Climate Change in North East India



D Printers & Publicatio Kamakhya, Guwahati-10 Assam **CLIMATE CHANGE IN NORTH EAST INDIA:** A book on the compilation of selected articles presented at the ICSSR Sponsored National Seminar on the topic "Climate Change and its Impact in North East India: Understanding Recent Trends and Patterns", organized by the Department of Sociology and IQAC, Kamargaon College, Golaghat, Assam from 9-10 November, 2023. The book is edited by **Dr. Bijit Das**, Assistant Professor, Dept of Sociology, Kamargaon College and published by **JD Printers & Publication**, Kamakhya, Guwahati-10, Assam.

**ISBN :** 978-81-971380-7-2

©: Editor

Published : 2024

**Price :** 600.00

- **Cover** : Bhriguttam Borah
- Editor : Dr. Bijit Das, Assistant Professor, Dept. of Sociology, Kamargaon College, Golaghat, Assam
- Joint Editor : Anjan Saikia, Assistant Professor, Department of English, & Co-ordinator, IQAC, Kamargaon College, Golaghat, Assam

Nitul Kumar Borah, Assistant Professor, Department of Sociology, & Assistant Co-ordinator, IQAC, Kamargaon College, Golaghat, Assam

**Robin Hazarika**, Assistant Professor, Department of Political Science & Assistant Co-ordinator, IQAC, Kamargaon College, Golaghat, Assam

Sanjay Acharjya, Assistant Professor, Department of Assamese, Kamargaon College, Golaghat, Assam

**Disclaimer :** All rights reserved. No production in any form of this research book in whole or in part(except for brief quotation with proper reference in critical articles or reviews) may be made without written autorization from the publisher given below. The researcher are solely responsible for the content of their research papers including views, data and plagiarism, if any. The publisher and editor & others are not responsible for the views of the authors, authenticity of data not information and plagiarized content, in any way whatsoever.

### PREFACE

The northeastern region of India, known for its rich biodiversity, pristine landscapes, and unique cultural heritage, is increasingly vulnerable to the impacts of climate change. Characterized by dense forests, mighty rivers, and a predominantly agrarian economy, the region is home to some of the world's most diverse ecosystems, from the Brahmaputra plains to the Himalayan foothills. Despite its relative isolation from industrial hubs, North East India is witnessing the adverse effects of global environmental shifts – rising temperatures, erratic monsoons, and extreme weather events, including flash floods, landslides, and droughts.

Climate change in this region is not just an environmental challenge but a socio-economic one, as it threatens the livelihoods of millions who depend on agriculture, forestry, and fisheries. Indigenous communities, with their deep-rooted traditions and reliance on natural resources, are particularly at risk, as their way of life becomes increasingly precarious. Assam, Meghalaya, Arunachal Pradesh, and other northeastern states are already grappling with shifting rainfall patterns, leading to unpredictable agricultural yields, widespread flooding, and erosion of fertile land, especially along the Brahmaputra River. Furthermore, the region's rich biodiversity is under threat as warming temperatures and changing weather patterns alter habitats, endanger species, and disrupt the delicate balance of ecosystems. The impact on endemic flora and fauna, including rare species found only in this part of the world, could be profound, further accelerating ecological degradation. Addressing climate change in North East India requires urgent, coordinated efforts at local, national, and global levels.

Sustainable development, preservation of indigenous knowledge, and improved disaster management strategies must be integrated into the region's long-term planning. Through adaptation and mitigation, North East India has the opportunity to turn this global challenge into a catalyst for positive, inclusive change, safeguarding its natural beauty and cultural heritage for future generations.

This preface serves as an introduction to the pressing need to understand, address, and act upon the challenges that climate change presents to this sensitive and irreplaceable region of India

> **Dr. Gautom Kumar Saikia** Principal, Kamargaon College Golaghat, Assam

### Editorial

Northeast India, an enchanting land of rich biodiversity, lush forests, pristine rivers, and vibrant cultures, but today it stands at a critical crossroad. With its unique ecology and distinct geographical position, the region is acutely sensitive to the growing impacts of climate change. As this once seemingly isolated part of the world grapples with rising temperatures, unpredictable weather patterns, and the threat of environmental degradation, the urgency to address climate change in Northeast India has never been greater.

Northeast India is home to the Eastern Himalayas, the Indo-Burma Biodiversity Hotspot, and the Brahmaputra and Barak river basins, making it one of the most ecologically diverse regions in the world. Yet, this same diversity is also its vulnerability. The region is witnessing increasing instances of extreme weather events: flash floods, landslides, prolonged droughts, and unseasonal rainfall have become more frequent and severe, challenging traditional agriculture and destabilizing fragile ecosystems. The Brahmaputra River, the lifeline for millions, has seen increased flooding, partly driven by erratic rainfall patterns. With floods often comes devastation, displacement of communities, destruction of crops, and loss of infrastructure. Coastal ecosystems, such as the Sundarbans to the southwest, are threatened by rising sea levels, endangering both wildlife and human settlements. On the other hand, rainfall patterns in the region are becoming alarmingly inconsistent. This has led to water stress in certain parts, severely affecting agriculture, which is the mainstay of the region's economy. Traditional farming systems, which once thrived in harmony with nature, are increasingly at risk as unpredictable monsoons bring either too much or too little rain, jeopardizing food security and livelihoods.

Northeast India is celebrated for its incredible flora and fauna, but climate change poses an existential threat to this natural wealth. Species that rely on specific temperature ranges and ecosystems, like the endangered red panda and the snow leopard, are finding their habitats shrinking. Forests, which cover about 70% of the region, are already experiencing shifting vegetation zones, leaving native species unable to adapt quickly enough. This not only threatens wildlife but also the indigenous communities that rely on forests for sustenance and cultural practices. Moreover, increased human encroachment into forests, driven by economic pressures and population growth, exacerbates the degradation of these critical habitats. Deforestation, already a concern, accelerates climate change by reducing carbon sinks and increasing the risk of soil erosion. The region, thus, faces a dual challenge of protecting its biodiversity while fostering economic growth.

While the impacts of climate change are global, the solutions must be local. Thus, acknowledging the support from the former principal of Kamargaon College, Dr. Bijuli Borchetia and all the members of the Kamargaon College fraternity and ICSSR for organizing the national seminar titled "Climate Change in North East India: Understanding Recent Trends and Patterns" and its outcome through this book with a plethora of research papers from Humanities, Science and Social science gives a multi-faceted approach, encompassing diverse areas of economic development, environmental protection, indigenous knowledge and traditions, embracing modern innovations in sustainable practices would provide the readers with nuanced ideas to unearth the depth of climate change.

Dr. Bijit Das

### - Contents -

Impact of Climate Change on Tea Sector with Special Reference to Assam: A Systematic Review Panchi Haloi	13
Pollution and Climate Change: A Secondary Study on Urban Pollution in Assam	29
🖎 Dr. Nitul Saikia	
River Bank Erosion and Indigenous Knowledge of Deori's in Dhakuakhana Sub-Division: A Case Study of Kanchan Plantation and its Efficacy Mr. Bidyut Deori	35
Interpreting Climate Change through Magic Realism: A Study on <i>Gun Island</i> <b>Dr. Gayatree Bora</b>	43
Climate Change: Effects on Indigenous People of Assam > Aparajita Kaushik & Chayanika Saikia	49
Climate Change, Environmental Issues and Prospects of Jute Farming in Assam: An Analysis	58
	<ul> <li>Impact of Climate Change on Tea Sector with Special Reference to Assam: A Systematic Review</li></ul>

*	Community in Environment Protection and Climate
	Action-the concerns of Group of 20 (G20)
	under India's Presidency 67
	🖎 Dr. Parimita Bhuyan

- - ➤ Mriganko Kakoti\*, Rajib Lochan Deka, Parishmita Das and Kuldip Medhi

- Impact of climate change on the livelihood of beekeepers: A Case Study in Golaghat district, Assam .... 139
   Bhairab Talukdar, Dr Jitu Saikia

*	Metaphoric Retelling of the Histories of Colonization and Extractive Industrialization in Amitav Ghosh's The Living Mountain (2022) 165 > Meeraz Hoque
<b>*</b>	Climate Change and Health Risks for Slum Dwellers in Assam
*	<ul> <li>'The Risks of Late Modernity': Understanding Climate Change Adaptation Experiences From Assamese and Zimbabwean Students' Narratives.</li> <li>A Comparative Analysis</li></ul>
*	The Role of Digital Libraries in Sustainable Development
*	Impact of climate change on livelihood and lifestyle of people residing in Guwahati
*	Flood and it's effects on people and livelihood of the Lower Subansiri sub-basin at Lakhimpur District of Assam
*	জলবায়ু পৰিবৰ্তন আৰু দিচাংমুখ অঞ্চলৰ মিচিং জনজাতিৰ লোকসকলৰ সংস্কৃতি আৰু জীৱনশৈলীত ইয়াৰ প্ৰভাৱ 223 হ্ৰ <b>ৰাজলক্ষ্মী দিহিঙ্গীয়া</b>

### Impact of Climate Change on Tea Sector with Special Reference to Assam: A Systematic Review

Panchi Haloi Research Scholar, Assam University Silchar, Assam

#### Introduction

India is the second largest producer and exporter of tea (Tea Board of India, 2014) with the north-eastern state of Assam being a key producing region. Tea crops produced in northeast India are of major importance for the regional economy. Assam, a state in northeast India, is the single largest tea growing region in the world, producing approximately 57% of India's tea (Tea Board of India, 2017) and providing some of the world's finest black tea (FAO, 2016). Approximately 52% of the total tea produced in India comes from the state of Assam, northeast India. Assam tea is mostly known for its briskness, strength and bright colour of the brew. On its own, Assam contributes around 17% of world tea production and annually produces more than 50% of India's tea (Dikshit & Dikshit, 2014). Tea also plays a pivotal role in supporting the livelihoods of approximately 1.2 million laborers in Assam (Dikshit & Dikshit, 2014). This is one of the most economic crops of the region and millions of livelihoods are directly and indirectly dependent on it.

The region has around 312,210 ha of the area under tea plantations which produced about 645.14 million kg of tea in 2018

Climate Change in North East India ▶ 13

(Ghosal, 2019). Assam alone contributes around 12% of global tea production and supports the livelihoods of about 1.2 million workers related to the tea industry (Marx et al., 2017). Climate change is very much evident and presently influencing tea production in Assam (Duncan et al., 2016).

Climate change over the last 30 years has directly or indirectly caused considerable impact to the crop to varying degrees along with other secondary phenomena triggered by global warming (Dutta et al. 2012). Unfavourable weather conditions for tea plantations owing to rainfall abrasions have badly affected the tea plantations in Northeast India. Conditions such as drought or high-intensity rainfall had a serious impact on tea production in the state. In addition to these factors, a modest rise in temperature also had negative effects on tea plants. Climate change is expected to decrease not only the quantity of tea but also the quality (Ahmed et al., 2014).However, this paper is undertaken to assess and analyze the important dimensions of climate change impacts on tea sector related with respect to impacts on the current and future yields, tea quality, climate suitability, adaptation and mitigation strategies etc., especially by the small tea growers.

#### **Overview of Tea Sector in Assam**

The Tea Plantation Industry of Assam is an agro-based industry having a very peculiar past history. The Assam tea industry is more than 180 years old. Assam tea sector is rich not only in its quantity but also in its quality. Since its beginning the tea industry has become a part of Assam's way of life with major contributions in the socioeconomics sphere in the state (Baruah, 2007). Assam occupied a unique place in India by producing more than fifty percent of the national production having plantation area of about 3.22 lakh hectares which is more than half of the country's total area under tea. Tea industry has extended its largest support by generating highest employment opportunities in Assam. It is the single largest industry in Assam that provides average daily employment to more than six lakh persons in the State, which is around 50 percent of the total average daily waged employee in the country (Laskar.et.al, 2020). Assam produces about 6,29,050 tones (2013) of tea which are about 52.4 per cent of Indian tea production. Small Tea Growers constitute an integral part of tea industry. Production of Small Tea Growers of Assam is estimated at 2,20,168 tonnes (2013) which is around 35 per cent of the total tea production of Assam (Mohan E., 2016).

Assam Tea had lost its competitive edge in the market due to price rise. Over the last few years, the tea industry is facing problems as the land for tea plantations has not grown much while the work force had multiplied enormously which indicates vast surplus of labour in tea gardens (Nizara A., 2013).

The table below shows the estimated production of tea from 2015- March 2023 for Assam Valley, Cachar and India.

# **Table No. 1:** Estimated Production of Tea in Assam(2015 - 2022) (Quantity in million kg)

ricts	2015	2016	2017	2018	2019	2020	2021	2022
m	585.82	618.34	606.74	628.2	671.44	578.52	623.79	647
;y								
nar	45.4	51.18	46.79	48.78	45.05	39.83	43.94	40.93
l	631.22	669.52	653.53	676.98	747.93	618.35	667.73	687.93
	(52.224	(52.827	(51.103	(51.613	(53.804	(49,247	(49.717	(50.389

%)

30.25

%)

30.31

1311.63 1390.08

%)

28.25

1255.6

%)

32.14

1343.06

%)

29.69

1365.23

#### Source: Tea Board of India

State Dist

Valle

Cach

Tota

%)

25.37

1208.66

%)

28.69

1267.36

%)

24.91

1278.83

Assa Assa

m

Othe

India

rs

The above Table No.1 shows the estimated production of tea in Assam and its total share in India's tea production from 2015 to 2022. The bracketed figures with percentage shows Assam's share in India's

tea production. The Assam valley is depicting the picture of Brahmaputra valley whereas Cachar is depicting the picture of Barak valley. Almost, Assam's total share in India's tea production is 50%. So, we can say that Assam is a major contributor of India's tea production.

Figure 1: Percentage of area under tea in Assam, India.



Source: FAO, 2016.

The above figure shows the area of production under tea in Assam. The districts like Tinsukia, Dibrugarh, Sivasagar, Jorhat, Golaghat, Sonitpur, Udalguri, Darang have the highest percentage of area under tea production, while the districts like Karbi Anglong have the lowest percentage of area under tea production.

#### Impact of Climate Change on tea physiology

The average temperature for shoot development is found to be in between 18-25R"C and outside this range is not favourable (Costa et al., 2007). Late winter and early spring temperature influence plant phenology, including budding, leafing and flowering times (Kramer et al., 2000). A rise in temperature would lead to early spring plant phenology (Ahas et al., 2002). The daytime rainfall did not have an effect in plucking period for each tea bud and leaf grade for losses in economic output over past 40 years or so. The buds of perennial trees sprout earlier now because of warming in late winter and early spring (Lou et al., 2014). With rise in temperature in the spring the plucking period from 1985-2018 shortened causing decrease in economic outputs of the four cultivars i.e., the special early-onset cultivars, the early-onset cultivars, middle-onset cultivars, late-onset cultivars of Zheijiang province, China. In China the daytime rainfall during plucking period affects the tea bud, plucking leaf and also production (Lou et al., 2021). A very high rainfall reduces sunlight's availability, which in turn affects photosynthesis. Similarly, excessive rain causes waterlogging conditions, which affects soil saturation and plant's absorption capacity (Wijeratne et al., 2007). Heavy rain dilutes the phytochemicals and changes tea's taste, deteriorating the quality (Han et al., 2017) whereas nighttime rainfall is highly desirable as it does not hamper photosynthesis and plucking (Rahman, 2022). Tea's physiological and biochemical contents are reduced with increase of infestation of red spider mites which cause slow yield (Rahman, 2022). In Assam, extreme temperatures of upto 42R"C and temperature lows of 3R"C are outside the ideal tea growth range (Biggs et al., 2018). An increase in water availability results in a significant increase in growth of potted tea plants on the basis of both plant height and new leaves (Ahmed et al., 2013). The high-water availability had significantly more leaves than moderate water plants and low water plants (Ahmed et al., 2013).

#### Impact of Climate Change on Tea Quality

With the climate warming, the perennial trees sprout earlier and if not plucked in time, the economic value of the harvest rapidly decreases and quality deteriorates (Lou et al., 2014). In southwest and east China, tea quality deteriorated due to rising temperatures and drought events (Ahmed et al., 2014; W. Y. Han et al., 2017). With the increase of pests like mosquito bugs and red spider mites, the need for frequent foliar spray increases which reduces tea quality and production costs rises. The gardeners of Chottogram and Rangpur division in Bangladesh said that rainfall affects the tea quality and production cost (Rahman, 2022). Seasonality and the annual variation associated with changing environmental conditions are determinants of crop quality in both Yunnan and Fujian Province (W. Han et al., 2020). The tea plants are affected by both excess and shortages of water and suffer from increased climate stress. Changing climate conditions impact the concentration of secondary metabolites, which is important for tea quality (Ahmed, 2017). Multiple environmental parameters impact tea quality although the magnitude and directionality is not clear due to variations in various factors such as cultivar, environment and management conditions (Ahmed et al., 2019).

#### Impact on tea production

Production characteristics varied in North Bank and South Bank with 96-98% land owned or leased by plantation producers. Common annual average yield for plantations is 1500-2000 kg ha-1 in all regions, except Cachar where it is less than 1500 kg ha-1 (Biggs et al., 2018). Increase in annual total rainfall in Sri Lanka reduces tea production by reducing photosynthesis and disrupting plucking (Wijeratne et al., 2007). In Sri Lanka, with continuous heavy rainfall, the moisture content of the leaf increases and consequently the drying cost increases, in contrast, with prolonged drought the leaf becomes scorched (Rahman, 2022). In terms of cropping diversity, the greatest crop variation in North Bank could indicate greater resilience to potential adverse climate and crop conditions while Upper Assam lacks heterogeneity in varieties planted (Lin, 2011).

#### Mean Temperature and Tea Yield

The average temperature in Sri Lanka the current month is found to have a significant positive effect on tea production, whereas average temperature from the previous month was not significant(Gunathilaka et al., 2017). With 1R"C increase in long term average temperaturetea production for a particular estate reduces by 46% in production in Sri Lanka(Gunathilaka et al., 2017). An increase in mean temperature in Assam during January to March leads to increase in crop yield, both the early crop and main crop (Sen et.al, 1966). The mean temperature of five sampling sites of Jiangxi Province, Eastern China showed that temperature decreased with increasing elevation at the sampling sites in April, 2014 (W. Y. Han et al., 2017).

#### Maximum Temperature and Tea Yield

The daily extreme temperature between 34-36R"C decreases tea yield around 3.7% in China. However, yield losses due to extreme heat were less than by cold damage (Yan et al., 2021). The maximum temperature between February-March in Sri Lanka shows a negative correlation with March-April production, whereas a positive relationship exists between maximum temperature of May-June with production of June-July, and with maximum temperature from September-November with production from October-December (Nijamdeen et al., 2017). Climate Change especially increasing temperatures in tropical China negatively effect tea yield particularly in the tropical and subtropical regions and hence tea is considered vulnerable to changes in climate (Ahmed et al., 2014).

