas towards down pebble and gravel along with sandy bottom in the majority of hill streams. The average water temperature falls between 10°C - 20°C and pH ranges 6.5 - 7.0 for Aie, Manas, Champamoti and some other streams. The speed of water flow is faster in upland region and moderate towards down. The streamlets are mostly slow moving and narrow. The characters of different substrate influence the fishes during breeding and spawning in particular habitat. The algae, moss, phytoplankton & zooplankton and some macro invertebrates are the common biological parameters of streams found abundantly in this region. The marshy vegetation and beel-fisheries also contribute different variety of fishes to the district. The components of these water bodies are alluvial soil type, sandy bottom with clay and with aquatic plants which enhance abundance micro & macro inhabitants.

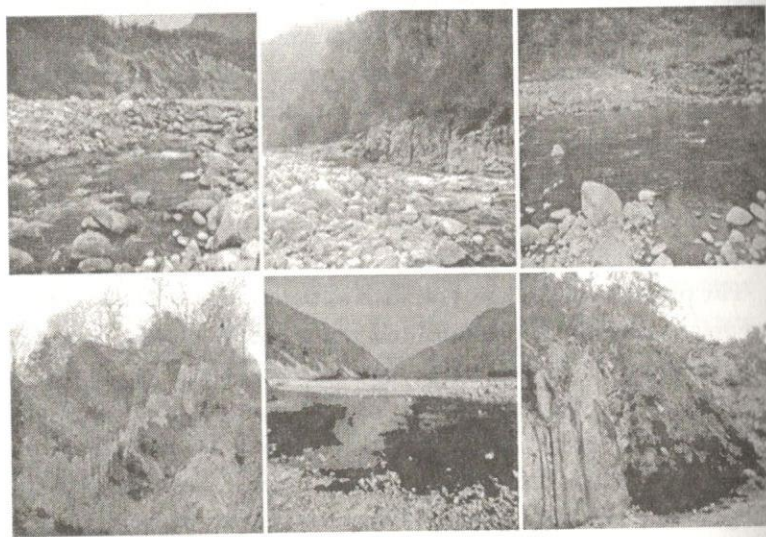


Fig.1. A view of Kalamati, the unique habitat of Biodiversity in Chirang District

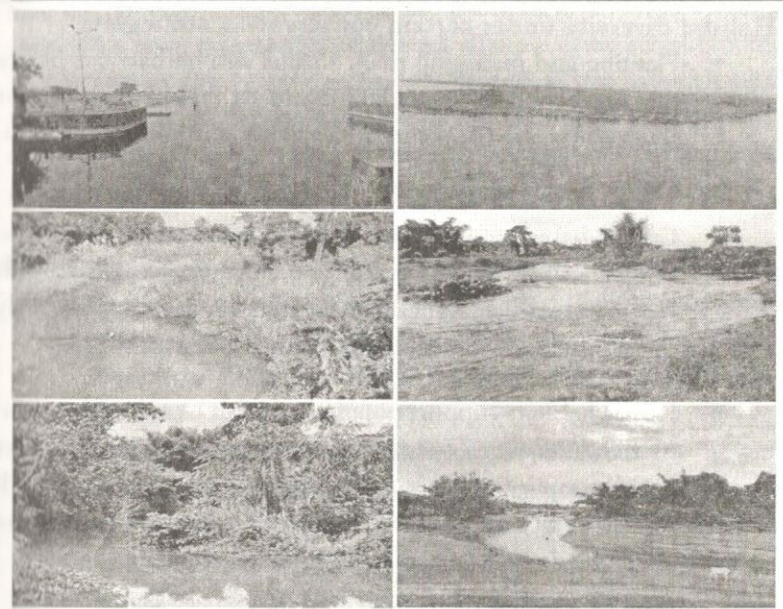


Fig.2. A view of Champamati, Langkhar and other streams aquatic habitat of in Chirang District

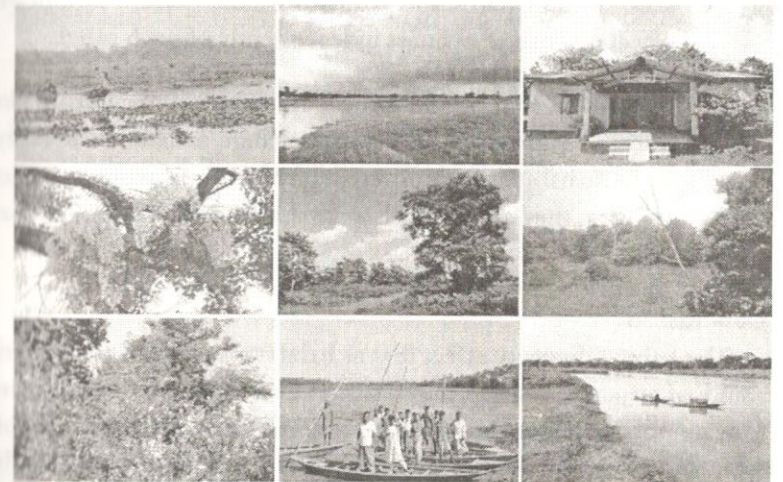


Fig.3. A view of Bishnupur Reserve Forest, Kalpanibeel and Kawatikawith diverse habitats

Habitat diversity under certain conservation strategies:

- ◆ Planting and managing trees, shrubs and herbaceous plants that are beneficial to wildlife is usually the most important thing you can do to improve habitat around your home landscape.
- ◆ Critical habitat is key to the survival of endangered species. In fact, a study by the Centre found, plants and animals with federally protected critical habitat are more than twice as likely to be moving toward recovery than species without it.
- ◆ Larger habitats support populations with higher carrying capacities. Higher quality habitats support populations with higher carrying capacities. There is no difference in population growth rate between large and small habitats. Population growth rates are higher in high-quality habitats than low-quality habitats.
- ◆ It is found that when keeping area constant, species richness is correlated with habitat diversity. Meanwhile, when keeping habitat diversity constant, species richness is correlated with area. So, both area and habitat diversity have a significant effect on species richness independently of each other.
- ◆ Ecosystem homogenization is caused by some factors like human disturbance results in a change in habitat diversity. Because habitats have different physical and chemical characteristics, they are likely associated with different sets of species.

Conclusion

The habitat diversity effect that as habitat area increases, the variability of structures within the habitat is likely to increase and therefore support a greater variety of species. The basic elements of habitat include food, water, and shelter. Habitat is the natural area inhabited by an animal, plant, or other type of organism. Habitat is also a function of the physical environment related to factors such as tem-

perature, elevation, soil condition, and hydrology. Air, water, climatic conditions, temperature, plants, animals all in the living area affect the habitat. Species that migrate and inhabit more than one natural habitat are also vulnerable. Preservation of these habitats helps to prevent the entire ecosystem being harmed. Presently, more species are facing extinction, hence to protect wildlife is becoming more important.