#### Minimum Temperature and Tea Yield

The daily temperature between 0-2R"C or 2-4R"C reduces tea yield by 2% or 4% in China(Yan et al., 2021). In Sri Lanka a strong correlation is found for minimum temperature and production in February, June and October, and if production lags by one month, then it shows greater significance for February-April. The minimum temperature in months of January to March shows positive correlation with production in the months of February-April (Nijamdeen et al., 2017). Low and sudden temperature (<10R"C) drop hinders the growth of leaf bud and reducing the tea yield of Uji city, South Kyoto(Ashardiono & Cassim, 2015).

#### **Temperature Variability and Tea Yield**

Both heat and cold temperatures were associated with significantly reduced tea yields. There is distinctive regional characteristics and inter annual variability. Regions above 25R"N are likely to suffer from more severe cold stress with yield reduction, for example- 56% yield reduction

in Shandong Province of China (Yan et al., 2021). The sudden drop of warm temperature at the end of fall season in Uji city, South Korea causes the tea plant growth to stop abruptly having a negative impact on the plant and reduce quality of next season harvest (Ashardiono & Cassim, 2015).

#### **Annual Total Rainfall and Tea Yield**

An additional wet day per month in Sri Lanka would increase tea production by 3.5% with total rainfall held as constant suggesting a more even distribution of rainfall is beneficial for tea production (Gunathilaka et al., 2017).

#### Seasonal Total Rainfall and Tea Yield

In Assam, an increase in rainfall during the January to March has more beneficial effect on early crop when temperature is high than it is low. Rainfall during January to March and July to September showed a beneficial effect on the main crop. Rainfall during April to June tends to depress the late crop while rainfall during October to December proved beneficial upon the late crop (Sen et al, 1966). In China, changes in growing season, precipitation and its effects on tea yield are marginal as compared to the extreme temperatures(Yan et al., 2021). The rainfall for January-March in Sri Lanka shows a strong positive correlation with production of February-April (Nijamdeen et al., 2017). The changes in rainfall pattern regarding onset and increased intra-seasonal variability cause changes in yield in Assam with delayed growth of tea crops, waterlogging affecting root development and increased soil erosion (Biggs et al., 2018).

#### Monthly Total Rainfall and Tea Yield

The monthly total rainfall from the current month was significant and negative on tea production, whereas rainfall from previous months showed highly significant positive effects Sri Lanka(Gunathilaka et al., 2017). However, the correlation for rainfall and production is strongest in February and March and shows greater significance for February to April-May if production lags rainfall by a month (Nijamdeen et al., 2017).

#### Mean Rainfall and Tea Yield

There was a negative relationship between average rainfall and yield among the 10 gardens of Bangladesh (Rahman, 2022). The mean rainfall of five sampling sites of Jiangxi Province, Eastern China linearly increased with increasing elevation during April, 2014 (W. Y. Han et al., 2017).

#### **Rainfall Variability and Tea Yield**

In the district of Nuwara Eliya, the rainfall data analysis for period 1945-2005 revealed that months of January, June, July and August have high rainfall variability emphasizing the need for special attention to reduce negative impacts on tea plants (Karunaratne et al., 2015).

#### **Impact of Pests on Tea**

Temperature plays a major role in the life cycle of insect and mite pests by influencing their reproductive potential, feeding rate, distribution pattern, duration of development stages, number of annual generations, migration etc. With more accumulation of degree-day during summer months some pests like mosquito, red spider completes their life-cycle faster than the expected during winter (Roy et.al., 2019). With increase in temperature, the reproductive rates of insects have increased which imbibes the plant sap. With 94 years analysis the average minimum temperature has increased in south bank region of Assam and North Bengal. The atmospheric conditions of CO2 in tea plantations in NE-India has have been rising steadily, 1.5 parts per million (ppm) per year - 364ppm in 2008, 385ppm in 2013, 398ppm in 2017. currently (2019) around 400 ppm future-500 ppm. with more accumulation of degree- day during summer months they completed their life cycle faster than the expected during winter (Roy et.al., 2019).

The decrease in rainfall and increase in temperature enhanced the population density of red spider mite even during the winter months in tea plantations of north- eastern India, especially during last 50 years (Prasadet.al, 2013). Climate change like shift in rainfall has increased the incidence of tea mosquito bug in the late monsoons and autumn months in the north east India (Royet.al, 2015).

Region-wise, factors such as temperature extremes, increase in insect and disease infestation and increase in wind velocity had more pronounced effects on tea production between Upper Assam and South Bank as compared with other regions. Between Upper Assam, North bank and Cachar, the problems of temperature extremes and increase in insect and disease infestation were significantly higher for North Bank and Cachar. Also, the proportion of tea plantations facing the problem of increase in insect and disease infestation varied significantly between South Bank and Cachar as well as between North Bank and Cachar (Baruah et.al., 2021).

#### **Impact on Livelihoods**

All the four regions Cachar, North Bank, South Bank, Upper Assam reported diversified incomes where fisheries were common in Cachar, Dairy/ Orchard in North Bank, South Bank and Upper Assam and Rice was common in North Bank (Biggs et al., 2018). Over the past 40 years in the Longjing province, the effects of climate change on spring tea production by small farmers have been less than in plantations (Lou et al., 2014). The employment generation and daily income depend on climatic variables like rainfall. In Bangladesh the gardeners minimize the cost of production in times of low yield due to climatic variables by contracting the contractual worker's job market. Similarly, the overtime work of the permanent workers is hampered. The tea workers receive irregular payments during low yield and increasing cost of production due to climatic variability (Rahman, 2022). Many tea workers of Assam identified vulnerability issues threatening their ability to sustain livelihoods caused by not only climate stresses like reduced rainfall, soil moisture, drought but also increase in pest attacks and increase in prevalence of plant disease (Biggs et al., 2018) The economic issue such as declining sales value and increasing expenses in cultivation have slowly affected the tea farmer's financial condition in Uji city, South Kyoto (Ashardiono & Cassim, 2015). In Assam approximately 1.2 million workers are employed within the tea sector (Dikshit and Dikshit, 2014), primarily by large commercial plantations which dominate around 65% of tea

production, the remaining 35% is produced by smallholder farmers with cultivable plots less than 10 hectares in size (Mansingh, 2013).

#### Future Predictions of impacts on Tea Yield and Production

Sri Lanka will be negatively affected by predicted long term changes in rainfall and temperature. The predicted proportional impacts of temperature and rainfall change are negative across all elevations. The proportional impacts of temperature change are predicted to be 2 to 10 times higher than those of rainfall change, depending on the General Circulation Models (GCM) scenario and time horizon. Aggregate proportional production for 2026-2035 is predicted to reduce by between 5.1 and 7.8%, for 2046-2055 predicted reductions range between 8.7 and 11.6%, for 2081-2090 production would reduce by 16.2 and 23.3% under all scenarios (Gunathilaka et al., 2017). In China, the cold stress is expected to fall, but heat stress is predicted to intensify in near future over almost all tea production regions at both 1.5R"C and 2.0R"C warming levels. Yield in regions above 28R"N producing 48% of national tea yield are estimated to increase around 2-10% under 1.5R"C warming (Yan et al., 2021). The mean air temperature of Kenya would increase by 2% by 2025 and 11% by 2075 and the suitability of tea growing areas is expected to increase by 8% in 2025 and decrease by 22.5% by 2075 (Muoki et al., 2020).

#### Adaptation

A study in the Rangpur division of Bangladesh revealed that one organic tea garden named Kazi and Kazi have high resilience capacity and have taken high adaptive measures knowing the distinct microclimatic pattern like soil mulching to conserve soil water and protect soil from evaporation, using organic matter which has high water holding capacity, increased density of shade trees to protect against scorching and planting trees repellent against pests and insects (Rahman, 2022). Plantation managers and smallholders across the regions of Assam stated multiple adaptation strategies like water conservation, irrigation from rain storage, dams, boreholes, tube wells or water pumps, afforestation, controlling emissions from factories and industries, need for climate change awareness programmes, control on pesticide and inorganic fertilizer use (use of bio fertilizers), soil conservation by soil mulching, contour drains and planting, proper shade, infilling bare ground and introduction to climate-resilient clones (Biggs et al., 2018). In Uji, all the tea farmers are not fully concern about the climate change effects nor are able to dedicate their resources to immediately to counteract with the on-going changes soby utilizing the agro-informatics system the farmers would be able to receive benefits such as monitoring and measurement data of their tea plantation conditions which helps in developing new methods and techniques to maintain high standard of tea quality. Also, the utilization of precision agriculture system would create new intervention methods to ensure quality and quantity of tea harvest (Ashardiono & Cassim, 2015). Soil mulching was considered as best technique by the tea growers of Assam to minimize degradation of soil and other natural resources, and to improve soil moisture content. Drains created in the periphery of the plantation obstructs the outflow of water and improve groundwater recharge, dense bushes planted around the plantations reduces the negative impacts of pesticides and other chemicals (Deka et al., 2022). Adoption of a multi-targeted approaches in Kenyalike complex physiological, biochemical and molecular regulatory networks associated with stress responses will ensure sustainability of the tea sector (Muoki et al., 2020).

#### Conclusion

Thus, it is true that climate change is a serious impact at present and has impacted all the sectors of the economy. It has impact on both cash crops and plantation crops especially the tea sector. Both the direct and indirect variables of climate change adversely affected the tea production, its productivity, the small tea growers and their livelihoods. However, the large tea growers can withstand the negative affects due to their adaptive capacity which the small tea growers cannot and thus faces losses. Based on the impact adaptation strategies should be implied like planting of drought tolerant cultivar, reduction of chemical fertilisers, organic practices, soil mulching with succulent vegetative matter, planting shade trees, proper drainage system and rainwater harvesting.

#### References

- Adhikari, U. et.al., (2015). Climate change and eastern Africa: A review of impact on major crops. Food Energy Secur. 4, 110-132.
- Ahmed, S. et.al., (2019). Environmental Factors Variably Impact Tea Secondary Metabolites in the Context of Climate Change. Frontiers in Plant Science, 10. https://doi.org/10.3389/ fpls.2019.00939
- Ahmed, S. et.al., (2014). Effects of water availability and pest pressures on tea (Camellia sinensis) growth and functional quality. AoB PLANTS, 6. https://doi.org/10.1093/aobpla/plt054
- Ahmed, S. et.al., (2014b). Effects of extreme climate events on tea (Camellia sinensis) functional quality validate indigenous farmer knowledge and sensory preferences in Tropical China. PLoS ONE, 9(10). https://doi.org/10.1371/journal.pone.0109126
- Ashardiono, F., & Cassim, M. (2015). Adapting to Climate Change: Challenges for Uji Tea Cultivation. In International Journal Sustainable Future for Human Security J-SustaiN (Vol. 3, Issue 1). http://www.j-sustain.com
- Biggs, E. M., Gupta, N., Saikia, S. D., & Duncan, J. M. (2018). The tea landscape of Assam: Multi-stakeholder insights into sustainable livelihoods under a changing climate. Environmental Science & Policy, 82, 9-18.
- Boehm, R., Cash, S. B., Anderson, B. T., Ahmed, S., Griffin, T. S., Robbat Jr, A., ... & Orians, C. M. (2016). Association between empirically estimated monsoon dynamics and other weather factors and historical tea yields in China: results from a yield response model. Climate, 4(2), 20.
- Bore, J. K., Cheserek, B. C., & Ngeno, P. (2013). Long term impact of climate change on tea yields. Tea, 34(2), 57-67.
- Das G.M. (1965). Pest of Tea in North-East India and There Control. Memorandum No. 27, Tocklai Experimental Station, Tea Research Association, Assam, India, 169–173.

- Duncan, J. M., Saikia, S. D., Gupta, N., & Biggs, E. M. (2016). Observing climate impacts on tea yield in Assam, India. *Applied Geography*, 77, 64-71.
- Dutta, R. (2014). Climate change and its impact on tea in Northeast India. *Journal of water and climate change*, *5*(4), 625-632.
- Gunathilaka, R. D., Smart, J. C., & Fleming, C. M. (2017). The impact of changing climate on perennial crops: The case of tea production in Sri Lanka. *Climatic Change*, *140*, 577-592.
- Han, W., Ahmed, S., Wei, C., Orians, C. M., & Landi, M. (2020).
  Editorial: Responses of Tea Plants to Climate Change: From Molecules to Ecosystems. In *Frontiers in Plant Science* (Vol. 11). Frontiers Media S.A. https://doi.org/10.3389/ fpls.2020.594317
- Han, W. Y., Huang, J. G., Li, X., Li, Z. X., Ahammed, G. J., Yan, P., & Stepp, J. R. (2017). Altitudinal effects on the quality of green tea in east China: a climate change perspective. *European Food Research and Technology*, 243(2), 323–330. https://doi.org/ 10.1007/s00217-016-2746-5
- https://www.indiatoday.in/india/story/assam-west-bengal-teaproduction-affected-by-flood-rainfall-1974935-2022-07-13.
- https://www.newindianexpress.com/business/2022/jul/12/rainfallaffects-production-in-assam-north-west-bengal-says-teaassociation-2475706.html.
- https://www.financialexpress.com/economy/good-rains-in-assam-raise-hopes-for-normal-tea-output/3022696/.
- https://weather.com/en-IN/india/climate-change/news/2022-12-29climate-change-continues-to-impact-assam-tea-production.
- https://nenow.in/north-east-news/assam/climate-change-impacting-assams-tea-production-to-great-extent.html.
- https://www.sentinelassam.com/north-east-india-news/assam-news/ assam-tea-production-adversely-affected-by-climate-change-630879
- Lou, W., Sun, S., Wu, L., & Sun, K. (2014). Effects of climate change

on the economic output of the Longjing-43 tea tree, 1972–2013. *International Journal of Biometeorology*, *59*(5), 593–603. https://doi.org/10.1007/s00484-014-0873-x

- Muoki, C. R., Maritim, T. K., Oluoch, W. A., Kamunya, S. M., & Bore, J. K. (2020). Combating Climate Change in the Kenyan Tea Industry. In *Frontiers in Plant Science* (Vol. 11). Frontiers Media S.A. https://doi.org/10.3389/fpls.2020.00339
- Nijamdeen, A., Zubair, L., Dharmadasa, M., Najimuddin, N., & Malge, C. (n.d.). *Seasonal Impact of Climate on Tea Production in Sri Lanka*. http://iridl.ldeo.columbia.edu
- Lou, W., et.al., (2021). Impact of climate change on inter annual variation in tea plant output in Zhejiang, China. *International Journal of Climatology*, *41*, E479-E490.
- Rahman, M. M. (2022). Effect of Rainfall Pattern on the Tea Production in Bangladesh: An Analysis of Socioeconomic Perspectives. *Journal of Agroforestry and Environment*, *Forthcoming*, 15 (1), 43-55.
- Roy, S., Barooah, A. K., Ahmed, K. Z., Baruah, R. D., Prasad, A. K., & Mukhopadhyay, A. (2020). Impact of climate change on tea pest status in northeast India and effective plans for mitigation. *Acta Ecologica Sinica*, 40(6), 432-442.
- Roy, S., Muraleedharan, N., Mukhapadhyay, A., & Handique, G. (2015). The tea mosquito bug, Helopeltis theivora Waterhouse (Heteroptera: Miridae): its status, biology, ecology and management in tea plantations. *International Journal of Pest Management*, 61(3), 179-197.
- Sen et.al.,1966-Tocklai\_Experimental\_Station-The Influence of Climatic Factors on the Yield of Tea in the Assam Valley.
- Wijeratne, M. A. (1996). Vulnerability of Sri Lanka tea production to global climate change. *Water, Air, and Soil Pollution, 92*, 87-94.
- Wijeratne, M. A., Anandacoomaraswamy, A., Amarathunga, M. K. S. L. D., Ratnasiri, J., Basnayake, B. R. S. B., & Kalra, N.

(2007). Assessment of impact of climate change on productivity of tea (Camellia sinensis L.) plantations in Sri Lanka. *Journal of the National Science Foundation of Sri Lanka*, 35(2), 119–126. https://doi.org/10.4038/jnsfsr.v35i2.3676

Yan, Y., Jeong, S., Park, C. E., Nathaniel D Mueller, Piao, S., Park, H., Joo, J., Chen, X., Wang, X., Liu, J., & Zheng, C. (2021). Effects of extreme temperature on China's tea production. *Environmental Research Letters*, 16(4). https://doi.org/10.1088/ 1748-9326/abede6

0 0 0

### Pollution and Climate Change: A Secondary Study on Urban Pollution in Assam

**Dr. Nitul Saikia** Assistant Professor, North Bank College, Ghilamara, Assam

#### Introduction

This paper examines the relationship between pollution and climate change, with a specific focus on urban pollution in Assam, India. Assam, known for its rich biodiversity and cultural heritage, is facing significant environmental challenges due to rapid urbanization, industrialization, and population growth. The study analyzes the sources of pollution in Assam's urban areas, the impact on climate change, and the socio-economic consequences. Furthermore, the paper discusses the efforts and policies implemented to mitigate these issues and suggest strategies for sustainable urban development in Assam. Pollution and climate change are two of the most pressing global environmental challenges today. While pollution directly affects human health and ecosystems, it also plays a crucial role in exacerbating climate change. Urban areas, especially in developing regions, are hotspots for pollution due to the concentration of industrial activities, vehicular emissions, and waste generation. Assam, a northeastern state of India, is no exception to this trend.

Assam, with its unique geographical location and climatic conditions, is particularly vulnerable to the impacts of climate change.

*Climate Change in North East India* ▶ 29

The state's urban centers, such as Guwahati, Dibrugarh, and Silchar, have witnessed rapid urbanization in recent decades, leading to increased pollution levels. This study aims to explore the extent of urban pollution in Assam, its contribution to climate change, and the potential measures to address these challenges. The issue of pollution is widespread across the globe. Urban areas, in particular, are highly affected and the pollution can also impact more distant regions. Pollution involves the introduction of harmful substances into the natural environment, resulting in negative changes. These harmful substances are referred to as pollutants, which can originate from natural sources or be man-made. Pollution negatively impacts the quality of land, water, and air. One major environmental problem that has a negative impact on ecosystems, human health, and quality of life is land contamination. The deterioration and pollution of land surface through the deposition of liquid and solid materials negatively impacts both the soil and groundwater levels. This issue is highly significant as it not only affects humans but also animals and the environment. Land pollution occurs when waste materials and other harmful substances are discarded onto the land, leading to contamination.

Numerous contaminants have accumulated in the soil as a result of growing rates of industrialization, urbanization, and agricultural activities. These pollutants have disrupted natural processes and added to greater environmental degradation. The purpose of this essay is to present a thorough analysis of land contamination by determining its main causes, evaluating its effects, and investigating workable solutions. This study aims to provide effective ideas for reducing land pollution and improving sustainable land management.

#### **Objectives:**

1. Identifying the primary sources of land contamination

2. Offering potential recommendations to enhance pollution control methods and land management techniques

#### Methodology

This study utilizes a descriptive and analytical approach, relying primarily on secondary sources of information. Secondary data has been gathered through thorough review of scholarly publications, books, journals, environmental reports from governmental and nongovernmental organizations, internet resources, newspapers, and credible sources. Key databases such as JSTOR, PubMed, and Google Scholar have been utilized to collate relevant literature.

#### Discussion

Multiple factors contribute to land pollution, each exacerbating environmental degradation and soil quality. Several causes include:

- Industrial operations frequently generate hazardous waste, such as heavy metals, chemicals, and toxic byproducts. Improper disposal of these materials can lead to soil contamination, inhibiting plant growth and potentially entering the food chain.
- The use of artificial fertilizers, pesticides, and herbicides in agricultural practices is a leading cause of land contamination. These substances have the potential to seep into the soil, leading to nutritional imbalances, reduced soil fertility, and contamination of groundwater resources.
- Urban expansion and construction: Rapid urban development and construction activities generate a substantial volume of waste, such as concrete, asphalt, and other materials. Improper waste management practices during construction can lead to soil pollution and loss of natural habitats.
- Challenges in waste management: The inappropriate disposal of solid and liquid waste, including household garbage and industrial effluents, contributes to land degradation. Mismanagement of landfills can result in leachate, which contaminates nearby soil and water.
- Vehicular Emissions: The rapid increase in the number of vehicles in urban areas has led to higher emissions of greenhouse gases (GHGs) and other pollutants such as particulate matter (PM), nitrogen oxides (NOx), and sulfur dioxide (SO2). Guwahati, the largest city in Assam, has seen a sharp rise in vehicular emissions, contributing significantly to air pollution.

• Industrial Activities: Assam is home to several industries, including oil refineries, paper mills, and tea processing units. These industries release large quantities of pollutants, including carbon dioxide (CO2), methane (CH4), and other toxic chemicals, into the atmosphere. Industrial pollution is a major concern in cities like Dibrugarh and Tinsukia, where industrial clusters are located.

#### The consequences of land contamination consist of :

- The negative impact of soil pollution on soil fertility leads to reduced agricultural output and biodiversity, affecting the environment.
- Contaminated soil can disrupt ecological processes and wildlife, in addition to posing health risks when consumed through contaminated food or water.
- Health conditions such as developmental delays, malignancies, and respiratory ailments are linked to land pollution, impacting human health.
- Land contamination results in increased remediation costs, reduced agricultural output, and decreased property values, affecting both governments and communities financially.

The socio-economic impact of urban pollution and climate change in Assam is profound. Air pollution in urban areas leads to a higher incidence of respiratory and cardiovascular diseases, increasing healthcare costs and reducing the quality of life. The changing climate patterns also pose a threat to Assam's agriculture, which is heavily dependent on monsoon rains. Erratic rainfall and rising temperatures can lead to crop failures, affecting the livelihoods of a large section of the population. Urban flooding, exacerbated by climate change, is another significant issue in Assam. Cities like Guwahati are prone to flooding during the monsoon season, leading to loss of property, displacement of people, and disruption of economic activities. Pollution refers to the introduction of harmful substances or products into the environment, causing adverse effects on living organisms and the ecosystem. It can take many forms, including air pollution, water pollution, soil contamination, and noise pollution. Climate change, on the other hand, refers to long-term changes in temperature, precipitation patterns, and other climate variables, largely driven by human activities such as deforestation, industrialization, and the burning of fossil fuels.

The link between pollution and climate change is well-established. Air pollutants, particularly greenhouse gases like carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), contribute to global warming by trapping heat in the Earth's atmosphere. Additionally, pollutants like black carbon and particulate matter exacerbate the effects of climate change by altering cloud formation and reducing the Earth's albedo (reflectivity), further accelerating the warming process.

#### Suggestions

To effectively combat land pollution, the following recommendations are proposed:

- Advanced waste treatment technology, bioremediation, and phytoremediation can effectively cleanse contaminated soils. Phytoremediation involves the use of plants to absorb or modify pollutants, while bioremediation utilizes microorganisms to break down pollutants.
- Government policies and regulations are crucial for managing land contamination. Adhering to waste disposal guidelines, minimizing the usage of hazardous materials, and enforcing environmental laws can help reduce pollution.
- Community cleanup initiatives, public awareness campaigns, and educational programs promote environmentally friendly practices and responsible waste management. Community involvement is essential for the success of pollution control efforts.
- Strengthen and tighten waste management and pollution control laws and ensure that companies adhere to environmental regulations, with stricter penalties for those who do not comply.
- Promote the adoption of sustainable agricultural practices such as integrated pest management and organic farming to reduce reliance on chemical inputs.
- Support the research and development of innovative

methods for pollution control and cleanup, and invest in technologies that offer cost-effective ways to remediate contaminated land.

• Foster community participation in environmental conservation efforts and enhance public awareness of the impact of land contamination. Educational initiatives should focus on the benefits of reducing pollution and practicing responsible waste management.

#### **Conclusion:**

In summary, land pollution presents a multifaceted challenge, impacting the economy, environment, and human well-being. This research underscores the importance of addressing land pollution through a blend of technological advancements, regulatory measures, and community-based initiatives that pinpoint sources and assess consequences. To promote sustainable land usage and combat pollution, it is crucial to implement effective management and remediation strategies. By collaborating, the adverse effects of land pollution can be significantly diminished. Governments, businesses, and communities need to unite to develop enduring remedies and preserve the health of the planet and its inhabitants.

#### **References:**

- Danny, L. D., & Robert, R. M. (2015). \*Waste Management and Resource Recovery\*. CRC Press.
- de Waal, J. M. H., & Klink, M. C. P. M. G. (Eds.). (2007). \*Land Pollution: Monitoring, Modelling and Remediation\*. Springer.
- Masters, G. M., &Ela, W. P. (2014). \*Introduction to Environmental Engineering and Science\*. Pearson.
- Sharma, R. K., & Gupta, B. B. (Eds.).(2013). \*Soil and Environmental Quality\*. CRC Press
- Vesilind, P. A., & Peirce, J. J. (2011). \*Environmental Pollution and Control\*. Butterworth-Heinemann

#### 0 0 0

## River Bank Erosion and Indigenous Knowledge of Deori's in Dhakuakhana Sub-Division: A Case Study of Kanchan Plantation and its Efficacy

**Mr. Bidyut Deori** Assistant Professor, Dept. of Political Science, Kamargaon College, Golaghat, Assam

#### Introduction

Floods are the most perennial havoc that affects most of the peoples, infrastructures and along with the natural environment with its vast intensity for almost half of the year. The north –eastern region of the country receives a large share of the summer south –west monsoon's rainfall that usually lasts between June to September, in comparison to rest of the country. When the monsoon winds, make its way over Assam, the Brahmaputra swells manifold, as do its tributaries. And the impact, the resultant floods cause, is devastating. Assam has always been prone to floods, but the Great Earth-quake of 1950,led to massive changes in the topography and the Brahmaputra valley has, thereafter, been seeing increased devastation, due to floods (Centre for Disaster Management, Assam, date not specified). Expert

say the river has become more unstable after the earthquake and the shifting of channels and erosion have turn more sever and frequent. The Brahmaputra valley has seen major floods from 1950's earthquake. The floods in 1988, 1998, 2002, 2004, 2007 and 2012 were worst in recent history.

Floods, flash floods, river-bank erosion and deposition of large amounts of sand by flood water are the most frequent water induced hazards in the eastern Brahmaputra basin in Assam. Flash floods are also a normal component of the flood regime. These hazards affects of the land, lives and livelihoods of communities living in the region to a significant degree. Annual cycles of hazards cripple people's resilience and intensify the poverty spiral. Thousands of hectares of fertile land in hundreds of villages with crops, settlements and wetlands are heavily affected due to deposition of debris, mainly coarse sand particles by flood waters (Das, 2009).

Flood occurring when embankments get breached are dreadful than a natural one. Embankment floods are sudden and catastrophic with greater intensity inundating extensive areas remaining stagnant for longer time periods than would be the case without embankments, some flood review committees of recent years have suggested not to erect new embankments presently in the Brahmaputra valley but to strengthen the existing weak and old embankments. The flood problem in the upper Assam is mainly due to high discharge in the Brahmaputra river. Floods also occur due to frequent breaching of the embankments which often fail to prevent flood height from overtopping and due to their inadequate sections.

In view of the growing dimensionality of the flood and erosion problem of Assam, the existing structural measures are quite inadequate and ad-hoc in nature. There's need of a whole-hearted holistic approach coupled with community initiatives towards disaster management in the land. Besides, the Government has made several efforts to control erosion, many of these being structural measures such as rising embankments, installing geo-bags, porcupines, boulder pitching, concrete block, spur and so on, but the most of the dwellers of the study area have not satisfied with the mode of flood mitigation and erosion protection measures. Thus, the floodplain dwellers of active and chronically flood affected zones usually undertake some kind of measures at their individual and community level to adjust with the flood and associated hazards.

This paper is a humble endeavour to substantiate the efficacy of the indigenous knowledge on erosion protection measures adopted by the villagers to protect their land property and to disseminate the innovative ideas for the benefit of the flood affected people.

#### **Objectives**

The main objectives of this research paper are

- (i) To examine the efficacy of the indigenous knowledge on erosion protection measure adopted by the villager.
- (ii) To analysis the potentiality of possible non-structural sustainable anti-erosion measure.

#### Methodology

The present study is mainly based on both primary and secondary data. The study is carried out through a field survey and observation methods. In this study, the ST households of the Bali Deori village under Dhakuakhana Sub-Division are mainly taken into consideration. For collecting the data and information of the study area, selected dwellers of the village have been interviewed at spot.

#### About Kherkatia River Suti:

The Kherkatia river, now popularly known as Kherkatiya Suti was once a prominent drainage channel of the Brahmaputra river on its north bank. The old channel of the Brahmaputra called Kherkatia Suti which separated Majuli from the north bank creating an island, has also been blocked by the E& D Department, Government of Assam, in 1979 by building a large embankment across the channel at its extreme eastern point where it originates from the present Brahmaputra. As a result, Majuli has lost not only a great drainage channel on its north, but what is galling is that it has also to lose its identity as an island, the largest of its kind, and unique in its character of being made by a river. Thus Majuli's identity as a river made island has now been questioned in certain quarters (D. Nath).

#### **Study Area:**

The Balideori village is the lone Deori community inhabited village under Dhakuakhana Sub- Division of Lakhimpur District. Though the village is a small having 112 household and 600 voters, yet this village is famous for the name and fame of Dr. Ram Prasad Deori, who was hailed from Balideori and awarded PhD by the University College of London on "Solid State Laser" in 1969. In fact, he was the first PhD Holder from Deori Community as well as entire Tribal community in Assam. Dr. Deori later joined in the Department of Physics, Dibrugarh University and retired as Reader. This village is actually situated at the bank of Kherkatiyariver, a tributary of Brahmaputra and the boarder river of Majuli and Dhakuakhana.

#### Flood in Brahmaputra valley:

Flood is a perennial problem for the state of Assam. The Brahmaputra valley has seen major floods from 1950s earthquake, followed by 1954,1962,1966,1972,1974,1978,1983,1988,1996,1998 and 2000 which tremendously changed the scenic landscape of the valley region of Assam (GOSWAMI, 2000). Being the flood affected area both the Dhakuakhana and Majuli have seen these major floods. But the floods in 1988, 1998, 2002, 2004 and 2007 are said to be the worst ever in the last 10 years. These floods were severe and affected the land, people, cattle, road, transport and communication system, economy and trade and commerce and social status etc. The same situation was prevails in the Dhakuakhana and Majuli also.

#### Mitigation of Flood and Erosion protection measures:

There is no major flood and erosion project has yet been implemented in the study area other than construction of embankments, installation of geo-bag, porcupines, spur, and pitching boulder etc. The construction of embankments was taken in the area in the year 1952 i.e. Haladhibari- Bechamara- Embankment and the Kamalabari – Jengraimukh-Haladhibari PWD Road in 1957. The E&D Department, Government of Assam, in 1979 blocked the river mouth of Kherkatia Suti by building a large embankment across the channel at its extreme eastern point where it originated from the present Brahmaputra. As a result, Majuli lost not only a great drainage channel on its north, but what is galling is that it has also to lose its identity as an island, the largest of its kind, and unique in its character of being made by a river (D. Nath, 2000).

Most of the old generation people now remember with pleasure their experiences of plenty of crops and fishes they had in the past. There is no record of use of any sort of fertilizer in agriculture in early times, except perhaps cow-dung. This was more so in case of Dhakuakhana and Majuli where natural fertility of the soil was abundant due to alluvium deposited during flood which was once a regular phenomenon in the area. Decrease in fertility of the soil was started in the area after man-made embankment was done to prevent the natural washing by flood (D. Nath, 2009).

#### **Result and Discussion**

## Experiment on non- structural anti erosion measure on Study Area:

The Balideori village is the lone Deori community inhabited village under Dhakuakhana Sub-Division of Lakhimpur District. Though the village is a small having 112 household and 600 voters, yet this village is famous for the name and fame of Dr. Ram Prasad Deori, who was hailed from Balideoriand awarded PhD by the University College of London on "Solid State Laser" in 1969. This village is actually situated at the river bank of Kherkatiya, a tributary of Brahmaputra and sharing the border with Majuli Island. The Dhakuakhana Sub-Division is a flood affected area since the past. Flood, flash flood and associated erosion hazard affect all aspects of the people of the area. Repeated annual cycles of hazards have been crippling the people of the area. Although some structural measures were taken in the form of raising and strengthening the embankment and anti- erosion work by Government of Assam, the problem of erosion and flood remained mostly uncontained. The installations of porcupine also not meet the expectation of the people. The dwellers of the study area have not satisfied with the mode of flood mitigation

and erosion protection measures. The flood plain dweller of chronically flood affected areas usually undertakes some kind of measures at their individual and community level to adjust with the flood and associated hazards. Thus, the flood of 1998 and erosion, caused by flood have insisted the villagers to think about an alternative way to mitigate the problem. As a result, Sri Bidya Sagar Deori, the pioneer of this measure have noticed a particular kind of aquatic plant having some unique features and at that moment he decided to make an experiment of as anti-erosion measure by planting sapling of KANCHAN plant in the year 1998. Accordingly he started the process of planting some branches of Kanchan, especially at erosion active zone at Kherkatiya river suti. Gradually the sapling started to penetrate the soil in a short period. He has noticed that it has surprising capability to encompass a large area and breeding multiply. Actually, the kanchan plant is a flood endurable plant and its branches that contact land, started instantly to extend root, again emerge new branches and that process become a continuous endless process. The branches of the kanchan plant have actual capability to protect the land from erosion as it deeply rooted in the ground and at the same time its numerous branches acted as natural spur as well as porcupine which can reduced the inner current of the river and thus effectively protect the river bank erosion hazard. The villagers of the study area have been adopting the same since 1998. The indigenous knowledge systems as adopted by the villagers have proofed to be an effective eco-friendly alternative anti- erosion measure for the thousands of people affected by erosion problem. This unique method can be a harbinger of hope for the millions of helpless people as it can give a positive result. Planting kanchan plant can definitely contribute a lot towards the preservation of environment and it is again costeffective. People can disseminate the non-structural idea for benefit of mankind.

#### Conclusion

The Brahmaputra River along with its tributaries has been devastating in Upper Assam since the last few decades. Lakhimpur,

Dhemaji and Majuli are the worst affected districts. Though the people of the region have been demanding for a permanent solution of the destructive flood and erosion problem, the department concerned has not moved to the grave problem. Floods also occur due to frequent breaching of the existing embankments. The Govt. of Assam have adopting some structural anti- erosion measures in the form of construction of embankments, raising and strengthening the existing old embankments, raised platform, installing geo bags, spur, ringbund, porcupines, sluice -gate, etc. The non- structural anti- erosion measure, adopting by the Deori's of Bali Deori can be considered as a potential alternative effective anti-erosion measure. The indigenous knowledge on anti-erosion mechanism is a sustainable, eco-friendly, and cost-effective. A common man can contribute a lot towards the preservation of environment by simply adopting this measure. Unfortunately, so-called policy maker, politician as well as engineers are not interested to recognize the efficacy of the Kanchan plant due to their vested interest. The sole purpose of this research is to popularize the indigenous knowledge of Kanchan along with the other established measure and to disseminate the knowledge of Kanchanplant as community approach to mitigate flood associated erosion hazard. The plantation of Kanchan plant can reduce the vulnerability of the river bank erosion by flood and so it demands a serious investigation by the researchers.

#### Acknowledgement

Author acknowledges the sincere help and contribution of Mr. Bidya Sagar Deori, Mr.Mula Ram Deori, Mr. Ranjan Deori and Mr. Krishna Mohan Deori of Bali Deori gaon, Dhakuakhana in collection of data incorporated in the study.

#### References

- ASDMA., (2011-12): Assam State Disaster Management Plan, Govt. fAssam.
- Nath, D., {2009) The Majuli Island Society, Economy and Culture, AnshahPublications, Delhi, pp.20-30, pp.148-159.

- Das, P., Chutiya, D., and Hazarika, N., (2009): Adjusting to floods on the Brahmaputra plains. Assam, India. Kathmandu: International Centre for Integrated Mountain Development (ICIMOD).
- Bora, A.K., (2003) :Floods of the Brahmaputra in Assam: AS Management Approach. In Sabhapandit, P.C. (ed.) Flood Problems of Assam-Causes and Remedies, Omsons Publications, New Delhi.
- Goswami, D.C. (1985): Brahmaputra River, Assam, India: Physiograph, Basin Denudation and Channel Aggradation. Water Resource Research (Amer. Geophys. Union),

Dutta, Arup K., (2001): The Brahmaputra, National Book Trust p.3

000

### Interpreting Climate Change through Magic Realism: A Study on *Gun Island*

**Dr. Gayatree Bora** Associate Professor, Department of English Kamargaon College, Kamargaon, Golaghat, Assam

#### Introduction

Amitabh Ghosh, the Gyanpith award winner in 2018 has published his novel Gun Island in 2019 and it deals with climate change, migration, etc. Itis an ecological novel and it encompasses nature and environment. Amitabh Ghosh published his book The Great Derangement in 2016 and in this book the writer explains why people are not taking the issue of climate change seriously and people are not willing to act on the climate change. This book examines the problem from three major cultural modes -literature, history, and politics. The Hungry Tide is another novel set in Sudarban and the main character Piya Roy is in search of the rare Irrawaddy dolphin. Gun Island is the sequel of this interesting and famous novel The Hungry Tide. In this novel Amitabh Ghosh starts the story at Sundarban with the myth of Manasa Devi and the legend of Chand Sadagar and the later part of the novel deals with migration of two teenagers, Tipu and Rafi where Italy is the background. wrapping with the myth and supernatural elements the novel uses magic realism and criticizes the men-made climate change and its effect and

*Climate Change in North East India* ▶ 43

difference between the scientific technological world and the ancient world of myth and supernatural.