Reference

- O. Ovaskainen and I. Hanski (2002). Extinction Debt at Extinction Threshold, Conservation Biology, Published by Wiley, Vol.16, No.3 (Jun.,2002), pp.666-73 <https://www.jstor.org/stable/3061213>
- Weidong Gu, Raimo Heikkilä and Ilkka Hanski (2002). Estimating the consequences of habitat fragmentation on extinction risk in dynamic landscapes, Landscape ecology, Vol.17, pp. 699-710 <https://link.springer.org>
- Tilman, David., Robert M. May, Clarence L. Lehman, Martin A. Nowak (1994). Habitat Destruction and the extinction Debt, Ecology, Evolution and Behavior, Nature 371, pp. 65-66. <https://www.researchgate.net/publication/232770892>
- Southwood, T.R.E. (1977). Habitat, the Templet for Ecological Strategies? Journal of Animal Ecology Published By: British Ecological Society, Vol. 46, No. 2 (Jun., 1977), pp. 336-365 (30 pages)
- Raven, J., Raven, J. C., & Court, J. H. (1998). Raven Manual: Section 4, Advanced Progressive Matrices, 1998 Edition. Oxford, UK: Oxford Psychologists Press Ltd.

Importance of Sedges (Cyperaceae) in wetland ecosystem restoration

Beauty Queen Goyari

Department of Botany, Bijni College
Bijni, Chirang, Assam

Martha Brahma

Department of Chemistry, Bijni College
Bijni, Chirang, Assam
Email: arecagoyari24@gmail.com

Abstract

Wetlands in India account for 4.7% of the total geographical area of the country. These wetlands provide numerous ecosystem goods and services, but are under stress due to urbanization, agriculture, deforestation, climate change, land use change and pollution. The family Cyperaceae (Sedges) is one of the largest monocotyledonous families with 90 genera and 5539 species in the world and are cosmopolitan in distribution especially in the temperate regions (Mabberley, 2017). They are major or even dominant components of wetland habitats. Wetland Sedge species attract wildlife by providing food and shelter, and the decline of sedge species within these types of habitats is a useful indicator of potential habitat damage. In terms of ecosystem services they can play a particular role in the maintenance and improvement of water quality. Constructed wetlands, artificial marshes or swamps created for anthropogenic discharge such as wastewater, runoff or sewage treatment in various parts of the world have in-

cluded Cyperaceae species such as *Baumea articulata* (R. Br.) S.T. Blake, *Bolboschoenus fluviatilis* (Torr.) Sojak, *Cyperus involucratus* Rottb. amongst others. For example, water treatment using cyperaceae have demonstrated up to 92% removal of nitrogen (Tanner, 1996) and significant sequestration of metals such as copper (Murray-Gulde et al., 2005). As India is losing wetlands at the rate of 2-3% each year a little contribution from the nature's side in the form of Sedges would be of great help to the conservation and restoration of wetlands.

Introduction

Wetlands provide several ecosystem services such as reducing erosion, recharging aquifers and providing habitat for several wildlife species. Due to various anthropogenic activities, wetlands in India and the world are being deteriorated, leading to change and damage of ecological environments of animals and plants living in wetlands as those species lose their living space, become endangered and die out.

India has diverse and unique wetland habitats supported by a wide variety of climate, seasons and geography (Prasad et al., 2002). These wetlands are distributed in different geographical regions ranging from Himalayas to Deccan Plateau. In India wetlands, attributes to about 4.7% of the total geographical area (Bassi et al. 2014). These wetlands provide numerous ecosystem goods and services, but are under stress due to urbanization, agriculture, deforestation, climate change, land use change and pollution. According to a non-government organisation Wetlands International South Asia (WISA), major cities that faced wetland loss include Mumbai (71%), Ahmedabad (57%), Bengaluru (56%), Hyderabad (55%), Delhi (38%) and Pune (37%).

The family Cyperaceae (Sedges) is one of the largest monocotyledonous families with 90 genera and 5539 species in the world and are cosmopolitan in distribution especially in the temperate regions (Mabberley, 2017). In India, it is represented by 39 genera and about 570 species (Singh & Prasad, 2001), of which 148 taxa are endemics (Singh & al., 2015). They occur through a wide range of altitudes from sea level up to 5000m in the Himalayas, and are present in a broad range of habitats, from high arctic tundra through to tropical forest,

and to seasonally wet grasslands. They can be major or even dominant components of many plant communities.

Sedges are usually annual or perennial herbs. Species such as *Bolboschoenus maritimus* L. and *Cyperus rotundus* L. usually bear small, woody rhizomes, but sometimes long creeping or emitting stolons with or without tubers. The rhizomes and stolons are clothed with scales which usually disintegrate leaving fibrous remains. The stems, especially near the base, are often triangular in cross-section and are solid (not hollow). The leaves are alternate, commonly in 3 ranks, usually with a closed sheathing base and a parallel-veined, strap-shaped blade. Leaves are sessile, shorter to much longer than the stem, flat, or involute. Leaf sheaths vary from few millimeters to several centimeters, membranous or herbaceous, usually closed; loosely or tightly enclosing the stem. Inflorescence in this family is constituted by the arrangement of spikelets because the flowers in sedges are very minute and inconspicuous. Spikelets of the sedges vary in the size, shape and color and are found either solitary or in the inflorescence. Each spikelet consists of a rachilla bearing glumes and flowers. Inflorescence is normally anthelate or capitates. Number of the bracts varies from one to several. Fruits in Cyperaceae are one seeded, indehiscent and usually known as nuts or achenes. Surface of the nut varies according to the species.

Sedges form an important ecological component of many ecosystems around the world. cyperaceae also have conservation and environmental importance. Most of the wetland habitats are dominated by different species of sedges. The sedges species of wetland attract wildlife by providing food and shelter and hence the decline of sedge species within these types of habitats is a useful indicator of potential habitat damage. They also play a particular role in terms of ecosystem services as they maintain and improve the water quality. Constructed wetlands, artificial marshes or swamps created for anthropogenic discharge such as wastewater, runoff or sewage treatment in various parts of the world have included Cyperaceae species such as *Baumea articulata* (R. Br.) S.T. Blake, *Bolboschoenus fluviatilis* (Torr.) Sojak, *Cyperus involucratus* Rottb. amongst others. According to Tanner

(1996) water treatment using cyperaceae have demonstrated up to 92% removal of nitrogen. Also, Murray-Gulde et al. (2005) reported that sedges show a significant sequestration of metals such as copper.

Materials and methods

This paper primarily reviews knowledge available in reviewed scientific literature, books and academic thesis. An Introduction to the ecological attributes of Cyperaceae is given where those attributes may be applicable to understand the conservational and environmental importance. The following standard taxonomic literature (including online sources) and online database were referred in the present study to follow the consistency in the presentation of data. They are: Abbreviations of authors' names are after Brummitt & Powell (1992).

For the Nomenclature of taxa, the recent Melbourne code, ICN (McNeill & al., 2012)

is followed consistently (<http://www.iapt-taxon.org/nomen/main.php>). IPNI – International Plant Names Index (<http://www.ipni.org>) provides an index to names of vascular plants and their place of publication. Index Nominum Genericorum – For names of genera in all groups treated by the ICN (<http://botany.si.edu/ing/>). The Plant List – provides the working list of all known plant species (<http://www.theplantlist.org>).

Structure of Sedges that aid in ecological restoration

The members of sedges that belongs to annuals are with fibrous roots. For e.g. *Bulbostylis barbata*, *Cyperus castaneus*, *C. compressus*, *C. difformis*, *C. iria*, *C. neochinensis*, *C. pumilus*, *C. squarrosus*, and *C. tenuispica*. While the perennial members have distinct rhizomes and they are usually small, woody, rarely long-creeping or emitting stolons which often bear tubers. The rhizomes and stolons are often clothed with scales which are usually cauducous and leave the fibrous remains.

Stems of cyperaceae members are often trigonous [*C. castaneus*, *C. compressus*, *C. paniceus*, *C. polystachyos*, *C. pumilus*, *C. richardii*, *Fimbristylis dichotoma* and *Scleria litbosperma*], triquetrous [*C. difformis*, *C. dubius*, *C. haspan*, *C. iria*, *C. mindorensis*, *C. rotundus*, *C. squarrosus*, and *C.*

tenuispica] and rarely subterete [*Fimbristyliscymosa*], planoconvex [*C. neochinensis*] and multi-angular [*Bulbostylis barbata*].

Leaves size ranges from 1.5–90 × 0.1–0.5 cm and are shorter or longer than the stem. They are always linear and rarely filiform [*Bulbostylis barbata* and *Fimbristylis ovata*].

The whole part of sedges plant can perform phytoremediation which is cost effective, green, non-invasive substitute technology for engineering-based remediation. The roots of *Lepidospermasp*, *Carexsp* etc. show cluster roots or dauciform roots that are suggested to function to acquire phosphorus from nutrient poor soil.

Wetland Ecosystem Restoration:

India has many important wetlands in different states which are beneficial to plants, animals and humans. Also wetlands are described as the kidney of the earth because of their high and long term capacity to filter pollutants from the water that flows through them. This property of wetlands comes from the soil, sand and plants that occupy it. Ramsar Convention was introduced around the globe for conservation of wetlands. In India, there are 46 Ramsar sites. The aim of Ramsar list is to develop and maintain an international network of wetlands which are important for the conservation of global biological diversity.

Sedges are partially aquatic and produces less biomass in comparison to other aquatic plants (Steed et al. 2002). Species like *Cyperus* grows in wetlands as weeds and they can tolerate environmental stress factors like hot and cold climatic conditions. The different parts of *Cyperus alternifolius* L., was found to remove heavy metals such as Cu, Ni etc when examined. (Soda et al. 2012; Yadav et al. 2012; Zhu et al. 2013). Some Cyperaceae are also used to decontaminate soil affected by mine waste (Hussein & Manal, 2012). Sedges are also important in maintaining mycorrhizal association and serve as agents for phytoremediation of Pb-contaminated soils (Muthukumaret al. 2004). Different species of sedges have also been tested in contaminated waters and found that the plant biomass can be used to remove heavy

metals. The roots of sedges also have sand binding ability and aid in water uptake and retention.

Conclusion

Study of uptake, accumulation and detoxification of metals in wetlands is quite important because the increasing population demands are deteriorating the kidney of our earth. The work on sedges is scarce around the globe but there are enough works to suggest that sedges are important family that can help in environmental cleaning. Sedges shows good biosorption of heavy metals along with bioaccumulation. There is an urgent need to explore the phytoremediation property of sedges as these are the most important taxa growing in and around wetlands. They are also the food source of many faunas growing in wetlands so it becomes extremely important to understand the impact of heavy metals on these plants.

References:

- Barret, Russell L. Ecological importance of sedges: a survey of the Australasian Cyperaceae genus *Lepidosperma*
- Bassi, N; Kumar, MD; Sharma, A; Saradhi, PP. 2014. Status of wetlands in India: A review of extent, ecosystem benefits, threats and management strategies.
- Ghosh, Ashok; Maiti, Gaurgopal. 2014. Taxonomy and present distribution of different species of *Carex* L., Cyperaceae in Darjeeling and Sikkim Himalayas, India.
- Mabberley, D.J. 1997. The plant-book: a portable dictionary of the vascular plants. Cambridge University Press, New York.
- Mishra, Sanjay; Tripathi, Ashutosh; Tripathi, Durgesh Kumar and Chauhan, Devendra kumar. 2015. Role of sedges in Wetlands, environmental cleaning and as food material.
- Prasad, SN; Ramachandra, TV; Ahalya, N; Sengupta, T; Kumar, A; Tiwari, AK; Vijayan, VS; Vijayan L. 2002. Conservation of wetlands of India – a review
- Simpson, DA; Yesson, C; Culham, A; Couch, C A and Muasya, A M; 2011. Climate change and Cyperaceae

Steed, J E; DeWald, L E & Kolb, T E; (2002). Physiological and Growth Responses of Riparian Sedge Transplants to Groundwater Depth. International Journal of Plant Sciences.

A study on the role played by Earthworms in Waste Management: Vermicomposting

Lipika Dey Dutta

Assistant Professor, Department of Zoology

Bijni College

Email: deyduttal@gmail.com

Abstract

Vermicomposting is a method of producing compost using earthworms and technology, and it is the scientific process of utilising them for the benefit of humans. Organic waste is converted into fertiliser by the earthworm. Earthworms consume cow dung, non-toxic solid and liquid waste from industries, municipal waste and household garbage, forest waste, wastepaper, and biogas slurry, all of which are converted into vermicompost. Though there are different species of earthworms, but most suitable for vermicomposting are epigeic group that live on soil surface and thrive on organic waste. For vermicomposting preference is given to the earthworm which have high composting qualities, better reproductive ability and are easy to procure and maintain in culture. In this purpose the most commonly used earthworm's species are *Eisenia foetida*, *Eudrilus eugeniae*, *Peronix excavator* and *Lumbricus rubellus*. The worms feed actively on the organic matter and assimilate only 5-10% and rest is excreted as loose granular moulds of vermicasting on the surface away from the feed source. Vermicompost production can be enhanced effectively by supplementing the organic waste like cow urine. Thus, the earthworms not only play a role in waste management but also help the cultivators by producing organic fertilizer. Vermicompost is an eco-friendly natural fertilizer prepared from biodegradable organic wastes and is free from chemical inputs. It does not have any adverse effect on soil, plant and

environment. It also improves water retention capacity of soil because of its high organic matter content.