Magic Realism is a style of literary fiction and art. It paints a realistic view of the world while also adding magical elements, often blurring the lines between fantasy and reality. Magic realism often refers to literature that in particular, with magical or supernatural phenomena presented in an otherwise real-world. Magical realism uses a substantial amount of realistic detail and employs magical elements to make a point about reality. Magical realism is often seen as an amalgamation of real and magical elements that produces a more inclusive wryly form than either literary realism or fantasy.

William Spindler, in his article "Magic Realism: A Typology" suggests that there are three kinds of magic realism:

- 1. Metaphysical magic realism,
- 2. Ontological magic realism,
- 3. Anthropological magic realism where a native world view is set side by side with the western rational world view.

Amitabh Ghosh uses anthropological magic realism in his novel *Gun Island*.

#### Analysis

In the very first line of the first chapter of *Gun Island*, Amitabh Ghosh mentions about his journey as strange one. He mentions, "The strangest thing about this strange journey was that..." [Ghosh-3]. By using the superlative degree of the word strange he establishes that the hero is going to have a strange journey. Amitabh Ghosh establishes one legend of Chand Sadagar in the very beginning of the novel. He narrates the legend comparing it with Greek legend:

But the legend of the merchant Chand differs from the Greek epic in that it does not end with the hero being restored to his family and patrimony: the Marchant's son Lakhindar, is killed by a cobra on the night of his wedding and it is the boy's virtuous bride, Behula, who reclaims his soul from the underworld and brings the struggle between the Merchant and Manasa Devi to a fragile resolution [Ghosh, p-6].

Along with the mythical wrapping the writer documents the real disaster – the Bhola cyclone, which has been held in 1970. He

describes it:

Eight days earlier – on November 12, 1970, to be precise – a Category 4 cyclone had torn through the Bengal delta, hitting both the Indian Province of West Bengal and the state that was then called East Pakistan [a year later it would become a new nation, Bangladesh]. Storms had no names in this region back then but the 1970 cyclone would later come to be known as the Bhola Cyclone [Ghosh-13].

Strange part of the story is that when the whole delta of Sundaban had been affected by the cyclone, one village which had a shrine of Manasa Devi was not affected by the cyclone. Villagers believed that Manasa rescued them from the cyclone. One interesting point is that it is not only a legend of Hindu. Both Hindus and Muslims believed in that legend and the keeper of the shrine is Muslim:

Nilima had asked if it was strange for him, as a Muslim, to be looking after a shrine that was associated with Hindu goddess. The boatman had answered that the Dham was revered by all, irrespective of religion: Hindus believed that it was Manasa Devi who guarded the shrine, while Muslims believed that it was a place of jinns, protected by a Muslim pir, 0r saint, by the name of Iliyas [Ghosh-15].

The second chapter of the novel *Cinta* introduces one Italian character Cinta who had a dream which was very similar to her past memory of visiting a Jatra at Calcutta. Interestingly the theme of that Jatra was the legend of Manasa Devi. Cinta is a scholar from Venice working on the role of Venice in the medieval spice trade from India. Through the character of Cinta, Amitabh Ghosh makes the supernatural natural in his novel which is one of the characteristics of magic realism. Cinta says, 'So to say that you don't believe in the "supernatural" is a contradiction in terms – because it means that you also don't believe in the "natural". Neither can exist without the other'[Ghosh-35]. In this way Amitabh Ghosh is raising a very important point that whether a modern rational person will believe in the supernatural or not.

Cinta is also referencing to tarantism. This word comes from the word tarantola or tarantulas, – a kind of venomous spider that lives in southern Italy. Its bite can have strange effects on people. Spider was taking important role in the 'Venice' part of the novel. Like the venomous spider, in the very first chapter, Calcutta, the narrator encounters with a king Cobra:

Staring at it now, at a distance of only a few feet, realized that it was no ordinary cobra but a king cobra – a hamadryad - of a size such that its upraised head was level with mine [Ghosh-77].

It is a very natural thing that a huge cobra is there in the shrine at Sundarban

and it strikes Tipu. But later Tipu behaves in a strange way and murmuring mysterious words. As a characteristic of magic realism, the incident is presented in a very natural way but in the course of time Tipu can foresight things as if some spirit enters his body:

In the meantime, words were still flowing from Tipu's mouth. '...they're all over my body, they're wrapped around my hands, they're under my feet... but I'm not afraid of them; they're trying to help me... or else they would have got me already...'[Ghosh-81].

Along with different natural disasters like cyclones, Ghosh is also referencing to wildfire of Los Angeles. Wildfires are man-made and also the result of global warming. Ghosh is describing the fire from his journey by Aeroplan and his observation of two huge birds with a snake is very natural. But his screaming inside the Aeroplan makes the situation uneasy and he has been arrested by police official. The supernatural elements are going hand in hand with realistic situations.

In the same chapter there is a scene where at the sea beach there is an encounter with dogs and a sea snake and both are killed. It is a pathetic scene and it is natural that as a result of the wildfire and excessive heat, these yellow- bellied sea snakes are migrating northwards. These are extremely venomous. But important point is that at that time Gisa feels the presence of Lucia- Cinta's dead daughter's spirit. It makes the natural situation somewhat supernatural.

The last chapter of the novel depicts a marvelous scene.

'Birds', she said. 'They're birds – hundreds of thousands of them. No. Millions. They must be migrating northwards – they're going to pass right over us.'

Rafi too had appeared beside us now: Gazing at the sky he said: 'It's just as it says in the story – the creatures 0f the sky and sea rising up...'...

And then there they were, millions of birds, circling above us, while below, in the waters around the Blue Boat, schools of dolphins somersaulted and whales slapped their tails on the waves. [Ghosh-281]

The human migrants are in the boat, migratory birds are there in the sky, dolphins of various species and whales are there in the sea water. A storm is coming but nothing happens to the migrants. The novel ends with the death of Cinta and just before her death she feels the presence of her dead daughter Lucia's spirit. The novel starts with a strangeness and ends with a note of mysticism.

#### **Research Findings**

- 1. In this novel, along with the world of realistic scientific world the world of supernatural is going hand in hand.
- 2. In the 21st century modern world Author finds some relation and similarity of situation with the world of legend.
- 3. The author is the critique of industrialization which is responsible for acidification of the ocean and death of many sea animals.
- 4. The author mentions about many dangerous disasters i. e. cyclones, storms, Bonfire etc. and successfully establishes the consequences human migration, animal migration, unnatural behaviour of sea animals.
- 5. The novel successfully depicts the consequences of climate change.

#### Conclusion

The novel *Gun Island* is a fiction that deals with many ecological problems. The novel deals with global warming and climate change. It also deals with water pollution and ocean acidification which results in the loss of biodiversity. The exploitation of nature by humans closely effects all living things on earth. Science is not enough to understand reality. The ancient myths and history are riddled with strange natural

occurrences. Amitabh Ghosh tries to establish these things and use mystical phenomenon for the interpretation of inner reality. Legends of Manasa Devi, BandukiSadagar, Iliyas, venomous snakes, spiders, spirits are used to create the supernatural environment of the novel. After analyzing the novel *Gun Island*, it can be established that Amitabh Ghosh is using magic realism to establish his themes.

#### **Bibliography**

Ghosh, Amitav, Gun Island 2019, penguin Random House.

- Ghosh, Amitav, *The Great Derangement Climate change and the unthinkable* 2016 penguin Random House, India.
- Ghosh, Amitabh, The Hungry Tide 2004 Penguin Books Limited, India
- Environmental Concerns in Amitav Ghosh's Gun Island https// www.jetir.org
- *Witnessing Climate Crisis in Amitabh Ghosh's Gun Island* by N. Pancholi, http://rupkatha.com
- Magic Realism: A Typology, W Spindler 1993 Forum for Modern Language Studies, Volume xxix, issuel

000

## Climate Change: Effects on Indigenous People of Assam

Aparajita Kaushik & Chayanika Saikia Lecturer, DIET, Nagaon, Assam

#### Introduction

In this 21st Century, climate change is the most persistent and fragile topic which need special attention. No doubt, it is true that the climatic change on earth is a complex, polycentric deviation, presently causes a threat to the basis of human existence. One of the main causes is the wide range of human activities in the process of production and consumption of human needs. But its effects become a global threat and require collective motivation to overcome it. Assam, a small part of North -East India has recently witnessed a drastic change of climate. It is true that Assam has the evidence of climate change over the years and its impact on the social and economic condition of the people can be prominently observed in the last few years. It is no doubt that climate change is real and it is happening over the years for which human being are mainly responsible. The general observance of the subject reveal that climate change normally refer to a long term shift of temperature and weather patterns. The United Nations Framework Convention on Climate Change (UNFCC), 2015 describe climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods and also describes

it as a long-term shift in the statistics of the weather. According to climate scientists, as a result of climate change billions of people, particularly those in developing countries could face shortages of water and food and also face greater risks to health and life.

Climate change is the greatest global challenge facing us today which through a multitude of impacts poses a risk to our ecology, economy and society. Observation shows that changes being experienced in the climate of Assam are over and above the natural climate variability prevailing in the region. Studies have shown that Assam falls within areas of greatest climate sensitivity, maximum vulnerability and lowest adaptive capacity. Already, water resources in the State are scarce and have a highly uneven distribution both temporally and spatially.

The world today is faced with the challenge of sustaining economic growth while ensuring environmental conservation. Climate Change is a serious environmental threat to humanity and has implications for sustainable development. Our climate is already changing. Along with continued warming of the atmosphere, erratic rainfall patterns are emerging and as result new patterns of droughts and floods are being observed, which are likely to get more frequent and severe in future given the warming of the earth because of the anthropogenic emissions of greenhouse gases. The state of Assam has reason to be concerned about Climate Change, as we have a large population dependent on agriculture and forests for livelihood. The state's economy is also dependent on natural resources and any adverse impact on these and allied sectors will negate our efforts to alleviate poverty and ensure sustainable livelihood for the population. This is an opportune time to integrate the concerns of Climate Change into our policies and ensure ultimate objective of sustainable development with inclusive growth.

#### Objectives

- 1. To study the impact of climate change in socio-economic aspects of indigenous communities of Assam
- 2. To study the adaptation practices of different indigenous community affected by climate change in their livelihoods.

#### Methodology

The information is collected from primary source like discussion with village people of many Assamese villages and secondary sources like, various books, journals, internet etc. The methodology was used in this work and was carried out using participatory and interactive process to understand the impacts of climate change on various issues of indigenous people. The collected information is discussed and analyzed in this study.

#### Limitation of the study

Assam, a small part of North Eastern Region of India is the most fragile and environmentally sensitive region of the world and is regarded as one of the ecological hotspot because of presence of rich flora and fauna. Basically Assam has been witnessing the adverse effects of climate change for the last few decades. The IPCC report also describes the Eastern Himalayan range, of which Assam is a part, and is highly sensitive to climate change. To understand the climatic change of Assam an empirical research study was done in some hotspot area and some fragile issue were observed. The study is limited to the indigenous people of Assam.

#### Analysis

Observations indicate that since the last 60 years (1951-2010), the annual mean temperature in Assam has increased by 0.59oC and the annual rainfall has decreased by -2.96/mm per year. Frequent, heavy precipitation in the form of cloud bursts have been reported in recent years which have led to devastating flash floods. Climate change projections for Assam indicate that mean average temperature is likely to rise by +1.7-2.2oC by midcentury with respect to 1971-2000. There is likely to be increase in extreme rain fall events by +5 to 38%. All across the State, except in the southern districts, droughts weeks are going to rise as well, by more than 75% with respect to the base line (1971-2000). As regards floods, projections increase a rise in events by more than 25%.

In several areas, the income of families who are solely dependent on agriculture for their livelihood has declined several folds as with climate change there has been a change in the rainfall pattern and also there has been a decrease in the rainfall. It was also seen that there has been a rise in the frequency of drought like situation in the state which is also affecting the economic conditions of the farmers in the state. The economic deterioration resulted the womenfolk who are basically home maker to work to supplement the families' income. Many poor families pointed out that this affects the education of the girl child also as the responsibilities of the household shifted to the girl child. In Majuli, the world largest river island in the river Brahmaputra, increased erosion has been considered as one of the major impact of climate change. The climatic condition varies from place to place, with drought on one hand in Baksa District, while heavy floods erode away huge tracts of land in Majuli and Dibrugarh District. It may be concluded that the impact of climate change in Assam can be observed mainly in following different issues- flood, livelihoods, tea production and rice production and on women. In this regard there is no concerted effort so far on the part of the Government agencies to address the issue of climate change as a whole, although work is done to mitigate the effects of flood and erosion in the state of Assam. It is needless to say that unless the problem is treated at the root by the concerted

We have tried to discuss about the impact of climate change on different tribal community through this study:

#### Impact on Assamese community as a whole:

Assamese people are mainly related to agriculture. About 49.34% of the working population is engaged in Agriculture and allied services8. Rice is the main cereal produced and about 105 million tons of rice was produced in 2012-13. The next brig crop is sugar cane, the production of which was 314 million tons during the same period2. The Tea industry plays a vital role in the State as well as national economy. The tea production of the country (Economic survey, Assam, 2009-10). Assam is also the third-largest producer of petroleum and natural gas in the country and has ample reserves of limestone. Bamboo artifacts, Muga silk, paper are some of the other natural resource based industries thriving in the State. Agriculture is

primarily rain-fed. But erratic rainfall in the past few years has compelled farmers to adapt to new cropping patterns. They are now focusing on cultivating Rabi crops and have decreased their dependence on paddy cultivation for livelihood. Warming of the temperature reduces production of staple crops such as rice, horticulture produce, economically important tea produce, milk yields and fish catch. Coupled with increasing intensity of rain fall in some areas and intensive droughts in others, emergence of new pests and diseases, the yield realization in a business as usual agriculture practice scenario are likely to become lower According to the Assam State Action Plan of Climate Change study, in recent years, seven districts of Assam have recorded more than 10 heat waves and 12 districts have recorded drought-like situation.

#### **Impact on Mishing Tribe :**

The Mishing tribe is one of the major indigenous tribes in Assam, primarily residing in the riverine areas of the Brahmaputra Valley. Mishing Tribe is also known as Miri community. Mishing people have rich cultural heritage and they are known for their distinct language, traditions, customs, food habits etc. Now a days their practices of living in the riverine areas become lower due to flash floods issue in Assam occur twice ina year. Their unique techniques for constructing houses on stilts, known as "Chang Ghar," which are resilient to floods are now-a- days not seen regularly in Mishing villages. They have extensive knowledge of sustainable agriculture technique such as organic farming, terrace cultivation, agroforestry; they also possess the knowledge of traditional flood resistant paddy cultivation. Mishing tribe, also have developed sustainable fishing practices based on their deep understanding of local rivers and fish habitats. They employ techniques like fish sanctuaries, fish traps, and selective fishing methods that help in maintaining fish populations and preserving aquatic ecosystems. But those indigenous practices are mainly seen in photos only now-a-days. Climate change has hidden their indigenous skills In Majuli like other parts of South Asia climate change is having disproportionate impact of marginal people particularly the Mishing communities who live and depend on the river island for their livelihood.

Majuli is stuggling with soil erosion, changing rainfall pattern, drainage discharge of the Brahmaputra River. The mishing community is seen migrated towards cities and any urban areas as they are affected by climate change as their livelihood becomes a question for them.

#### **Impact on Bodo Tribe**

The Bodo tribe, is an indigenous tribe in Assam, mainly residing in the Bodoland Territorial Region (BTR). The Bodo tribe is also an agrarian community. Their agriculture based practices mostly depends on rainfall. Due to the affects of climate change Bodo people also have migrated towards cities. The inevitable process of urbanization brought environmental degradation, besmirched quality of life and knocked out the root of sustainable development from cities and towns. The limited resource bases of cities are notable to cope with the ever increasing pressure of people migrating from rural areas for a variety of reasons.

#### **Impact on Tiwa Tribe**

The Tiwas are one of the indigenous communities residing in the state of Assam in northeastern India. The Tiwa tribe is also known as Lalung. The Tiwas inhabit in both the plains and hills of Assam. Concentrations of the Plains-Tiwas are prominent in Nagaon, Morigaon and Kamrup districts, while the Hills-Tiwas are mainly confined to westernmost part of Karbi Anglong district. The Tiwa people have a rich cultural heritage and possess traditional knowledge. They possess knowledge about agricultural practices, food habits, medicinal practices. The Tiwa tribe, rely on agriculture as their primary source of sustenance. They practice slash-and-burn agriculture known as "Jhum" in the hilly areas, while the Plain-Tiwas practice wet cultivation. The Tiwas grow multiple crops with paddy being the main crop along with maize, cucurbits, beans, yams, aroids, sesame, and other minor products. While crops are primarily grown for consumption, surplus produce, such as turmeric, chili, cucurbits, sesame, and aroids, is sold in local markets to generate cash income. Agroforestry, including the cultivation of bamboo, ginger, turmeric, broom grass, pineapple, and betel nuts, has become popular and has provided economic benefits. It is observed that climate change urged hill side Tiwa to migrate plain areas as land slide arises day by

day due to deforestation. By migration now a days cultivation of various hill side crops are observed very low as compared to the earlier century.

The Tiwa tribe also has a rich tradition of craftsmanship, including bamboo and cane work, pottery, weaving, and traditional handloom textiles. In present days these traditional crafts are less practiced in villages because of scarcity of raw materials as people build industries, buildings in hill side by cutting trees, demolishing hills. The Tiwa tribe has its own Community fishing affair. The Junbeel Mela is a popular community fishing event among the Tiwa people, particularly during the winter season when water levels decrease. It originated around the 15th century AD as a means to foster unity between the hill and plain dwellers. Junbeel mela is a three-day traditional fair held in the weekend of Magh Bihu at a place Dayang Belguri in Junbeel near Jagiroad in Morigaon district of Assam. One unique aspect of the Junbeel Mela is the prevalence of a barter system. Since last decades the mela has lost its charming because people do not get much more products like earlier. Climate change is the cause of this. Deforestation makes hills a no man zone and people loose their livelihoods.

#### Impact on Karbi Tribe

Karbi also known as Mikir, especially living in the hill s areas of Assam. Karbi people are mainly residing in Karbi Anglong and west Karbi Anglong districts of Assam. Besides these two districts karbis are inhabited in the areas including DimaHasao, Kamrup, Marigaon, Nagaon, Golaghat, Karimganj and Sontipur districts of Assam. Natural products are generally used in the construction of their houses. Various locally available natural products are used constructing their houses. Elements of a house like khuta (post), borkhuta (main post), roof, door, boundary fencing are constructed using different species of bamboo, tree, and thatch which they can easily gather from the immediate environment. Due to the scarcity of bamboos and other trees, Karbi tribe becomes less interested to practice their indigeneous habits.