Key words: Earth worm, Vermicompost, organic waste, fertilizer, vermicast

Introduction

Vermicomposting is generally defined as the solid phase decomposition of organic residues in the aerobic environment by exploiting the optimum biological activity of earthworms and microorganisms (Garg, Gupta, 2009). Earthworms are important drivers of the biochemical decomposition of organic matter because they fragment and condition the substrate and significantly change its biological activity, even if microbes are ultimately accountable for the process. By blending the organic matter, earthworms act as mechanical blenders, changing its physical and chemical status, gradually lowering its carbon-nitrogen ratio, increasing the surface area exposed to microorganisms, and creating an environment that is much more conducive to microbial activity and further decomposition. They move pieces and bacteria-rich excretions a lot while passing through the earthworm's gut, which homogenises the organic materials. The majority of the nutrients are found in the vermicompost, which is a finely divided peat-like substance with great porosity and water holding ability. These earthworm castings have high rates of mineralization and are rich in organic matter, which suggests that the availability of nutrients to plants particularly ammonia and nitrate is considerably increased (Dominguez, Edwards, 2004).

Earthworm activity results in the production of vermicompost, which is high in macro and micronutrients, vitamins, growth hormones, enzymes including lipase, cellulase, and chitinase, as well as immobilised microflora. Even after being expelled from the worms, the enzymes continue to break down organic substances (Barik et al., 2011).

Objective of the paper is to know the process of vermicomposting and also know the species of earthworms suitable for composting.

The paper is based on secondary data collected from different books and websites.

Types of Earthworms Used in Vermicomposting

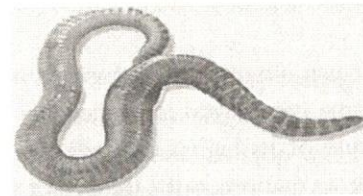
Earthworms constitute a diverse group of burrowing annelids having more than 6000 living species. Different species has different life strategies and occupy different ecological niches. Thus, earthworms are categorised based on both their niche and their eating behaviour. They belong to the endogeic, epigeic, anecic, and compost ecological categories.

Endogeic: Burrowing is a characteristic of these earthworms. They typically dig a horizontal tunnel and ingest the soil particles present at the earth's deep surface.

Epigeic: These earthworms are epigeic, meaning they live on the soil surface. They eat dirt that is fitter. They are not meant for digging. Typically, they are red-brown in colour. They are smaller than other kinds of earthworms and do not have stripes.

Anecic: They dig a vertical burrow and devour the organic matter in the soil. They can be found in deep dirt burrows as well as the top layer of the soil. Castings of these earthworms can be found in meadows.

Compost: These earthworms are found in compost pit. These particular earthworms live in warm environments with moisture and are found in readily accessible composite materials.



Lumbricus rubellus *Eisenia foetida*

The best types of worms for vermicomposting are red wigglers (*Eisenia foetida*) which are epigeic and red worms (*Lumbricus rubellus*). These two species are used for the compost bin because they prefer a compost environment to plain soil, and they are very easy to keep. Worms that feed on vegetable waste, compost, and organic bedding produce richer casting than those that feed on plain soil.

Vermicomposting process:

It is a non-thermophilic, aerobic, bio-oxidation process of organic waste decomposition that relies on earthworms to comminutate, mix, and promote microbial activity.

The process includes -

A. Bedding: Bedding is any material that provides a relatively stable habitat to worms. For good vermicomposting, this habitat should satisfy the following criteria-

- o **High absorbency:** As worms breathe through skin, the bedding must be able to absorb and retain adequate water.
- o **Good bulking potential:** The bulking potential of the material should be such that worms get oxygen properly.
- o **Low nitrogen content (high Carbon- Nitrogen ratio):** Although worms consume their bedding as it breaks down but this should have very slow process. High protein and nitrogen levels can result in rapid degradation and associated heating may be fatal to worms.

B. Food source: The most crucial phase in the vermicomposting process is to consistently provide the earthworms with food sources. Although they can consume a wide range of organic materials, earthworms do have preferred foods.

Even in harsh conditions, earthworms can obtain enough food from the soil to survive. Worms can consume more food than their own body weight in ideal conditions. Because of its higher nitrogen content, livestock excrement, specifically goat manure, cattle dung, or pig manure, is the most popular worm feedstock. Nitrogen supplements should be provided to allow for efficient decomposition when using a material with a higher carbon content and the carbon-nitrogen ratio exceeds 40:1.

C. Moisture: Earthworms need adequate moisture. They require moisture in the range between 60-70%. The feed stock should not be

too wet otherwise it may create anaerobic conditions which may be fatal to earthworms.

D. Aeration: Factors such as high levels of fatty substances in the feedstock or excessive moisture combined with poor aeration may render anaerobic conditions in vermicomposting system. Worms suffer severe mortality partly because they are deprived of oxygen and partly because of toxic substances (e.g., ammonia) produced under such conditions.

E. Temperature: Temperature has a significant impact on earthworm's activity, metabolism, growth, respiration, and reproduction. Most earthworm species used in vermicomposting require temperatures ranging from 10 to 35 degrees Celsius. While tolerances and preferences differ between species. Cold and moist conditions are far more tolerable to earthworms than hot and dry conditions.

F. pH: Worms can survive in pH ranges from 5 to 9, but 7.5 to 8.0 is considered optimal.

Other factors influencing earthworm's growth and survival include pre-composting of organic matter, salt content, presence of toxic components and the presence of pests and diseases.

Process of vermicomposting

Vermicomposting can be carried out in wells, pits, concrete tanks, or wooden crates. To stop water from entering during rain, a 2x1x1 m³ hole is dug beneath cover. To aid in drainage, broken bricks or pebbles are placed on the bottom of the pit before being covered with coarse sand. A layer of loamy soil that has been wet and injected with earthworms covers it. Small clumps of fresh or dried animal dung, followed by a layer of hay, dried leaves, or agrowastes, cover the surface. Water is sprinkled over it every day for around 20 to 25 days to keep the entire setup moist. Each week, dry, green leaves are added to the pit until it is full. Vermicompost can be used after 40 to 45 days.

Nutritional status of vermicompost:

Following table shows the nutritional status of vermicompost

Nutrient element	Vermicompost (%)
Organic Carbon	9.8-13.4
Total nitrogen	0.51-1.61
Phosphorus	0.19-0.126
Potassium	0.15-0.256
Sodium	0.058-0.158
Calcium	1.18-7.61
magnesium	.093-0.568
Iron	0.2050-1.3313
Zinc	0.0042-0.110
Manganese	0.0105-0.2038

Roles of vermicompost in agriculture

Vermicompost has several advantageous uses (Adhikary, 2012) -

- (1) Red worm castings have a high humus content. Clustering of soil particles is aided by humus, which increases the soil's ability to hold water and makes pathways for air to travel through.
- (2) Humus is thought to help protect against dangerous bacteria, nematodes, fungus, and plant infections.
- (3) A biologically active mound called vermicast is made up of thousands of microorganisms, enzymes, and leftover plant elements that the worms could not digest.
- (4) Castings have nutrients in them that are easily absorbed by plants.
- (5) The worm intestine acts as a little composting tube, mixing the environment and inoculating the waste.
- (6) Worm castings work well for greenhouses, indoor plants, farming, and gardening.
- (7) According to some research, the high quantities of nutrients, humic acids, and humates in vermicompost may be the cause of the

plants' growth responses, which resemble "hormone induced activity."

- (8) Antibiotics and actinomycetes found in vermicompost aid in boosting the "strength of biological resistance" of crop plants against pests and illnesses.
- (9) There appears to be convincing evidence that worm castings occasionally deter bugs with hard bodies.
11. Vermicompost also contains plant growth regulators and other compounds produced by microorganisms that influence plant growth.
12. Earthworm-processed organic wastes contains cytokinins and auxins.
13. Earthworms emit certain metabolites into the soil, including vitamin B, vitamin D, and related compounds.
14. The casts also have higher P, K, Ca, and Mg availability in addition to increased amount of N and C.

Conclusion

Vermicompost is high in macro and micronutrients, vitamins, growth hormones, enzymes including lipase, cellulase, and chitinase, as well as immobilised microflora. Vermicompost is the best organic manure for improving plant development by protecting them from harmful pests without harming the environment. and output in general. Vermicompost application promote plant growth, increase nutrient content, and enhance fruit and seed quality. Vermitechnology, solid waste manage is a potentially useful method that has shown promise in a variety of difficult fields, including food production expansion, wasterecyclingsolid waste management andso on. Vermicomposting has the potential to increase land fertility and productivity. It also provides nutritious and secure food in India and other countries where pollution is increasing due to the accumulation of organic waste and lack of organic manure. As a result, the potential of vermicomposting is enormous.

References

- Dube, R.C., A text book of biotechnology. Chand and Publication, New Delhi, ISBN-978-81-219-2608-9, PP(548-549).
- Pramanik, P., Ghosh, G.K., Ghosal, P.K., and Banik, P. 2007. **Changes in organic – C, N, P and K and enzyme activities in vermicompost of biodegradable organic wastes under liming and microbial inoculants.** *Bioresource technology* **98(13):2485-94.330**
<https://www.intechopen.com/chapters/60445>
https://www.researchgate.net/publication/335378138_Vermicomposting_and_its_uses_in_Sustainable_Agriculture
<https://en.m.wikipedia.org/wiki>
<https://www.nswai.org/docs/Vermicomposting.pdf>

Management of Flood in Assam through Community Participation

Jayshri Narzary

Assistant Professor, department of Physics
 Bijnai College
 Email: ijayshri@gmail.com

Abstract

Increasing population and various other socio-politico-economic considerations in Assam have forced people to live in uninhabitable areas like flood prone areas of major river systems in Brahmaputra Valley and Barak Valley recognising flood as major disaster due to its frequency and devastating nature. Assam is experiencing multi disasters where flood and cyclone are recurring disasters. The Government of Assam has adopted various plans, organised many preparedness, Prevention and Mitigation, Emergency Response and Rehabilitation activities to manage the disaster. To face or to manage the disasters caused by the flood, it is not possible for the government alone to manage disasters until the community people do not come forward along with the government as the first responders of this disaster are the community. As most of the rivers of Assam causes floods in most of the year, to tackle disasters caused by the flood, along with the government, every community people must take part in the various programmes organised by the Assam state Disaster Management Authority under the government of Assam; in the designing and implementation of programs for reducing disaster risks and vulnerability and building community capacity. This paper high-

lights the participation of community people in the management of flood.

Keywords: Disaster management, flood hazard, community participation

Aims and Objectives

The main objective of this paper is to discuss the disasters and management special reference to flood of Assam, role of community people in disaster management through their active participation. For this, secondary data are collected from the secondary sources such as newspapers, government documents and research journals.

Introduction

Assam is in the eastern-most projection of the Indian Plate tectonics. In most of the year Assam faces the disaster caused by floods as all the rivers in Assam are liable to floods mainly because of heavy rainfall within a short time and collect a tremendous amount of silt and other debris and raise the level of the river beds. Therefore, it becomes impossible for the main channel to cope with the vast volume of water received during the rains. Considering the geographical location, access issues, population exposure, scale and diversity of resources there is an urgent need for implementing and expanding State wide comprehensive disaster management strategies encompassing Preparedness, Prevention and Mitigation, Emergency Response and Rehabilitation. Hence disaster event should be faced with proper plan and programs through which active participation of affected people has to be ensured in an attempt to reduce the damages of property and to shorten the pains and sufferings of people as well as enhance the sustainable development process. In so doing, the government of Assam adopted Disaster Management Act, 2005 and prepared the Assam State Disaster Management Plan (ASDMP) in 2010, emphasizing on capacity building as well as on promoting livelihood of the disaster-prone community in accordance with philosophy of alternative perspective of disaster management [1]. Its activi-

ties also include improvement of the safeguard of core community facilities such as schools, diffusion of best practices in disaster risk management at the community level and formulation of integrated programmes for sustainable development through disaster risk management programmer's initiatives. This paper discusses programs and practices adopted for management of flood in Assam that engage communities to cope with disaster risk.

Methodology

This paper is based on the secondary sources collected from the research journals, Assam State Disaster Management Authority (ASDMA) and department of water resources of Assam.

Community Based Disaster Management (CBDM)

The increasing disasters and their severe impact on individuals, communities, society, economy and environment in the last few years, the subject of disaster management has received greater attention for the Community based disaster preparedness (CBDP/CBDM) in India at all levels (UNDP Report, 2003). Community Based Disaster Preparedness or Management (CBDP/CBDM) is part of Disaster Management Plan through which people are bring together within the same community to enable them to collectively address a common disaster risk and to collectively pursue common disaster preparedness. Through CBDP process a group of people can be mobilize in a systematic way in achieving a risk less and durable society; a dynamic community that equalizes power relations, binds the group cohesively in the process of making decisions, deals with conflicts, resolves issues, and manages individual and collective tasks through addressing and bouncing back from hazards (Sufri et al., 2020).