#### Impact on fishing community:

In a village in Nagaon district, Assam, fisherwomen from the Kaibarta community – a Scheduled Caste – would gather every

evening in groups, across different water bodies nearby, to catch fish for dinner. They would use this time to socialize, talk to each other about their problems, and gossip. This was the only time of the day that they had for themselves-it was their 'leisure' time. And at the end of it, they would return home with food for dinner. Community fishing had been a part of their culture for long. Since childhood, these women had seen their mothers finish their household chores and go fishing with other women. For generations of fisherwomen, this activity was not only liberating, but also empowering. This is because unlike their upper-caste counterparts who were hardly allowed to step out of the house, women of the Kaibarta community could go out and contribute to the family income. Deteriorating ecology in the area over time has led to many community water bodies drying up or becoming polluted. Consequently, the social lives of these fisherwomen are slowly vanishing. They now have no place to practice community fishing and spend leisure time with other women. The only place they meet each other now is at self-help group (SHG) meetings. Changes to the local climate have fundamentally altered an important part of their life, and a long-standing tradition.

#### **Community dependent on Forest and Biodiversity:**

Forests essentially play a key role in providing different ecosystem services that include its role in conditioning the microclimate in and around forests, conservation of watersheds originating from within forests, and providing timber and biodiversity that are harvested to sustain livelihoods of forest dependent communities. In Assam, forests are increasingly getting degraded due to population pressure and associated drivers. Further, climate change is influencing the biodiversity, thus affecting forest produce and hence dependent livelihoods. The State is also endowed with extensive biodiversity rich wetlands that are increasingly being threatened by anthropogenic drivers.

#### Major Findings of the study:

Major findings of the study can be stated as follows:

Climate change is a matter of great concern for the indigenous communities of Assam. Life styles of the indigenous communities

*Climate Change in North East India* **▶** 56

are getting changed due to climate change. Climate change is posing a threat to the indigenous practices of these communities. Indigenous agricultural practices are disrupted due to changing pattern of rainfall and other climatic conditions. Climate change is also affecting the food culture of the state.

#### Conclusion

This study's analysis and findings show the multifaceted effect of climate change on the indigenous communities of Assam. To preserve their unique lifestyles and indigenous practices these communities should adopt new strategic plans. The study can provide a basis for promoting sustainable solutions to the adverse effects of climate change. The study can also deepen our awareness of the difficulties that are being faced by these communities of Assam. Due to the flood the children of different communities are affected by different diseases like dysentery, jaundice, skin disease, malaria, cold and fever. In Baksa and Goalpara District, due to flood and soil erosion people from Rabha and Hajong community become homeless and their child and upcoming generation have been struggling with many more health issues which become a hurdle of development of that underdeveloped and marginalized section.

#### Reference

- https://www.sentinelassam.com/topheadlines/climate-change-and-itsimpact-in-assam-646497
- https://www.un.org/esa/socdev/unpfii/documents/back grounder%20climate%20change\_FINAL.pdf

https://files.eric.ed.gov/fulltext/ED503680.pdf

https://link.springer.com/article/10.1007/s11356-022-19718-6

https://www.researchgate.net/publication/311301385\_ Climate\_Change

#### 0 0 0

## Climate Change, Environmental Issues and Prospects of Jute Farming in Assam: An Analysis

#### **Dr. Bidyut Jyoti Kalita** Assistant Professor, Department of Commerce JDSG College, Assam

#### Introduction

In recent years, the issue of climate change has become increasingly pressing and demands urgent attention. The Earth's climate is rapidly transforming due to various human activities, such as the burning of fossil fuels, deforestation, and industrial processes, which release greenhouse gases into the atmosphere. This leads to a significant rise in global temperatures, extreme weather events, rising sea levels, and disruption of ecosystems. The consequences of climate change are far-reaching and affect every aspect of life on our planet. From threatening biodiversity and agricultural productivity to endangering human health and exacerbating socio-economic disparities, the impacts are both wide-ranging and severe. Urgent action is needed to mitigate the effects of climate change and reduce our carbon footprint to ensure a sustainable and habitable future for generations to come. Efforts to combat climate change require collective action from governments, businesses, communities, and individuals. It is essential to transition to cleaner energy sources, promote sustainable practices, and adopt policies that prioritize environmental conservation and preservation. Environmental issue is

the prime concern of policy makers and other stakeholders of economy of the contemporary era. Globally consumers are also becoming environment friendly and Indian consumers are not an exception to it. Although the per capita income of Indian household is much lesser than the households of developed nations, but in terms of ecological concern growing consumer awareness is remarkable. Restricting the use of single use plastic by the government is an appreciable step in this regard. However, availability of alternative of plastic packaging material is an issue that requires attention of the policy holders, researcher across the world. It is anticipated that using natural fibre will help to preserve the environment and significantly lessen the ecological problems the globe is currently facing. The least expensive natural fibre that is frequently used as packing material is jute. Due to its intrinsic qualities, jute ranks second in the world among natural fibres, only behind cotton. Jute's technical benefits, such as its strength and fibre length, are secondary to its environmental friendliness and biodegradability. Jute and related fibres are in demand as environmentally acceptable packaging materials in the light of increased worldwide awareness of environmental issues. Environmentalists contend that synthetic fibres are polluting the environment. (Sadat & Chakraborty, 2015). The Food and Agriculture Organisation (FAO) has designated 2009 as the "International Year of Natural Fibres" in recognition of the ecological value of natural fibre. This process of making these natural fibres more widely known is accelerated by the inclusion of environmental sustainability as one of the main goals of the Millennium Development Goals (MDG). Jute has historically been employed as a packing material, but because to its diversification in the modern era, it is now used in all facets of human life.

#### Literature review

The negative effects of global warming have raised awareness of the need to protect the environment. Because of this, natural fiberbased eco-friendly goods and services are well-liked both domestically and abroad (Mohiuddiin, 2015). Afrin (2011) emphasised the need to switch from plastic bags to jute bags. According to the author, consumers of jute bags expressed satisfaction with the bags' multiple usage, weight, durability, and environmental friendliness. According to Pandey (2013), it is imperative to replace plastic with renewable natural fibres such as jute, ramie, hemp, and kenaf in order to preserve the environment. These renewable and biodegradable fibres have the tactical benefit of being widely accessible. Once more, the author claimed that farmers involved in crop production and processing would directly profit from the use of these conventional fibres in certain activities. Therefore, the underprivileged and impoverished members of society will benefit from the investigation and diversification of surplus and residual fibres. By creating a balance between the socioeconomic and environmental needs of the present and future generations, sustainable development strategies promote harmony between the process of growth and the protection of nature (Sadat & Chakraborty, 2015).

#### Objectives

Present study is undertaken with the following objectives;

- (i) to study the growing importance of natural fibers in the contemporary era,
- (ii) to highlight the contemporary scenario of natural fiber farming in Assam, and
- (iii) to highlight the constraints faced by the farmers in the process of production of jute fiber.

#### Methodology

The primary and secondary data were used in the study. Books, journals, and websites belonging to different national and international organisations were visited for secondary material. The researchers conducted a field survey to gather primary data. Geographically, Nagaon district of Assam is the study's location. Primary data were gathered using a multi-step sampling technique. In the lack of a specific sample frame of Jute producers of Nagaon district were chosen from two agro-climatic zones based on area and volume of raw Jute output. 100 farmers in all were interviewed; they were chosen using a nonprobabilistic snowball sampling technique and a predetermined timetable. Depending on the objectives of the study, the farmers' responses are recorded on a nominal and likert scale.

#### Analysis and findings

#### Growing demand of environmental friendly natural fiber

Growing environmental consciousness around the world is encouraging a move from petroleum-based chemicals to renewable resources, which opens up new markets for natural fibres. Jute fibre is environment friendly and biodegradable. It preserves the natural equilibrium and safeguards the ecosystem (Islam and Ahmed, 2012). As per Chowdhury & Rashed (2015), there is a growing demand for Jute goods in both domestic and international markets, along with increased awareness of the environment. India has a monopoly on the global jute market because it is the world's largest producer of jute. Nonetheless, the majority of its production is consumed domestically, which affects the amount of exports overall. Cultivation of Jute in India is mainly confined to the eastern region states West Bengal, Bihar, Assam, Tripura, Meghalaya, Orrissa and Uttar Pradesh. Nearly 50 per cent of total raw Jute production in India alone figures in West Bengal. The following table shows export data jute goods from India. It includes, traditional and non-traditional jute products

#### Table1: Export of Jute goods from India

Year	Quantity	Value
2013-14	161.70	20243.56
2014-15	102.50	17269.48
2015-16	87.10	18332.64
2016-17	84.01	20151.45
2017-18	92.29	20947.15
2018-19	71.63	21681.21
2019-20	71.37	23370
2020-21	57.01	26435.60
2021-22	81.44	36597.51

Source: Compiled from data of National Jute Board



**Diagram 1: Export of Jute goods from India** 

Source: Compiled from the data of National Jute Board

From the above table it is clear that export of Jute goods (in terms of value) is increasing in the last decade. It implies the growing demand of products made from natural fiber. This emphasised on the growing demand and market opportunities for all the stakeholders of the economy including farmers.

#### Contemporary scenario of Jute production in India:

The contemporary scenario of Jute production in the last decade is presented with the following tables,

#### Table 2: Contemporary scenario of Jute production in India

Year	Production
2010-11	1960380
2011-12	1912000
2012-13	1944000
2013-14	1968000
2014-15	1789200
2015-16	1853749.2
1	

Year	Production
2016-17	1877760
2017-18	1726380
2018-19	1709460
2019-20	1700820
2020-21	1720000

Sources: Compiled from data of FAO

#### Diagram 2: Contemporary scenario of Jute production in India



Sources: Compiled from data of FAO

#### Constraints faced by the Jute farmers

A weighted problem index was constructed to identify the most influencing factors or problems faced by farmers in the area. Higher the index higher is the problem intensity (Hussian et. al., 2002)

SINo	Problems related with Jute cultivators	Rankorder
1	Lack of availability of labour	1
2	Increasing wages of labour	2
3	Increasing price of the seeds	3
4	Increasing price of fertilizer	4
5	Problem related to pest and disease	5
6	Problem of price related information	6
7	Problem of pest and disease in storage	7
8	Lack of grading knowledge	8
9	Excessive dependency of middleman	9
10	Lack of interest among new generation for the crop	10

Table 3 : Rank order of the problem faced by farmers

Among the above stated problems, the foremost problem faced by the growers is the scarcity of labour forces. Jute is a labour intensive crop, and more than 80 per cent of cost of production is comprised of labour cost. The scarcity of labour force arises mainly due to migration of labour forces to the other industrialised areas of the nation in search of non-farm livelihood. Declining interest towards farming among rural youth and growing preferences for non-farm incomes is another factor. They prefer to adopt and involve in non-farm incomes like shop keeping, retailing, electrical work, plumbing etc., rather than farming. Different government schemes like, subsidized rice through ration shop, MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) etc., has also an influence on labour supply. Another problems faced by the farmers is the increasing input cost. Increasing cost of inputs increases the total cost of production and thus influence profitability. Increasing price of seeds, price of fertilizers and wages of labour often affect the farmers. Another problem that needs action on the part of concerned authorities is the establishment of proper market

*Climate Change in North East India* **→** 64

structure. It may be in terms of physical infrastructure, market intelligence etc. It was observed that due to absence of proper storage facilities they are unable to get the storage advantage till the price rise. Besides, dissemination of market intelligence in a transparent way can lead the farmers towards remunerative returns. Bepories (traders) or the fellow farmers are the only source of price related information. Thus, traders take undue advantage of ignorance of the farmers by forming unfair understanding among them. Elimination of excessive dominance of bepories can contribute towards stable earnings for the farmers. Declining productivity is another issues faced by the farmers, due to absence of soil testing, inappropriate use of fertilizer the fertility of the soil is degraded. Again, Pest and disease, poor quality seed can be attributed to this cause to some extent as revealed by sample respondents. Thus actions of these problems is utmost important to have a better yield. It was observed that farmers are using the conventional method of retting and most of them are ignorant about modern retting facilities. Due to use of stagnant water farmers are unable to produce quality fiber in conventional retting. Colour of the fiber is also deteriorate due to the influence of mud in this traditional retting procedure. As a result farmers are unable to get a reasonable price in market. As the colour of the fiber is one of the major criterions in determining the market prices of raw Jute in the primary market.

The coverage of JCI is also very low in the area. Lack of interest among of new generation towards this crop is another concern in the study area. This was more visible among the farmers belonging to Assamese community.

#### Conclusion

In this era environmental awareness, eco-friendly products and services are becoming popular among the people across the globe. Environmental sustainability is ensured through the use and adoption of environment friendly, renewable, biodegradable resources. In the process of achieving environmental sustainability, it is utmost important to ensure uninterrupted fiber supply. This is possible only when the fiber cultivation is viable in terms of its economic return. This demand adequate concerns on the issues and constrains of the farmers from a holistic perspective. To apprehend the opportunities arise out of environmental awareness, strengthening the existing production base, removing fluctuating decline in production as well as acreage, value addition through quality production and promoting diversification at the grower's level is suggestive. Identification and removal of the above mentioned constrains, capacity building, creation of awareness on modern method of cultivation can contribute to a large extent in this context.

#### **References:**

- Chowdhury, Iftekhar Uddin Ahmed and Rashed, Sharfuddin. (2015). Market access of Bangladesh's jute in the global market: Present status and future prospects, *Journal of Economics and Sustainable Development*. Vol.6, No.3
- Hussian, Mohammad, Rahman, M., Uddin, M.N., Taher, M.A., Nabi, M.N. and Mollah, A.F (2002) Problems and solution in jute cultivation faced by farmers in a selected areas of Bangladesh. 2.9.628-629
- Islam, M. S. and Ahmed S. K. (2012). The impacts of jute on environment: An analytical review of Bangladesh, Journal of Environment and Earth Science, Vol 2, No.5, 24-32
- Mohiuddin, M. (2015). Green marketing of jute and jute products: A study on Bangladesh. *IOSR Journal of Business and Management (IOSR-JBM)*, Volume 17, Issue 2. 52-57.
- Pandey, A.K. (2013) Development of technology to produce seamless low cost jute carry

bags using modified power loom. Project Report. National Jute Board, Kolkata

Sadat, Abdul. & Chakraborty, Kaushik. (2015). Insect pest constrains of jute and its control by biological agents under modern eco-friendly sustainable production system. *international Journal of Multidisciplinary Research and Development*. 2. 3.316-321

#### 0 0 0

Climate Change in North East India >> 66

### Community in Environment Protection and Climate Action-the concerns of Group of 20 (G20) under India's Presidency

#### Dr. Parimita Bhuyan

Assistant Professor, Department of Political Science, Government Model College, Kaziranga, Assam

#### Introduction

The academic discourse and policy dialogue concerning environment and climate issues perceives 'community' as a core component emphasizing on two major aspects- fulfilling the needs of the community in the course of environment protection and climate action; and simultaneously, ensuring the engagement of the community in environmental protection and climate action. The global environmental regime has recognized 'community' as a significant stakeholder in environmental protection and climate action and consequently, global platforms have taken into attention the potential role of community in this regard. The Group of 20 (G20) which is an informal platform of developed and developing countries have placed environment as one of its core agenda recognizing that deliberations on development cannot be encouraged in exclusion to environmental and climatic issues. The holding of G20 Presidency by India from 1st December, 2022 to 30th November, 2023 has led to the prioritization of issues concerning environment and climate change. The G20 deliberations under India's Presidency reaffirm the commitments of earlier initiatives as-fulfilling the Sustainable Development Goals (SDGs) by 2030; achieving Paris Conference Climate Goals; reaffirming the Addis Abada Action Agenda; reestablishing the earlier principles of Common but Differentiated Principles (CBRD) and so on (G20 New Delhi Leaders' Declaration, 9-10 September, 2023). These recent G20 deliberations under India's Presidency also advocated some unique strategies and principles as part of solutions to the problems of environment and climate change as-Sustainable Lifestyles for Climate Change; sustainable, just, affordable and inclusive Energy Transitions; Circular Economy; Zero Waste and Resource Efficiency; Climate Sensitive and Agro Ecological Approaches and so on (G20 New Delhi Leaders' Declaration, 9-10 September, 2023). The Principle 1 of G20 High Level Principles emphasizes on the adoption of an "integrated multilevel and multi-stakeholder approach" (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June, 2023) thereby recognizing the role of multiple stakeholders in environmental protection and climate action. In this multi-level and multi-stakeholder approach 'community' is recognized as a prominent stakeholder with strong potential to contribute towards environment protection and climate change. The G20 High Level Principles as well as the G20 Outcome documents released under Indian Presidency has made strong reference to the 'community' in the sphere of environment protection and climate action. In this context, the author has felt the need to examine how the community is placed as a core component in environmental and climate discourse in G20 deliberations under India's Presidency.

#### **Objective and Methodology of the Paper**

The paper aims to study how 'community' has been emphasized

as a significant actor in environment protection and climate action in G20 deliberations under India's Presidency. Under this broad objective, the paper looks into three main aspects:

- i. Conceptualization of 'community' in G20 environment discourse under India's Presidency
- ii. Recognition to vulnerabilities of community in G20 environmental discourse under India's Presidency
- Emphasis laid on community engagement (in terms of community behavior, community knowledge and community participation) in G20 environmental discourse under India's Presidency.

With this understanding, the paper proceeds to point out the limitations of G20 deliberations in conceptualizing and strategizing 'community engagement' in environment protection and climate action.

The paper relies on data collected from two sets of literature. The first set of literature consists of G20 outcome documents released under India's Presidency as- Outcome Document and Chair's Summary of G20 Development Ministerial Meeting Varanasi, 12 June, 2023; Outcome Document and Chair's Summary of G20 Environment and Climate Minister's Meeting, Chennai, 28July, 2023; G20 New Delhi Leaders' Declaration, 9-10 September, 2023 and so on. This set of literature has helped the author to examine the nature and content of G20 environmental discourse and deliberations under India's Presidency. The second set of literature consists of reports and scholarly writings of prominent agencies and authors; and this set of literature has helped the author to gain comprehensive and critical understanding of terms as community, community participation, community engagement, community behaviour and so on. The paper is descriptive and analytical in nature and content.

# G20 Environmental Discourse on Conceptualizing 'Community'

The term 'community' is conceptualized in social science with reference to not one single criterion or standard as there are multiple

standards across social science disciplines to conceptualize the term. Community is understood in relation to physical proximity; or shared values, beliefs, worldviews; or group identity; or interaction; or belonging; or support or many other themes or standards (Cobigo, Martin &Mcheimech 2016). The academic discourse in social sciences, in general, perceives community as a social group of people with some distinct features as-living together and/or sharing a common history or values with a spirit of togetherness in supporting one another(Hassan& Islam 2014; Martin&Mcheimech 2016). Perceived in this sense community has the distinction of being a collective based on shared values, history and belief; and is closely tied together with a spirit of belongingness.

Community participation that forms one significant dimension of community engagement implies the involvement of a group of people residing in a specific geographic area and conditioned by the subcultural or life processes of cooperation, assimilation, competition and conflict in a particular project or endeavor (Pender 2006). Environmental community initiatives are marked by collective approaches where individual form or join a group in order to pursue a common goal; encompasses bottom-up strategies; and theyaim to change themselves by changing their behaviour and the behavior of the communities they are embedded in (Sloot, Jans&Steg 2017). Environment conservation through community participation, as perceived by United Nations Framework Convention on Climate Change (UNFCCC) is integrating traditional conservation activities with livelihood issues.