Community participation in flood management

Community participation has been considered as important part to reduce the problems occurrence during and after the disasters, particularly small and medium scale disasters. The active participation of people through various experiences and practices brings positive

impact in approaching the disaster preparedness, disaster mitigation and disaster risk reduction. In the absence of specialized skill, by using their traditional coping and survival skill and strategies, disasters like flood are responded long before help reaches them. Disasters can become uncontrollable, once the event has got underway. Therefore, preventive steps need to be taken before, during and after the disaster events. If the community is not well prepared, control over the disaster event would be usually lost during its occurrence. If each individual in the community is familiar with ways of coping and precautionary measures, then the disruption by a disaster can be reduced. All communities and villages have some vitally important assets to deal with disasters. These may include knowledge of disaster warning signs, locally safe and vulnerable areas, experience of past disasters, methods of survival and social relations that are often vitally important in coping with crisis. Local communities have an active part to play before, during and after disasters due to the reasons mentioned below:

1. Before arriving helps, local response teams can save many lives during first few hours after or during the flood hazards.
2. Numerous survival and health problems caused by the disaster can be dealt with more efficiently by the active and well organised community (WHO 1989).

Community participation can be discussed in three sections: before, during and after a disaster. Pre-disaster participation of community can reduce disaster impact by adopting many approaches, such as using traditional experience and knowledge, preparing for any possible hazard by having emergency kits ready for the event, having family or community disaster management plans as well as improving adaptive behaviour, strengthening houses, providing emergency protection of doors and windows from high winds, organizing capacity building training courses on first aid, evacuation plans, permanent relocation of the community away from unsafe sites (Bezboruah et al., 2021). Community can also cope during a disaster by drawing on the support of their community, taking stock to determine what

they have and what or who is missing, restoring communications to facilitate aid distribution, mitigating future risks (both psychological as well as material threats) and regarding the entire experience as a learning process. After disaster, concerns need to be addressed during the recovery process to build more resilience communities are planning of community recovery plan that links social, physical, economic and environmental recovery, regard of physical recovery work as bereavement therapy and a possible income source and the entire reconstruction experience as a learning process, drawing on support of the community by being adaptable, flexible and patient (Deen, 2020).

1. Where possible ensure that local labour and locally purchased reconstruction goods are used to revitalize the damaged local economy.
2. Recognize the value of a prepared community who know what to do to recover.
3. Take actions to reduce future vulnerability as the recovery proceeds

Conclusion

For sustainability, strong participation, empowerment and involvement of community during decision making on policies and strategies of disaster management also play a vital role. During the disaster, community participation is must because local people are capable of initiate and sustain their own community development, various community members and groups in the community may have different perceptions of risk and varying vulnerabilities.

References

1. <http://sdmassam.nic.in/dma.html>
2. Sufri, S., Dwirahmadi, F., Phung, D., & Rutherford, S. (2020). Progress in Disaster Science Review article A systematic review of Community Engagement (CE) in Disaster Early Warning Systems (EWSs). *Progress in Disaster Science*, 5, 100058. <https://doi.org/10.1016/j.pdisas.2019.100058>

3. Bezboruah, K. C., Sattler, M., & Bhatt, A. (2021). *Flooded Cities/: A Comparative Analysis of Flood Management Policies in Indian states*. 8, 1–20.
4. Deen, S. (2020). *Flood Disaster Management in Assam*. December.

Environment and Human Relationship

Bibha Talukdar

Assistant Professor, Department of Philosophy
Bijni College, Bijni
Email: bibhatalukdar@gmail.com

Abstract

There is a close relationship between environment and human beings. Every life depends upon nature for their food, breath, shelter etc. Sound environment is very much essential for happy and healthy life. Human beings have a great responsibility to preserve some gift of nature which is possible for them. Sustainable development is an important issue related with environment and human beings. People can try to maintain good environment through plantation of different kinds of valuable trees, flowers, fruit trees etc. which has a great role in the economy. Some fruits and trees act as source of food and medicine. People can produce such types of products according to their demand. It must be benefited to the human society. A good environment can be created by the people with positive thinking. Some actions of the people adversely effect on environment. Deforestation is a cause of soil erosion, climate warming which is bad for environment and health of living beings. So, people must try to maintain good environment with good action. They must try to stop use pesticide on land, stop use of more plastic things etc. The industrial useless liquid should not throw to pond, river etc. Water is most essential for living beings. People must save pure drinking water without wastage. Water pollution should control for healthy environment. In this point people must be aware about their surrounding areas. The

cause of air pollution is industrial smoke and bad smell which is not good for health. Human beings must try to control water pollution, air pollution through increase awareness among the people of the society. Indeed, human beings must try to bring sustainable development on environment.

Key words: Environment, Human Being, People, Water, Pollution.

Introduction

The word 'environment' simply means 'the total situations that surround men, animals, plants etc. in a particular place or time.' When we study nature, we see that our surrounding is full of river, forest, mountain, desert and also combination of all. Man transformed natural landscapes into villages, towns or cities. We depend on every moment on nature. Not only man depends on nature, but also all animals, plants and other creatures depend on nature. We cannot live without natural and natural resources. Human have been interacting with the environment since people born in the earth. So, many environmentalists refer environment as 'Mother Nature' and most traditional societies have learned that respecting nature is vital for their livelihood. (Aggarwal, Vijay, "Environmental Studies" P-3) The essential needs for survival of human beings are found from environment. Since civilization starting from domestication of animals and plants the relationship exists between man and environment. Man enjoys a dominant position over living and non-living world around him since prehistoric time. (Purohil, S.S.Shammi, Q.J, Agarwal, A.K., "Environmental Science" P-5)

Man may try to establish power in nature through technological innovations, economic growth and development. Many people thinks that they are all powerful and the master of nature. So, they want to treat nature as their own will. But they do not think the dangerous effects on nature. The skill and technology develop by man apply on the nature and used the benefit for their own sake. But people do not think that the environmental degradation will affect in life of the people and other organism. The degradation has changed the face of the

earth with the development of society. Since the dawn of civilization man has tried to excel it by conquering nature for his development or for the sake of enjoyment (Tiwary, H.H. "Environmental Law" P-7). But there are some other who believes that we should respect the nature because nature provides us everything.

Environmental ethics is regarded as a part of environmental philosophy which maintains an ethical relationship between human beings as well as environment. It deals with the rights of the individual which are fundamental for life and well-being without any effect on nature. This right is not only regarding the right of present generation but also of future generation. Environmental ethics deals with such things which are related to utilization and distribution of resources with sustainable development.

Objectives

The specific objective of this study includes—

1. The main objective of the study is to find out the relationship between man and environment.
2. Another objective is to enquires into the responsibility of man to protect nature by treating animals, plants and environment as living things which are essential for man's life.