The G20 outcome documents under India's Presidency referred to terms as "local communities and indigenous people", "community based and indigenous led efforts" (G20 Environment and Climate Ministers Meeting- ECMM Chennai, 2023) "traditional communities", their 'participation', their 'knowledge', "community behaviour" (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June,). The outcome documents emphasized "community based and indigenous led efforts" in forest management, restoration of degraded land, in protection of marine ecosystem and so on. Based on study of these outcome documents it may be perceived that G20 deliberations have taken into account multiple criteria or standards in their conceptualization of community. The G20 deliberations take into account the criteria of geographical proximity detailing "local community"; whereas the understanding of "community behavior" is based on perceived sense of belongingness to a greater collective. The recognition given to traditional knowledge and experiences of local communities in the field of environment protection and climate action clarifies that G20 deliberations under India's Presidency has taken into account the criteria of shared experiences and values in its conceptualization of community. The outcome documents in projecting their commitment to address the vulnerabilities of community, have specifically taken into account the vulnerabilities of the most vulnerable as women, poor people, people with disabilities and so on. Based on the study of the G20 outcome documents under India's Presidency, it may be stated that Community Engagement in G20 deliberations is conceptualized as climate actions from below which are directed towards bringing positive changes in the climate and environment. These documents mainly mention three terms in relation to Community Engagement in climate action - Community Participation; Community Behaviour and Community Knowledge. Precisely, G20 deliberations under India's Presidency adopt an inclusive and comprehensive notion of community. The placement of community as a significant stakeholder portrays G20's transition towards adoption of a bottomup approach in environmental discourse.

# G20 Environmental Discourse on recognizing Vulnerabilities of Community

The incorporation of an integrated approach in G20 environmental and climate discourse under India's Presidency promises the achievement of three dimensions of sustainable development; namely- economic, social and environmental- in a balanced and integrated manner (Outcome Document and Chair's
Summary, G20 Development Ministerial Meeting, Varanasi, 12 June 2023). Accordingly, recognition is paid to the interrelationship between the environmental and the social: and that the environmental or climate problems need a social lens for its solution. The outcome documents stated that the consequences of climate change are acutely felt by those sections of population who are in vulnerable situations as-women and girls, local communities, youth, children, older persons and persons with disabilities (Environment and Climate Ministers Meeting- ECMM, Outcome Document and Chair Summary, Chennai, 28th July, 2023). Hence, the documents confirmed that solutions to environmental problems must go together with addressing their vulnerabilities. The G20 deliberations emphasized that an approach of sustainable development must take into consideration the fulfillment of their socio-economic needs in a sustainable manner. The documents reaffirm that eradication of poverty in all its forms and dimensions, including extreme poverty, is crucial for sustainable and climate resilient development paths (ECMM, Outcome Document and Chair Summary, Chennai, 28th July, 2023). The G20 document's came up with the concept of 'antyodaya' that aims to fulfill the basic needs of the poorerst of the poor and this concept has further been emphasized in the Principle 2 of the G20 High Level Principles on Lifestyle for Environment. The principle states, "Aim to support the international and national efforts towards meeting the basic needs of all people, especially poor and people living in vulnerable situations and leaving no one behind" (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June,). The principle projects its concern towards community by promising to address the aspirations of the poor and people leaving in vulnerable situations in the course of achieving environmental and developmental goals. The High Level Principle 2 mentions its commitment towards "poverty reduction; reduction of "energy poverty" and "upliftment of the poor and people living in vulnerable situations".

#### **Diagram 1: G20 documents recognizing Vulnerabilities of Communities**





The G20 deliberations on environment and climate action under India's Presidency perceive the needs of the community in an allinclusive manner and therefore, addressing the needs of women constitutes a core component of the environmental discourse. The provisions of equal opportunities for women in education, skill training, decent work, nutrition and so on are conceived as pre-requisites in the way of achieving women's involvement in climate change mitigation, adaptation action and disaster risk management (Outcome Document and Chair's Summary, Varanasi Development Ministerial, 12 June 2023). The rights of women to live freely from gender based violence and abuse; women's equal access to economic, digital and health resources and social protection; women's accessibility of affordable care infrastructure and so on- are emphasized in the course of environmental deliberations which signifies the concern towards fulfilling the needs of the entire community inclusive of women. In a similar tone, the G20 deliberations take into account the specific needs of the local communities who are dependent on forest for the fulfillment of their economic and social needs. The documents state that policies aimed at curbing deforestation must take into account the social and economic challenges of indigenous people and local communities (ECMM, Outcome Document and Chair Summary, Chennai, 28July, 2023).

Precisely, the G20 environmental discourse under India's Presidency reaffirms the inter relations between the 'environmental', 'social' and 'economic' dimensions of sustainable development. The environmental discourse of G20 under India's Presidency perceives the community in an all-inclusive manner that incorporates women, poor, youth, forest dwellers and so on; and thereby, proceeds to meet their basic needs in due course of environmental protection and climate action.

#### G20 Environmental Discourse on Engagement of Community

The recognition of the needs of the community in G20 environmental discourse under India's Presidency is followed by its concern towards ensuring the engagement of the community in environmental protection and climate actions. The G20 deliberations emphasize community engagement in multiple levels of climate change mitigation and climate risk management as in-wildlife management; forest management; water management; climate resilient blue economy and so on. With an aim to study community engagement in G20 environmental/climate discourse (under India's Presidency), the paper emphasizes on three points:

- Community Behaviour in Environment Protection and Climate Action
- Community Knowledge in Environment Protection and Climate Action
- Community Participation in Environment Protection and Climate Action

The G20 environmental discourse has come up with inputs from behavioural science approaches and therefore, advocates climate friendly/environment friendly consumer choices and sustainable production patterns. Under the dictum of "lifestyle for environment", the G20 documents uphold the responsibility of various stakeholders (including private sector, government, market, community and even individual) to carry on sustainable lifestyles (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June, 2023). This concept of "lifestyles for environment" is intricately connected to approaches as resource efficiency, circular economy including zero waste initiatives and other relevant approaches. The underlying philosophy is reducing the pressure on environment through sustainable choices. The Principle 3 of G20 High Level Principles on Lifestyles for Environment states-"Promote environmentally friendly individual and community behavior including by using behavioural sciences approaches such as nudging and incentives for sustainable and an environmentally conscious lifestyle and choices" (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June, 2023). The building up of a system of sustainable lifestyle- a lifestyle that is inclusive, accessible, affordable and environmentally sustainable; lies at the core of the project of lifestyle for environment. The role of the community is prominent in this regard as the community (and individual) has to aspire for this lifestyle. The motivation of community towards such lifestyles depends on- quality education, training, awareness of community members as consumers and in this regard the role of policy makers becomes significant. The role of behavioural science approaches as nudging and incentives are highlighted in this connection as moulding of community behaviour lies at the core of sustainable consumer choices. The adoption of sustainable and resilient food systems, sustainable agricultural practices, green skilling of produces and consumers and so on has been considered as significant initiatives in the attainment of sustainable lifestyles.

The importance of community knowledge or knowledge of indigenous communities constitutes a significant dimension of community engagement in G20 deliberations. In this connection mention may be made of Principle Seven of G20 High Level Principles on Lifestyles for Sustainable Development. The principle states-"recognize and amplify the role of I) ocal communities, local and regional governments and traditional knowledge in supporting sustainable lifestyles" (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June, 2023). The principle recognizes that local communities possess knowledge on ground level sustainability practices; sustainable use and management of biodiversity and ecosystems. With this recognition, the principle advocates empowering traditional and local people (and indigenous communities) facilitating their sharing of knowledge as well as their participation in policy making through inclusive planning process. This principle mentions that incorporation of local community's traditional knowledge in formal planning process is a way towards "SDG's localization" (G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June, 2023); that implies realization of the SDGs at local level with utilization of local knowledge so as to make sustainable, inclusive and just transitions globally. Local communities dependent on forest find specific mention in the G20 documents on environment and climate action. The G20 environmental discourse recognizes the potential of these local communities in sustainable management of forests and urges for supporting them in this regard. It has been stressed that the forest communities are to be empowered to trade in forest products that have been legally harvested and sustainably produced (ECMM Outcome Document and Chair Summary, 28 July, 2023). The utilization of community knowledge and practice for better conservation of forest based natural resources as well as for reduction of impact of forest fires gave been highlighted in the G20 environmental discourse under India's Presidency (ECMM Outcome Document and Chair Summary, 28July, 2023).

The third aspect of community engagement that has assumed a place of significance in G20 environmental deliberations under India's Presidency is ensuring the participation of community (community participation) in environment protection and climate action. As a part of community participation, the G20 documents emphasized enabling women to take up leadership and decision making roles at all levels including climate change mitigation, adaptation actions and disaster

risk management (Outcome Document and Chair's Summary, Varanasi Development Ministerial, 12 June 2023). In the context of remediation of degraded mining lands, the G20 documents promises to put people first through public and community participation; and to respect, protect and promote traditional knowledge of indigenous people as set out in the UNDRIP (ECMM Outcome Document and Chair Summary, 28 July, 2023). The G20 environmental discourse brings forth the concept of inclusive engagement and stresses on the involvement of local communities and indigenous people in ensuring sustainable and integrated water resource management (ECMM Outcome Document and Chair Summary, 28July, 2023). The protection and conservation of the Ocean and the promotion of a Sustainable and Resilient Blue/Ocean based economy is a distinguishing development in G20 environment discourse under India's Presidency. The mainstreaming of community involvement is emphasized in the realization of a Sustainable and Resilient Blue/Ocean based economy and this has to be achieved through "fostering protection and inclusion of traditional knowledge" and "engaging indigenous people" in due course of action (ECMM Outcome Document and Chair Summary, 28July, 2023). Precisely, community engagement constitute a significant component of G20 environment and climate discourse and it encompasses the twin aspects of- utilization of community knowledge/skill/participation for environment protection and climate action; as well as sharing the benefits of environment friendly development to the community under just policy arrangements.

#### Challenges to Community Engagement in Environment Protection and Climate Action

The emphasis on community engagement in G20 deliberations under India's Presidency, faces some major challenges both at conceptual and practical level.

The G20 is an informal grouping of countries that aims to influence policy legislations of national governments. The G20 outcome documents lack formal and authoritative force to impel the national governments for formulation of national legislations which could ensure community engagement in environment protection and climate action.

The conceptualization of 'community' in G20 deliberations lacks clarity and definiteness. As discussed above the conceptualization of community in G20 deliberations is inclusive enough to accommodate local people, indigenous people, forest communities and people sharing vulnerabilities. This conceptualization also attends to the vulnerabilities persistent in communities in relation to gender, disability, poverty and soon. However, the conceptualization faces limitation in drawing the synergy between climate actions of people within the local governmental arrangements (as Panchayats, Municipalities in the context of India) and climate actions of local communities independent of the governmental arrangements.

The realization of community engagement at practical level faces another limitation in the context of India due to the recent amendments in Forest Conservation Amendment Act, 2023. The issue of engagement of forest communities in sustainable forestry practices becomes debatable with the introduction of this Amendment Act. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 states that without the permission of community one cannot convert a forest area into non- forest use as for construction or development purpose. However, the recent amendment says that forest lands can be diverted to non-forest use i.e. for roads, railways, strategic projects of National importance & projects concerning national security within 100 kms of international border or line of control or Line of Actual Control. The recent amendment curtails the control of local community over local forest resources and in matters of forestry management. Therefore, the Forest (Conservation) Amendment Act, 2023 stands in contradiction to the commitments of G20 environmental discourse.

Additionally, the entire idea of moulding of community behavior through sustainable consumption and production choices is constrained by the consumerist ethics of Neo-liberal structure. The neoliberal structure is identified more as 'consumer culture' i.e. as culture organized around consumption of goods and leisure; rather than the production of material and services (Mcdonald, Gough, Wearing and Deville, 2017). In addition, neoliberalism "abstracts the individual from society" (Augoustinos, Walker & Donaghue, 2014; cited in Mcdonald, Gough, Wearing and Deville, 2017). Based on the ethics of individual entrepreneurial freedom, neoliberalism advocates self-interest, self-reliance and competitive social relations. This ethics of individual centeredness and consumerism, under a neoliberal structure may deter the moulding of community behavior and the adoption of sustainable consumer choices. The liberalization, privatization and globalization of the Indian economy have facilitated the erection of a neoliberal structure in India; thereby, eulogizing the ethics of consumerism and entrepreneurial self. This ethics of neoliberalism may stand as in impediment towards the growth of collective conscience and unified collective action for protection of environment.

Community engagement in environment protection and climate action faces limitation in terms of influence of elite forced within local communities. Under the elitist pressures the people facing environmental vulnerabilities are unable to take concerted actions to positively contribute towards environment protection and climate action. Therefore, community engagement must go hand in hand with empowerment and capacity building of local communities in order to realize the goals of environment protection as well as environment friendly development.

#### **References**:

- Augoustinos, M., Walker, I., &Donaghue, N. (2014): Social cognition: An integrated introduction (3rdeg.) London: Sage
- Cobigo, Martin & Mcheimech, (2016): "Understanding Community", *Canadian Journal of Disability Studies*, 5(4), pp. 181 to 203
- G20 High Level Principles on Lifestyles for Sustainable Development, Varanasi Development Ministerial Meeting, 12 June, 2023 (https://g7g20-documents.org)

- G20 New Delhi Leaders' Declaration, 9-10 September, 2023 (https://www.mea.gov.in)
- Hassan, R.S. & Islam, S. (2014): Community Based Tourism for Socio-economic Development: Bangladesh Perspective, Dhaka: University of Dhaka [cited in Rop, Manonn&Kiptanui (2023): "Building community cohesion for effective community participation in community based tourism", International Journal of Tourism and Hospitality Reviews, Vol. 10, No. 1, pp. 01-07]
- McDonald, M. Gough, B., Wearing S.L. & Deville, A. (2017): Social Psychology, Consumer Culture and Neoliberal Political Economy, Journal for the Theory of Social Behaviour 47 (3)(https:// www.researchgate.net/publication/313406374\_Social\_ Psychology\_Consumer\_Culture\_and\_Neoliberal\_Political\_ Economy)
- Martin, L & Mcheimech, R. (2016): "Understanding Community", Canadian Journal of Disability Studies, pp. 183 to 203 [cited in Rop, Manonn&Kiptanui (2023): "Building community cohesion for effective community participation in community based tourism", International Journal of Tourism and Hospitality Reviews, Vol. 10, No. 1, pp. 01-07]
- Outcome Document and Chair's Summary of G20 Development Ministerial Meeting, Varanasi 12 June, 2023 (https://g7g20documents.org)
- Outcome Document and Chair's Summary of G20 Environment and Climate Minister's Meeting, Chennai, 28 July, 2023 (www.g20.in)
- Pender, L. (2006): "Managing the Tourism System", in L. Pender & R. Sharpley, *The Management of Tourism*, London: Sage Publications [cited in Rop, Manonn&Kiptanui (2023): "Building community cohesion for effective community participation in community based tourism", International Journal of Tourism and Hospitality Reviews, Vol. 10, No. 1, pp. 01-07]

Sloot, D.; Jans, L. & S. Linda (2017): The potential of environmental community initiatives- a social psychological perspective (https:/ /www.researchgate.net/publication/326572285\_The\_potential\_ of\_environmental\_community\_initiatives\_-\_a\_social\_ psychological\_perspective/citation/download)

The Forest (Conservation) Amendment Act 2023

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

 $\circ \circ \circ$ 

### Climate Change and agriculture: A sociological study based on Sivasagar District of Assam

#### Dr. Priyanka Tamuli<sup>1</sup>

Assistant Professor, Department of Sociology Gargaon College, Sivasagar, Assam

#### Mohananda Tamuli<sup>2</sup>

Assistant Professor Department of Sociology, Gargaon College, Sivasagar, Assam Email: Priyankatamuli16@gmail.com

#### Introduction:

The topic of climate change is frequently brought up in conversation. UN reports define "climate change refers to long-term shifts in temperatures and weather patterns". Assam is an extremely unique region, in terms of geography and ecologically. Climate change has a significant impact on the Assam and Sivasagar district as well. The primary indicators of climate change are rising temperatures, altered rainfall patterns, altered flood-drought cycles, and so forth. These changes have impact on agriculture which directly or indirectly effects on poverty, poor agricultural output, health-related problems, etc. However, there has been little research and knowledge about the effects of climate change. The purpose of this paper is to investigate the impact that climate change carries in the agricultural transformation of the region. Thus, climate change is one of the most significant challenges facing humanity in the 21st century. Its effects are global, influencing ecosystems, economies, and societies. Among the sectors most vulnerable to climate change is agriculture, which is not only a cornerstone of human survival but also a critical component of economic stability, particularly in developing countries. The relationship between climate change and agriculture is complex, characterized by both challenges and opportunities. This essay will explore the impact of climate change on agriculture, the ways in which agriculture contributes to climate change, and the potential solutions to mitigate these effects. Agriculture is the backbone of Assam's economy, employing over 70% of its population and contributing significantly to its GDP. The state is known for its diverse agricultural practices, including the cultivation of rice, tea, jute, and various horticultural crops. Assam's fertile alluvial soil, ample water resources from the Brahmaputra and Barak rivers, and favorable climatic conditions have historically supported its agrarian society.

Rice is the staple food of Assam, with the state producing several varieties, including the famous aromatic Joha rice. Tea is another significant agricultural product, with Assam tea being renowned worldwide. The state's diverse agro-climatic conditions also support the cultivation of fruits, vegetables, spices, and pulses. Agriculture is the backbone of Assam's economy, employing over 70% of its population and contributing significantly to its GDP. The state is known for its diverse agricultural practices, including the cultivation of rice, tea, jute, and various horticultural crops. Assam's fertile alluvial soil, ample water resources from the Brahmaputra and Barak rivers, and favorable climatic conditions have historically supported its agrarian society. Rice is the staple food of Assam, with the state producing several varieties, including the famous aromatic Joha rice. Tea is another significant agricultural product, with Assam tea being renowned worldwide. The state's diverse agro-climatic conditions also support the cultivation of fruits, vegetables, spices, and pulses.

#### Methodology:

The paper is mainly based on primary data and exploratory research design has been used for the study. This study is conducted

in Rohdoi panchayat, in Sivasagar district of Assam. Total 10 respondent are selected purposively for this study.

#### **Findings**:

The impact of climate change on agriculture is profound and multifaceted. Rising temperatures, changing precipitation patterns, and increasing frequency of extreme weather events are altering the conditions under which crops are grown, livestock are raised, and fisheries operate. Global temperatures are rising, with significant implications for crop yields. Many crops have optimal temperature ranges for growth, and deviations from these ranges can lead to reduced yields. For example, wheat, rice, and maize staple foods for much of the world—are sensitive to temperature increases, particularly during the critical flowering and grain-filling stages. In some regions, where temperatures are already high, further increases could significantly reduce agricultural productivity.

Assam's agriculture is heavily dependent on the monsoon, which traditionally provides ample rainfall for crop cultivation. However, climate change has led to erratic rainfall patterns, with some years experiencing excessive rainfall leading to floods, while others face drought-like conditions. The Brahmaputra River, a lifeline for Assam's agriculture, frequently floods during the monsoon, damaging crops, soil fertility, and infrastructure. Floods have become more intense and frequent, destroying standing crops, washing away topsoil, and leading to a decline in agricultural productivity. Paddy fields, which cover large swathes of Assam, are particularly vulnerable. In contrast, inadequate rainfall during critical growing seasons has led to drought stress, further affecting crop yields.

Rising temperatures due to global warming are another challenge for Assam's agriculture. The increase in temperature affects the growth and development of crops, particularly temperature-sensitive crops like rice. Higher temperatures can lead to heat stress, causing a reduction in crop yields and affecting the quality of produce.

Tea, a major cash crop in Assam, is also susceptible to temperature changes. The ideal temperature for tea cultivation ranges between 18°C to 30°C. However, the rising temperatures have led to

changes in the growth pattern of tea plants, affecting the quality and quantity of tea production. Tea plants are also more prone to pests and diseases in warmer conditions, further exacerbating the problem.

The frequent flooding and heavy rainfall associated with climate change lead to soil erosion, which strips the soil of essential nutrients and organic matter. This degradation of soil quality has long-term implications for agricultural productivity in Assam. The loss of fertile topsoil reduces the land's capacity to support healthy crop growth, necessitating the increased use of chemical fertilizers, which can further degrade the soil over time.

Additionally, the changing climate affects the microbial composition of the soil, which is vital for maintaining soil health and fertility. The disruption of these microbial communities can impair nutrient cycling, further reducing the productivity of agricultural land.

Due to climatic variations agricultural process have faced challenges at micro level in Assam. Generally, in Assam, rainfall is started from second half of month of April and it was continued up to first half of month of October. Majority cultivator in Assam, therefore are ready to work for their paddy field in these seasons. But due to climatic change the time of rainfall has became uncertain. Sometime early rainfall have caused drought. Moreover, the rate of rainfall is very low or very high at times. Basically, the agricultural activity in Assam is fully based on climate for which paddy cultivation is suitable. Hence the cultivators who yield rice paddy as a main crop face various challenges and are unable to gain satisfactory production.

Agricultural activity in rural area in Assam is one of the diverse cultural activity and it is related other culture of Assamese rural people. This agricultural activity is highly associated with season of the environment of Assam. But climatic change has affected the seasons of Assam. When the monsoon season starts earlier the winter season also starts. So, the temperature of environment failed to maintain time scheduled as original environment of Assam. It affects the cultivators on rate of the crops production. Because the production of crops depends on temperature. The climatic change directly affected to maintain suitable temperature for rice paddy production in Assam. The high temperature of sunlight is one of major challenge of cultivators to production. Due to climatic change, the temperature of sunlight becomes veryhigh in Assam. The leaf of the crops burns by high temperature of sunlight, which was one of the major challenges for crop yield of Assamese cultivator. After burn the tree of the crops by sunlight, the tree leaf became dry and these leaves fail to proper photosynthesis. Hence the tree fails to high production and many time the tree permanently fail to production.

Impact of climate change on agriculture is not only one of the major challenges for the future food security of the people of Assam but also a challenge for indigenous seeds preservation by the cultivators. These indigenous seeds were fit for land of Assam and the cultivator were free from some obstacle of production. But when the farmer fails to preserve the indigenous seeds they must do some extra activity to protect their crops. Many time, farmer face high lost from their work. These type of lost faced by farmer because of climatic change.

Impact of climate change on griculture will be one of the major challenge which influencing the future foodsecurity of the people of Assam. Agriculture is extremely vulnerable to climate change. Understanding the weatherchanges over a period of time and adjusting the management practices towardsachieving better harvest are challenges to the growth of agricultural sector as awhole. The climate sensitivity of agriculture is uncertain, as there is regional variationin rainfall, temperature, crops and cropping systems, soils and managementpractices. The inter-annual variations in temperature and precipitation were much higher than the predicted changes in temperature and precipitation. The crop lossesmay increase if the predicted climate change increases the climate variability.Different crops respond differently as the global warming will have a complex impact. The tropics are more dependent on agriculture as 75% of world population lives intropics and two thirds of these people's main occupation is agriculture. With lowlevels of technology, wide range of pests, diseases and weeds, land degradation, unequal land distribution and rapid population growth, any impact on tropical agriculture will affect their livelihood. Rice, wheat, maize, sorghum, soybean andbarley

are the six major crops in the world grown in 40% cropped area, and contribute to 55% of non-meat calories and over 70% of animal feed (FAO, 2006).Consequently, any effect on these crops would adversely affect the food security.

Climatic change is highly associated with human health. Due to climatic change the farmers faced numbers of challenges to grow their crops. Heavy rain fall and sudden high temperature and extreme sunlight create some diseases of crops. Moreover, lack of rain for long time is one of the major problems for agricultural productivity. Hence farmers for high yield use chemical fertilizers, hormones and other chemical artificial techniques. Use of artificial fertiliser directly or indirectly harmful to human health. Now a days, agriculture is mostly depending on chemical fertilizer. Most importantly, many farmers do not know about how much chemical should spray in his crops. By using high quantity of chemical, the farmers destroy the sustainability of their farming land. Hence these farm lands permanently lost its fertility and create Agricultural challenge for long duration. The root course of this type of challenges is climatic change.

#### Conclusion

Changing climate on agricultural production, which are directly or indirectly impact on challenge food security in the future. Climate change contributes on food insecurity in the future, including increasing food prices, challenges in nutritional values and reducing food production etc. Concerted efforts are needed in develop by government, NGOs as well people to minimised the effects of climate change. Government should formulate region-specific plans, programmeand strategies to deal with current and future climate change. Developing and promoting the cultivation of climate-resilient crop varieties is crucial. Research institutions in Assam are working on developing rice varieties that are flood-tolerant, drought-resistant, and can withstand temperature fluctuations. Similarly, tea research is focused on developing cultivars that are more resistant to pests, diseases, and heat stress. The adoption of sustainable agricultural practices, such as integrated pest management, organic farming, and agro forestry, can help mitigate the impact of climate change. These practices enhance soil health, reduce dependency on chemical inputs, and improve the resilience of farming systems to climatic shocks.

#### **Reference :**

- 1. https://www.researchgate.net/publication/359215224\_ Climate\_Change\_its\_Impact\_on\_Agriculture\_in\_India
- 2. https://www.researchgate.net/publication/344064949\_ Effects\_of\_Climate\_Change\_on\_Agriculture
- 3. Singh, P Naveen, Singh Surendra & Anand Bhawana. 2019. Impact of Climate Change on Indian Agriculture: An Agro-Climatic Zone Level Estimation. POLICY BRIEF. ICAR

 $\circ$   $\circ$   $\circ$ 

Evaluating the Variability of Indian Summer Monsoon Rainfall (ISMR) in Response to El Niño Southern Oscillation (ENSO) in a Warming Climate Scenario

### Mriganko Kakoti<sup>\*</sup>, Rajib Lochan Deka, Parishmita Das and Kuldip Medhi

Department of Agrometeorology Assam Agricultural University, Jorhat, Assam

#### Introduction:

The El Niño Southern Oscillation (ENSO) phenomenon stands as one of the most influential climate patterns globally, affecting weather, oceanic conditions, and ecosystems on a vast scale. Rooted in the intricate interplay between the ocean and the atmosphere, ENSO exhibits a cyclical behavior, oscillating irregularly between two contrasting phases: El Niño and La Niña. These phases, along with the transitional ENSO-neutral period, significantly influence regional climate patterns, with profound implications for agriculture, water resources, and socio-economic development. The historical roots of ENSO trace back centuries, intertwined with indigenous observations and early scientific discoveries.

Indigenous peoples living along the coasts of Peru and Ecuador noticed anomalies in ocean conditions during the Christmas season,

Climate Change in North East India ▶ 89

dubbing the phenomenon "El Niño," meaning "Little Boy" in Spanish. These observations, dating back to the 16th century, highlighted the periodic warming of coastal waters off South America, disrupting marine ecosystems and fisheries (Dijkstra, 2006). Scientific understanding of ENSO began to take shape in the late 19th and early 20th centuries, propelled by pioneering research and advancements in meteorology and oceanography. One of the earliest recorded observations of abnormal ocean conditions in the Pacific Ocean was made by Norwegian explorer Fridtjof Nansen during his 1892 expedition. Nansen documented unusually warm sea surface temperatures (SST) in the eastern Pacific, noting the presence of a warm-water anomaly extending from the coast of South America towards the central Pacific (Nansen, 1893). This anomalous warming, later recognized as a characteristic feature of El Niño events, sparked scientific interest and laid the foundation for further investigations into the dynamics of ENSO. The seminal work of British meteorologist Sir Gilbert Walker in the early 20th century provided key insights into the Southern Oscillation, a large-scale atmospheric pressure seesaw between the eastern and western tropical Pacific. Walker's research revealed a coherent pattern of atmospheric variability, with alternating high and low-pressure anomalies propagating across the Pacific basin (Walker, 1928). Building upon Walker's findings, Norwegian-American meteorologist Jacob Bjerknes proposed the concept of ENSO in 1966, integrating oceanic and atmospheric dynamics into a unified framework (Bjerknes, 1966). Bjerknes' ground-breaking hypothesis posited that the ocean and atmosphere interact dynamically, giving rise to a coupled system capable of generating large-scale climate variability. He proposed that during El Niño events, weakened trade winds and reduced upwelling in the eastern Pacific lead to the accumulation of warm surface waters, triggering atmospheric teleconnections that influence weather patterns worldwide. Conversely, La Niña events are characterized by enhanced trade winds and upwelling, resulting in cooler-than-normal SST in the eastern Pacific and distinct atmospheric circulation patterns (Bjerknes, 1969). The recognition of La Niña as the cold phase of the ENSO cycle followed decades later,

with advancements in satellite technology and oceanographic observations providing new insights into ocean-atmosphere interactions. The advent of the Tropical Atmosphere Ocean (TAO) array in the tropical Pacific revolutionized ENSO monitoring and prediction, enabling scientists to monitor oceanic conditions in realtime and anticipate ENSO-related climate impacts (McPhaden et al., 2006). Today, the monitoring and prediction of ENSO events rely on a suite of observational tools, including satellites, buoys, and climate models, which provide valuable data on sea surface temperatures, atmospheric pressure, and wind patterns. Indices such as the Southern Oscillation Index (SOI) and the Oceanic Niño Index (ONI) serve as key indicators of ENSO activity, helping forecasters anticipate the onset and intensity of El Niño and La Niña events (Climate Variability: Southern Oscillation Index, 2009). The global reach of ENSO extends far beyond the tropical Pacific, influencing weather patterns and climate variability across continents. El Niño events typically bring warmer and drier conditions to Southeast Asia, Australia, and South America, leading to droughts, wildfires, and agricultural losses. La Niña, conversely, tends to enhance rainfall in these regions, mitigating drought impacts and replenishing water resources (Australian Climate Influences, 2013). In India, the impact of ENSO on regional climate patterns is particularly pronounced, with implications for the Indian monsoon, agriculture, and food security. The Indian monsoon, occurring annually during the northern hemisphere summer, is a lifeline for millions of people dependent on rainfed agriculture for their livelihoods. The variability of ENSO can disrupt monsoon

dynamics, leading to deviations from normal rainfall patterns and affecting crop yields, water availability, and rural livelihoods (Roy et al., 2019). Understanding the complex interactions between ENSO and the Indian monsoon is essential for mitigating the impacts of climate variability on agriculture and food security. This review aims to provide a comprehensive overview of the relationship between ENSO, the Indian monsoon, and food security, drawing on existing literature and scientific research. By elucidating the mechanisms driving ENSO variability and its regional manifestations, we can enhance our ability to predict and adapt to climate-related risks, ultimately fostering resilience and sustainability in agricultural systems.

#### Methodology:

To comprehensively understand the impact of ENSO on the Indian monsoon and food security, a review of existing literature was conducted. Relevant research articles, scientific publications, and reports from reputable sources were analyzed to gather insights into the historical background of ENSO, its cycle, monitoring techniques, regional climate impacts, and implications for Indian agriculture. The retrieved articles were carefully reviewed and synthesized to provide a comprehensive overview of the topic.

#### **Results and Findings:**

#### Historical Background of ENSO

The enigmatic weather pattern of ENSO has intrigued scholars and scientists for centuries, with early observations dating back to indigenous peoples living along the coasts of Peru and Ecuador. The term "El Niño," meaning "Little Boy" in Spanish, was coined by Peruvian fishermen who noticed anomalies in ocean conditions during Christmas time in the 1960s (Dijkstra, 2006). Scientific understanding of ENSO began with Fridtjof Nansen's discovery of abnormal warming in the Pacific Ocean in 1892. Gilbert Walker later characterized the Southern Oscillation, and Jacob Bjerknes coined the term "ENSO" in 1966, encompassing both El Niño and La Niña phases (Bjerknes, 1966; Walker, 1928). Subsequent research led to the recognition of La Niña as the cold phase of the ENSO cycle in 1980.

### ENSO Cycle

The ENSO cycle comprises three phases: ENSO-neutral, El Niño, and La Niña. During the neutral phase, trade winds blow from east to west across the tropical Pacific Ocean, leading to the formation of high and low-pressure systems and convection. In El Niño years, these trade winds weaken or reverse direction, causing warm water to accumulate in the eastern Pacific and altering atmospheric circulation patterns. La Niña events, on the other hand, intensify the

neutral phase, resulting in cooler-than-normal sea surface temperatures in the central and eastern Pacific (Australian Climate Influences, 2013).

### Monitoring of ENSO

Several indices are used to monitor ENSO events and their associated changes in sea surface temperatures and atmospheric conditions. The Southern Oscillation Index (SOI) measures pressure differences between Tahiti and Darwin, while the Oceanic Niño Index (ONI) tracks sea surface temperature anomalies in the tropical Pacific (Climate Variability: Southern Oscillation Index, 2009). These indices help forecast the onset and intensity of El Niño and La Niña events, providing valuable information for climate monitoring and prediction.

### Impact on Regional Climate

El Niño and La Niña events have distinct regional impacts on climate patterns worldwide. El Niño typically brings drier-thanaverage conditions to Southeast Asia, Australia, and South America, while La Niña results in increased rainfall in these regions. In India, El Niño events disrupt monsoon dynamics, leading to below-average rainfall and drought conditions. La Niña, conversely, enhances the Indian summer monsoon, benefiting agriculture and food production (Liu et al., 2012).

### Impact on Indian Summer Monsoon Rainfall (ISMR)

The impact of the El Niño Southern Oscillation (ENSO) on Indian summer monsoon rainfall is a subject of considerable significance, given the vital role of the monsoon in sustaining agriculture, water resources, and livelihoods across the Indian subcontinent. The Indian monsoon, characterized by seasonal winds and precipitation, is a complex meteorological phenomenon influenced by various factors, including sea surface temperatures, atmospheric circulation patterns, and land-sea thermal gradients. ENSO events, particularly El Niño and La Niña, exert a notable influence on these underlying drivers, leading to pronounced variability in monsoon rainfall patterns and intensity. During El Niño episodes, characterized by the abnormal warming of sea surface temperatures in the tropical Pacific Ocean,

the Indian monsoon tends to weaken, resulting in below-average rainfall over large parts of the Indian subcontinent. The atmospheric teleconnections associated with El Niño disrupt the normal monsoon circulation, altering wind patterns and moisture transport mechanisms. In particular, the weakened Walker circulation, a large-scale atmospheric circulation pattern over the equatorial Pacific, leads to subsidence and sinking motion over the Indian region, inhibiting cloud formation and precipitation (Gadgil and Sajani, 1998). The impacts of El Niño on Indian summer monsoon rainfall are multifaceted, affecting different regions and agricultural systems in diverse ways. One of the most evident consequences of El Niño-induced droughts is water scarcity, posing significant challenges for rain fed agriculture and rural communities dependent on monsoon rainfall for irrigation and livelihoods. Reduced soil moisture and groundwater levels during El Niño years exacerbate crop stress, leading to yield losses and food insecurity in vulnerable regions (Sikka, 2006). The spatial distribution of rainfall anomalies during El Niño events reveals distinct patterns of deficit rainfall across different parts of India. While some regions experience severe drought conditions, others may receive near-normal or above-normal rainfall, highlighting the complex nature of monsoon variability. The western and central parts of India, including Maharashtra, Gujarat, and parts of Madhya Pradesh, are often more severely affected by El Niño-related droughts, leading to crop failures, livestock losses, and socio-economic distress (Gadgil and Sajani, 1998). In addition to agricultural impacts, El Niño-induced droughts can have far-reaching consequences for water resources, hydroelectric power generation, and rural livelihoods. In many parts of India, especially in semi-arid and drought-prone regions, the availability of water for drinking, irrigation, and industrial purposes becomes severely constrained during periods of below-average rainfall. This not only affects agricultural productivity but also disrupts household water supply, sanitation, and public health services, exacerbating socioeconomic inequalities and vulnerabilities (Rajeevan et al., 2012). The economic ramifications of El Niño-related droughts extend beyond the agricultural sector, impacting various industries and sectors

household livelihoods. Moreover, the ripple effects of drought-induced food shortages and price volatility can strain food supply chains, exacerbating poverty and food insecurity in already marginalized communities (Ninan, 2011). In contrast to El Niño, La Niña events are associated with cooler-than-average sea surface temperatures in the tropical Pacific, often leading to above-average rainfall and enhanced monsoon activity over the Indian subcontinent. The atmospheric teleconnections associated with La Niña tend to strengthen the monsoon circulation, promoting moisture convergence and convective activity over the Indian Ocean and the Indian landmass. This results in increased rainfall intensity, prolonged wet spells, and higher agricultural productivity in many parts of India (Sikka, 2006). The impacts of La Niña on Indian summer monsoon rainfall are generally positive, with above-average precipitation benefiting rainfed agriculture, water storage reservoirs, and rural livelihoods. The enhanced monsoon rainfall during La Niña years replenishes soil moisture, recharges groundwater aquifers, and sustains surface water supplies, mitigating the impacts of previous droughts and bolstering agricultural resilience. In regions prone to water scarcity and irrigation deficits, La Niña events offer a reprieve from water stress, enabling farmers to cultivate multiple crops and improve crop yields (Rajeevan et al., 2012). It is essential to recognize that the relationship between La Niña and Indian monsoon rainfall is not deterministic, and the impacts can vary depending on regional climatic factors, land surface conditions, and atmospheric dynamics. While La Niña tends to favor above-average rainfall over most parts of India, certain regions may experience anomalous dry conditions or erratic rainfall patterns due to localized influences and atmospheric variability. Therefore, while La Niña events generally enhance monsoon rainfall, their effects may be modulated by other factors, necessitating a nuanced understanding of regional climate dynamics (Rasmusson and Carpenter, 1983).

dependent on water resources and climatic conditions. Reduced hvdropower generation during drought years can lead to energy

shortages, affecting industrial production, urban infrastructure, and

#### Implications for Food Security

The impact of ENSO on the Indian monsoon has profound implications for food security and agricultural production. Drought conditions associated with El Niño events can reduce crop yields, disrupt water supplies, and exacerbate food shortages, particularly in rural and vulnerable communities. Conversely, La Niña events can boost agricultural productivity, leading to higher crop yields and improved food availability. The variability of ENSO poses challenges for farmers, policymakers, and food security experts in managing risks and building resilience to climate-related hazards (Lobell et al., 2011).