Methodology

This paper is written with the help of some books, journal and internet etc. The study is socio-ethical and analytical and evaluative research methodology is applied in this study. By observing the gradual degradation of environment, an ethical evaluation of the attitude and activities of human being towards nature is applied here.

Relation between man and environment

There is a close relation between man and environment. The relationship between man and environment has been established in the early periods of time. Human beings lives in the natural kingdom and man continuously interact with nature. As human beings interact with the environment it also modifies the environment according to their

needs. Environment gives us many materials needed in our home, at work and for leisure activities. 'Environment is the source of life on earth and it not only directs but also determines the existence, growth and development of mankind and all its activities'. (Saxena, H.M., "Environmental Geography" P-1) It is an inseparable whole with intricate web of integration and change, its constituent elements are interdependent, and destruction of any one will harm the whole system. Man as a living organism surviving with functional relations under the ecosystem at different places but the functions of human being is ever changing in the way of development which leads large scale changes in nature. Man has continually at increasing rate changing the form and modes of his interaction with the environment. Man has been interfering with nature since the dawn of civilization with large scale modification of the natural size through agriculture industries, construction of road, railway and creating problems. Human cut forests to clean land and to grow crops or build building. We change the environment in doing that. So the human activity influences the environment and again the environment influences on human both positively and negatively. Now days the needs of human beings are not only the basic needs, the human society running for fulfilling endless needs emerged in the way of developing of human society. As a result, the qualitative and quantitative characteristics of environment components are continuously undergoing changes. (Joseph, K. Nagendran, R. "Essentials of Environmental Studies" P-102)

Human change their environment both positively and negatively. The affect of environment in human live will depend on man's uses on environment. The main interaction between man and environment can be grouped into the use of resources and the use of wastes of production. Man depends on environment for obtaining food, water, fuel, medicines, materials for building and various other things. But modern uses of science and technology exploit the environment for own benefit and luxurious. As a result, such type of activity creates pollution and damage on environment. The impact of environment problems on humans is significant. It affects all human activities

such as health, socio-economic development etc. So, the relationship between man and environment will depend on the uses of environmental resources.

The relationships between human and environmental resources are dependency from human side for eco-system. The development with sustainability is a philosophy which aims to protect and improve the health of the environment. The relationship between man and environment have reached such a stage that has undergone a profound change that leaves a question of sustainability both in case of nature and its resources and human society and its activity. The activities of man have been changing diversely with the nature of activities from primary production, secondary production and others. These activities have been modifying the present world in natural and cultural landscape. The adverse effect of human activity e.g. different kinds of pollution, deforestation etc. collectively degrading environment and it will create several problems in human society. Present development of human society creates lots of burning problems faced by all living community over the earth and diminishing resources for future generation. We should protect nature by changing the attitude of destroying it. We should have same feeling towards other living being like man. In Indian philosophy the Buddhist and Jainism treat creatures like human being. In Jaina religions worship the nature as the beholder of all living as well as non-living things. In Atharba Veda nature has been uttered as 'Mother Earth'.

Man, environment relationships refer to the interactions and feedbacks between the man and the natural components. So, there is a linkage between social and the geophysical system. This man and environment relation operates a series of concept. Man and environment relationship can be explained from philosophical point of view. In philosophy one of the concepts is Determinism and determinism pointed out that all events are determined fully by previous cause. According to determinism environment causes social development or in other word natural environment influences people. Philosophy of determinism opines that the decisions and actions taken by man are just effects and governed by causal law. So, this concept believed

that all the human actions are the result of prior factors. Determinism should not be confused with the self-determinism of human actions by reasons, motives and desires. This concept is based on the interaction between ancient human society and strong force of nature. Determinism is about interactions which affect our cognitive process in our life. (en.m.wikipedia.org.)

Another concept of philosophy is environmental determinism. Environmental determinism is defined that natural environment is responsible for all human actions. This means that natural environment controls the human action. Environment is the cause of social development or natural environment influences man. It is important because it places human culture in its proper context. Environment provides all necessary items of life. The cultural environmental determinism pointed out that the social aspects of a person's environment determine what kind of person he will become. And technological environment determinism says that technology is most responsible for shaping man's values and behaviours.

Possibilism on the other hand is the theory which pointed out that people can adjust or overcome an environment. Possibilism pointed out that environment has limited the number of choices. According to possibilism nature provide man a number of opportunities and possibilities, so man is free to choose the natural resources. Man has changed their environment by increasing its capacity according to the needs and demands. The philosophy of possibilism attempts to explain the man and environment relation in another way by taking man as an active agent. By using advanced technology and industrial revolution the possibility of environment can be increased. Human being is the most powerful agent and they can modify the surface of the earth. They create possibilities with the resources which gift environment or nature. In this sense Lucian said that "there are no necessities but everywhere possibilities". Supporting possibilism, Favre also observed, "There are no necessities but everywhere possibilities". (<https://old.amu.ac.in>)

The Responsibility of man to protect Nature

Environmental ethics considers the ethical basis of environmental protection. It tries to make radical change of human attitude about nature. It is one of the applied ethics. Because its result is applied to the sphere of the environment, such as human beings, animals, plants and other inanimate objects of nature. It is not only related to rights and duties of man, but it tries to find out the rights of all animals, plants and non-living things. In this respect, environmental ethics study not only the value of human being, but also value of other life and objects of nature. Environmental ethics is rational application of the world and also the relation to the community of living and non-living sphere of this world. It also determines that men are to live with right relations to the nature.

The environmental degradation is air pollution, water pollution, land pollution, soil pollution, imbalance of nature due to deforestation, use of disposable plastic etc. which are making global warming situation. This degradation also creates some unknown diseases in man and other creatures. The human centric view of environmental ethics says that man is the centre of the universe and in-charge of nature. In this world, there is unlimited stock of resources. The standard of human living has improved due to economic growth. Again, a healthy economy leads to a healthy environment. We become more successful if we found more benefit from nature which attitude is supported by industrial society. Such attitude of human being degrades environmental values as well as nature will be exploited by man and environment will be polluted. So, such attitude leads our existence to the dangerous way and avoids such attitude.

The life-centric view holds that our duties to the nature arise directly from moral relations to the nature. All objects of nature such as – animals, plants etc. are considered as inherent worth and intrinsic value. So, man has not only rights of natural resources, but also other living beings. But natural resources are limited. When these resources are used by man, they should think that natural resources are not only meant for consumption. Man's quest for economic development has been mainly responsible for the ruthless exploitation of

natural'. (Thoreau, Walden, Henry David Thoreau, "A founder of the American conservation movement" P- 35)

If development includes all, such development is fruitful. Moreover, healthy economics is possible by healthy environment. Preservation of natural resources is important factor of environmental ethics. Human centric ethics assumes greater important to preservation of wilderness. But life centric ethics would give moral point of view. In this ethics the obligation and responsibility are also given to animals and plants in nature. To protect environmental degradation people, have great responsibility and they must come forward with their moral support. It is very much necessary to realize the ethical value of nature for the protection of environment which can ensure healthy and sustainable life for present and future generation.

Valuing Nature

As a responsible citizen, every man is essential to value nature. Humanity is an important concept and it is related to do something better for the welfare others. Every people ought to enjoy their life without affecting nature. In this point, everyone must try to do better for the nature by protecting plants, animals, birds and other natural resources. Population growth with modern culture of consumerism has caused damage to environment. In a civic society development is mostly essential because it will standard of living. All people know that forests clean up air. All the things which we used are found from nature directly or indirectly. Some natural resources are used directly and some others are used as raw-materials. Some raw materials used for industrial products which are found from forest. The solution of environmental problem is to go back to nature, traditional ideals and values. So, it is the responsibility of every citizen to value nature. People appreciate the values of many natural things from ancient time, such as mountains, rivers, trees and animals. Nature was respected and protected by man in past. Forests were associated with the name of God and goddesses. Some trees like Banyan, Peepal, Tulsi were worshiped by ancient people. Again, some trees are valued for their fruits

and flowers. For example, Mango tree is protected for its fruit, Mohua tree is also protected for its flowers.

Like plant, some animals are also respected as sacred. For example, elephant is associated with Ganesha, Vishnu is associated with the eagle, Ramchandra is linked to Monkeys, Lion is linked to Durga, Cow is associated with Krishna Owl is associated with Lakshmi and Swaraswati is associated with Swan. Thus, from ancient time plants and animals are respected, so that all will live peacefully.

The beauty of nature attracts all living and non-living beings of earth. People appreciate the magnificence of a mountain, the power of the sea, the beauty of a forest and vast expanse of the desert. We take the opportunity to spend time in the silence of the forest. We also enjoy listening the songs of birds and the sound of the wind which comes through the leaves. Again, we observe a tree through a change of seasons as it gets new leaves, flowers; fruits and seeds etc. The beauty of nature inspired artists to develop their arts and poets to create their works. So, it is duty to everyone to protect nature and stock natural resources for future generation, so that they will live happily and found everything from nature.

Conclusion

In conclusion, it is clear that there is a close relation between man and environment. It is necessary to create consciousness among people for healthy environment. Environmental ethics is rooted on the principles of non-violence and egalitarianism. It is the fact that the prominent environmentalists were very much concerned about environmental degradation. To save environment on 5th June every year we celebrate 'World Environmental Day'. On that day millions of people unite for the planet with a strong call for environmental action. This will create awareness about protecting environment. It is also necessary to arrange seminar, group discussion etc. for awareness among people. Every parent ought to teach their children for plantation and responsibilities towards animals and birds. On World Environmental Day, people are encouraged to take concrete steps towards making

the planet greener and clearer. So, protecting environment all will live happily.

References

1. Aggarwal, Vijay. Environmental Studies. Prerna Prakashan (2010) p. 03 Joseph, K. Nagendran, R. Essentials of Environmental Studies. Personal Education, Delhi. (2004) P. 102.
2. Joseph, K. Nagendran, R. Essentials of Environmental Studies. Personal Education, Delhi. (2004) P. 102.
3. Purohil, S.S., Shammi, Q. J. And Agarwal, A. K., Environmental Science. Student edition, Jodhpur-003, (2004) P. 5
4. Sarma, Dr. Hari Prasad. Environmental Education Assam Higher Secondary Education Council, First Publish (2012) P. 18.
5. Saxena, H. M., Environmental Geography. Rawat Publications, Jaipur and New Delhi. (1999) P. 1 Tiwari, H. H., Environmental Law, Allahabad Law Agency, Faridabad, Haryana, (1999) P. 7
6. Tiwari, H. H., Environmental Law, Allahabad Law Agency, Faridabad, Haryana, (1999) P. 7
7. Thoreau, Walden. Henry David Thoreau, a founder of the American conservation movement. (1849) P. 35. en.m.wikipedia.org)
8. en.m.wikipedia.org.
9. <https://old.amu.ac.in>

Key Note Speaker



Dr. Arup Kumar Misra

Chairman,
Pollution Control Board,
Guwahati, Assam, India

Invited Speakers



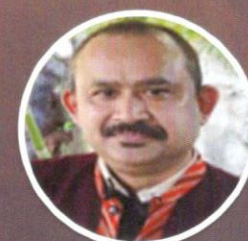
Dr. Dipak Nath

Assistant Professor & Head (i/c),
Centre for Disaster Management,
Tezpur University, Assam, India



Dr. Hilloljyoti Singha

Professor & Head,
Department of Zoology,
Bodoland University, Assam



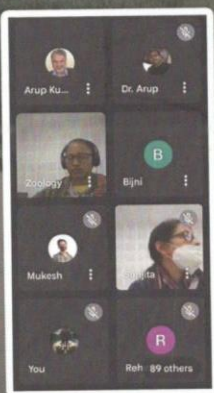
Dr. Bibhab Kumar Talukdar

Chief Executive Officer, Aaranyak &
Senior Advisor (Asian Rhinod) of
International Rhino Foundation, USA

Advisory Committee

Kandarpa Pathak, Vice Principal, Bijni College, Bijni
Saroj Kumar Pasayat, Convenor, Academic Cell, Bijni College, Bijni
Dr. Arup Sarkar, Coordinator, IQAC, Bijni College, Bijni
Dr. Anindita Chakravarty, Faculty, Zoology Department, Bijni College, Bijni
Sanjita Ray, Faculty, Physics Department, Bijni College, Bijni
Dipak Bhattacharyya Faculty, Chemistry Department, Bijni College, Bijni
Abdul Kader Hussain, Faculty, Mathematics Department, Bijni College, Bijni
Lipika Dey Dutta, Faculty, Zoology Department, Bijni College, Bijni
Syed Jawahar Hussain, Faculty, Physics Department, Bijni College, Bijni
Dr. Prasanta Das, Faculty, Mathematics Department, Bijni College, Bijni
Dr. Jabin Chandra Ray, Faculty, Botany Department, Bijni College, Bijni
Martha Brahma, Faculty, Chemistry Department, Bijni College, Bijni
Beauti Queen Goyary, Faculty, Botany Department, Bijni College, Bijni
Dr. Sulabh Ch. Das, Convenor, Research Cell, Bijni College, Bijni

Snapshot of Webinar



Environmental Issues : Risk, Management And Sustainable Development

ISBN : 978-81-951163-1-7



Proceedings of International Webinar
Held on 28th & 29th January, 2022