#### Discussion:

The relationship between ENSO and Indian monsoon variability is complex and multifaceted, influenced by a myriad of atmospheric and oceanic processes. While El Niño events tend to suppress monsoon rainfall, La Niña events enhance it, leading to contrasting impacts on agricultural production and food security. Understanding the mechanisms driving ENSO variability and its regional manifestations is crucial for improving climate prediction models, developing early warning systems, and implementing adaptive measures to mitigate the adverse effects of climate change on agriculture and food systems.

#### **Conclusion:**

In conclusion, the El Niño Southern Oscillation (ENSO) exerts a significant influence on the Indian monsoon and food security, with implications for millions of people reliant on agriculture for their livelihoods. El Niño events disrupt monsoon dynamics, leading to below-

average rainfall and drought conditions in India, while La Niña events enhance the monsoon, resulting in above-average rainfall and favorable agricultural conditions. The variability of ENSO poses challenges for farmers, policymakers, and food security experts, highlighting the need for proactive measures to build resilience and adapt to climate-related risks. Future research should focus on improving climate prediction models, enhancing monitoring techniques, and developing sustainable agriculture practices to mitigate the impacts of ENSO on Indian agriculture and food security.

### Reference:

- Bjerknes, J. (1966). A possible response of the atmospheric Hadley circulation to equatorial anomalies of ocean temperature. Tellus, 18(4): 820-829.
- Bjerknes, J. (1969). Atmospheric teleconnections from the equatorial Pacific. Monthly Weather Review, 97(3): 163-172.
- Climate Variability: Southern Oscillation Index. (2009). Retrieved from Australian Bureau of Meteorology website: http:// www.bom.gov.au/akamai/https-redirect.html
- Dijkstra, H. A. (2006). A century of sea level measurements in the Netherlands. Journal of Geophysical Research: Oceans, 111(C8).
- Gadgil, S., and Sajani, S. (1998). Monsoon prediction-A challenge. Current Science, 75(10):1021-1035.
- Liu, Y., Wang, L., Zuo, J. and Guo, P. (2012). Impacts of El Niño-Southern Oscillation events on crop yields in China during 1951-2009. Journal of Geographical Sciences, 22(6): 1011-1024.
- Lobell, D. B., Schlenker, W. and Costa-Roberts, J. (2011). Climate trends and global crop production since 1980. Science, 333(6042): 616-620.
- McPhaden, M. J., Meyers, G., Ando, K., Masumoto, Y., Murty, V. S. N., Ravichandran, M. and Smith, D. M. (2006). RAMA: The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction. Bulletin of the American Meteorological Society, 87(8): 1069-1078.
- Nansen, F. (1893). Oceanography of the North Polar Basin. The Geographical Journal, 2(5): 457-476.
- Ninan, K. N. (2011). Climate change and India: A 4X4 assessment A sectoral and regional analysis for 2030s. Earthscan.

- Rajeevan, M., Bhate, J. and Jaswal, A. K. (2012). Analysis of variability and trends of extreme rainfall events over India using 104 years of gridded daily rainfall data. Geophysical Research Letters, 39(18).
- Rasmusson, E. M. and Carpenter, T. H. (1983). The relationship between eastern equatorial Pacific Sea surface temperatures and rainfall over India and Sri Lanka. Monthly Weather Review, 111(3): 517-528.
- Roy, S. S., Routray, A. and Pai, D. S. (2019). Understanding the relationship between El Niño Modoki and Indian summer monsoon rainfall. International Journal of Climatology, 39(1): 543-561.
- Sikka, D. R. (2006). Some aspects of the large-scale fluctuations of summer monsoon rainfall over India in relation to fluctuations in the planetary and regional scale circulation parameters. Proceedings of the Indian Academy of Sciences-Earth and Planetary Sciences, 115(3): 443-459.
- Walker, G. T. (1928). World weather V. Memoirs of the Royal Meteorological Society, 3(36): 81-92.

0 0 0

### Examining Assam's Recent Initiatives Towards Achieving Climate Justice

#### Anangsha Rajguru

Asstant Professor, School of Social Science The Assam Kaziranga University, Jorhat, Assam

#### Introduction:

Climate change is inducing extreme climate occurrences which are causing immense socio-economic losses. The developing nations and the vulnerable regions within them are facing its lopsided impacts. North Eastern India with its fragile ecology are facing the damages even before reaping the benefits of being rich in natural resources and biodiversity. All the North Eastern states are highly prone to floods, landslides, soil erosion and various impacts that the disasters bring along. In case of Assam, 40% of its land is prone to floods (Sarma 2023). Since Independence, average annual losses due to floods in Assam is estimated to be about Rs 200 cr. One of the most evident impacts of climate changein Assam is the halving of the Majuli island.

The impacts perceived are immediate in nature but the climate response is mostly of mitigation nature like focus on clean energy, energy efficiency etc. These concerns are important but equally important are adaptive measures. Currently only 25% of the climate fund is used in adaptation practices which needs to be paid more attention to. Adaptation implies curative measures to cope with the

impacts of climate change, moderate harm and pave the way towards climate resilience and security. The adaptive practices have been categorized into adjustment-based, reformist and transformative approaches (Santha 2020). The third approach combines indigenous and traditional knowledge systems, socio-cultural contexts, and technological and developmental aspects. It gives attention to local contexts, vulnerabilities, power structures, distribution of burden and benefits to ensure the inclusion of needs of the marginalized communities. This approach of climate adaptation is value, vulnerability and community based and is suited for heterogeneous social structures like in Assam. To achieve this transformation on the ground, interventions must be made at various levels like technological planning and intervention, policy-based intervention, behavioral change approaches, management of natural resources and developmental planning and intervention (Climate Cell 2011). This requires major institutional frameworks and financial investments in the area. The National Action Plan for Climate change, the eight identified national missions dealing with important thematic areas for intervention, the National fund for adaptation, the National Disaster management plans and their state level counterparts are major steps taken by India in this regard. Financial investments have been mostly public in nature until now. Though there is scope of private investments in terms of CSR and creation of a corpus fund for climate action.

Only 0.86 per cent of districts in India have a high adaptive capacity. The zone-wise analysis of hotspot districts suggests that five out of six zones in India, i.e., south, north, north-east, west, and central, have low adaptive capacity to extreme hydro-met disasters. States in the NE like Assam, Arunachal Pradesh, and Manipur have low adaptive capacities and are highly vulnerable to extreme floods.Dhemaji, Nagaon, Lakhimpur, Dhubri, Darrang, Dibrugarh, Golaghat, Karbi Anglong, Sonitpur, and Bongaigaon districts in Assam are most vulnerable to extreme floods and associated events (Mohanty & Wadhawan 2021).

Hence, to achieve the SDG goal 13 of Climate action, the concept of climate justice has to be followed as the climate crisis brings with

it social, economic and environmental injustices. Climate action must focus on responding to the needs of the marginalized and disempowered populations, their vulnerabilities being aggravated by the climate crisis. Climate justice links the crisis to how it has affected the vulnerable communities and its access to resources, sustenance, and basic freedoms.

#### **Objective:**

- Understand Assam's steps towards climate justice with focus on the Green Budget (2023-24) of Assam State Action Plan for Climate Change.
- Examine the role of community in climate adaptation and justice.

#### Methodology:

The article uses a descriptive review framework assisted by secondary materials like government documents, research journals, newspaper articles and reports to collate information. Attempt is to understand the climate action initiatives of Assam in terms of its adaptation practices. The impact that these practices will have on the local community and their participation in the process is explored.

#### Literature review:

Being the most vulnerable state to the climate crisis, the state of Assam has created a separate department to tackle climate change in 2021, which is reflective of its zeal towards solving issues related to it. It is called the Science, Technology & Climate Change department. The mandate of the department is to formulate, implement and encourage research in the areas of science, technology, and environment. Its focus areas as mentioned in its website, are on promoting clean energy, natural resource management through space technology etc. Climate change adaptation and the activities under it are closely associated with developmental activities, ensuring sustainable livelihood, disaster risk reduction and securing livelihoods.Initiatives to encourage adaptation practices with the local communities is conspicuously missing from its agenda. Under the green budget, financial allocations have been made to various schemes already run or newly initiated by 14 departments mapped to 9 areas of intervention under the Assam State Action Plan for Climate change (2021-30).

Sl. no	Vulnerable sectors	Departments identified		
1	Agriculture and allied areas	Agriculture		
2	Forestry and biodiversity	Environment & Forest		
3	Water resources	Water resources Irrigation Soil conservation		
4	Energy	Electricity (Power)		
5	Strategic knowledge	Science, Technology and Climate Change		
6	Disaster management	Revenue and Disaster Management Public Works (Roads) PWD (B&NH)		
7	Urban and rural (human settlement)	Panchayat and Rural development Housing and Urban Affairs		
8	Human health	Public Health Engineering		
9	Transport	Transport		

#### Source: Green Budget (2023-24), Assam

The goals of the schemes are categorized into three types: Climate mitigation, adaptation, and environmental sustainability. Mitigation involves prevention and precautionary measures to tackle the causes of climate change and reduce its impact while adaptation implies curative measures to cope with the impacts of climate change, moderate harm and pave the way towards climate resilient future. Environmental sustainability efforts on the other hand focuses on protection, preservation and control of natural resources and biodiversity for sustainability.

The table below tries to map the 14 departments identified to collectively work on climate action and the end goals of the schemes proposed or already running under them. The table also mentions the budgetary allocations made to the departments depending upon the relevance of the schemes for climate action.

SI. no	Name of department Number of schemes			Budget for highly favorable schemes*(in lakhs)			
		Climate mitigation	Climate adaptation	Environment & sustainability			
1	Agriculture dept	0	10	41	23, 141.05		
2	Soil conservation dept	5	5	4	264.6		
3	Water resources dept	0	9	0	-		
4	Irrigation dept	0	13 1		17,620.05		
5	PHED	0	0	5	595.6		
6	Environment& Forest dept	9	3	22	37,249		
7	Power dept	3	1	0	450		
8	Science, technology & climate change dept	2	0	11	422.22		
9	Revenue & disaster management dept	0	3	0	9,460		
10	Public Works (Buildings & National Highway)	0	4	19			
11	Public Works (Roads)	0	5	0			
12	PNRD	0	3	3			
13	Housing & Urban Affairs dept	0	0	10	38,248		
14	Transport dept	0	1	10	-		
Total:		19	57	126	104309.63		

### **Table 1:** Summary of schemes by 14 departments of Govt ofAssam; Source: Green Budget (2023-24), Assam

(\*Highly favorable schemes: schemes which directly work towards achieving environmental sustainability, resilience, and adaptation; Moderately favorable: schemes where achieving environmental sustainability forms a smaller component; Neutral schemes: schemes which do not have any impact on environment and sustainability; Less favorable: schemes which are negatively favorable to environmental sustainability) A look at the table above, shows that the number of schemes aimed towards achieving sustainability are the highest followed by adaptive and mitigation practices respectively. However, being home to around 19 lakh BPL population (MSJE 2004-05) and 39 lakh tribals (Census 2011) focusing on immediate response to climate threats faced by these marginalized populations through adaptation efforts is important. The origin of ideas regarding adaptation practices emerged in the public sphere in 2001 when the International Panel on Climate Change mentioned the same in its third assessment report (Ayers & Forsyth 2009). Adaptive practices focus on present challenges as well as ways of coping and forecasting future climate challenges. They are a multidimensional and multistakeholder area requiring convergence.



# Table 2: Indicating budgetary allocations of departments to environmentally favorable schemes; Source: Green Budget (2023-24), Assam

It can also be observed that the top five departments having high budgetary allocations are Housing and Urban Affairs, Environment and Forest Department, Agriculture department, Irrigation department and Revenue & Disaster management department in that order. The first two departments with highest allocations have minimal adaptation-based policies i.e., for Housing and Urban Affairs it is zero and for Environment and Forest Dept it is three. Also, the budget mentions that the neutral schemes which have

Climate Change in North East India ▶ 104

no direct impact on climate mitigation, adaptation and environmental sustainability has the highest budgetary allocation of around Rs  $10\,+$  crores.

#### **Discussion:**

According to the Green budget of Assam 2023-24, the departments having higher number of adaptation-based schemes are Irrigation, Agriculture, Water resources, Soil conservation, and Public Works (Roads) in that order. The discussion below highlights the adaptation-based practices of the above-mentioned departments in that order.

• The Irrigation department's adaptation schemes are around the scheme of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). Looking at the scarcity of water available for irrigation of farms specially during the post and pre monsoon period i.e., Oct to March in Assam, creating sustainable forms of irrigation methods is necessary to ensure agricultural productivity. Also, it tries to deal with the overdependence of farmers on rain for irrigating their fields. It is important to note that water has been a competitive resource, its accessibility being guided by social and economic structures. The village well/pond being only accessible to the upper caste high class households is a common sight in most setups. The poorer households will also be restrained by factors like inability to access credit to contribute 40% of the scheme and small size of land holdings. Implementing the scheme through FPOs might reiterate rural hierarchies and power. The Accelerated Irrigation Benefits Programme (AIBP) under which construction of irrigation-based infrastructure happens should ensure proper rehabilitation and resettlement of any population displaced by it. The beneficiaries and cost bearers of such programmes must be closely analyzed. Amongst the adaptation schemes of the department, 23% of the total schemes are highly favorable towards climate change whereas the rest of them are moderately favorable. So, while dispensing sustainable irrigation technology it becomes important to ensure that it reaches the small and marginal farmers and poorer sections.

• Promotion of natural and indigenous methods and knowledge of farming is one of the foremost initiatives of the Agriculture department to deal with climate change impacts. This requires undoing and relearning the usage and application of fertilizers, pesticides and technology popularized under green revolution. Traditional knowledge equipped with contextual scientific know how which is less credit intensive can pave the way towards food security and sovereignty. Other climate adaptation scheme of the department involves encouragement of millet and maize production in Assam. The crops are resilient to climate change and high in nutrition. Out of the eight varieties of millets, foxtail millet was traditionally grown in this part and is making a comeback due to the efforts of the Department. The Gorukhuti project in Darang district is also considered an important scheme under the department which is involving the local community in organic farming. However, a history of eviction of existing settlers of Bengali speaking Muslims is also associated with the project with no known resettlement frameworks. Flood damage restoration has also been included as a part of disaster management plans. All the initiatives of the department also need to ensure handholding of the farmers in the transition to sustainable agricultural methods. And should also involve, Farmer Producer Companies (FPOs) and other local farmer solidarity groups to participate in participatory mapping of risk and vulnerability of their specific farmlands and shared visioning before implementation of the schemes (Santha, 2020). 25% of the schemes of the department are highly favorable while the others are moderately favorable.

• The Water resources department focuses on restoration or construction of embankments, flood walls and other social erosion and flood preventive structures in the banks of Brahmaputra and Barak. It also plans to rejuvenate the Kollong river in Nagaon and improve its aquatic environment. In line with the National Water Mission and its objectives, it is important to note the involvement of the local community in identifying the risk areas, engagement in construction throughMGNREGA and forming monitoring committees under the mentioned schemes. Over the past years, almost 60% of the resources

under MGNREGA are spent on Natural resource management widening the scope of the scheme from a livelihood enhancer (MRD, 2019). The Department's attempts at climate mitigation and adaptation are mostly immediate or short term in nature. It is collaborating with the Asian development Bank to create long term solutions which involves community based and participatory flood risk management systems. The schemes provided by the department are moderately favorable.

• The Soil conservation department mentions its climate adaptation schemes to be based on afforestation, wetland management and other measures to prevent social erosion and maintain ecological balance. All the adaptation schemes are supposed to be highly favorable to climate change risks.

• The climate adaptation schemes under the Public Works (Roads) involves construction of bridges and disaster resilient roads which are moderately favorable towards solving climate related issues.

Another observation is that from the schemes listed by the 14 departments, the least number of them are highly inclined/favored towards solving the problem of climate change (81), while 118 are moderately inclined, 286 schemes are neutral and one is negatively inclined. And all the latter categories of schemes have estimated budgets more than the favorably inclined schemes altogether.

Certain other schemes mentioned in the budget gearing towards climate adaptation is led by the PHED called the 'Drink from Tap' in Tezpur which tries to deal with the access to fresh drinking water in every household in line with the Jal Jeevan Mission. Several other States like Odisha has also implemented the same to ensure that the marginalized communities have access to clean water in the face of increasing water scarcity and crisis especially in urban areas.

Another initiative by the Science, technology and climate change department is the Chief Minister's Fellowship for Climate Resilient Villages aimed at ensuring climate change awareness, mitigation, adaptation, and resilience building. This initiative focuses on awareness building and creating a local database of evidence of climate change impacts through fellows. For climate adaptation to be a bottom-up approach it must be based on participatory principles where the community plays the role of active agents in ensuring climate resilience. One way through which the fellowship can ensure this is by involving local youths belonging to target communities to analyze the ground while being supervised by officials or external stakeholders to ensure impartial enquiry. The next step of strategy and infrastructure building will originate from the community in accordance to the existing traditional knowledge. Local governance structure like the Goan panchayat and community-basedorganizations like SHGs, Yuva and Mahila mandals and Nehru Yuva Kandra must be involved in planning process to make the fellowship successful.

#### **Conclusion:**

Assam with its highly heterogenous population and a history of immigration and settlement forms a scenario in which ensuring climate justice becomes further complex. While the process of identifying the indigenous and immigrants is still in the process, it is important to ensure the existing communities get access to climate crisis responses and adaptation practices. Migration, identity-based discrimination, lack of land ownership, housing, livelihood and the recognition of a citizen might further push certain communities to brink of climate crisis in a state grueling under it. Measures taken must take into consideration the exclusion, marginalization and vulnerability faced by communities like the tea tribes, other tribal communities, the Bengali speaking population, population living in the char chaporis etc. Risk identification within these communities will have to be undertaken in a participatory manner to identify hyperlocal action plans and de-risking strategies. Ensuring participation of local governance structures, community level organizations like SHGs, Cooperatives and Village development committees are instrumental in adaptive practices. The Panchayati Raj and rural development department can take steps towards ensuring proactive participation and formulation of climate action plans at the local levels. The Agriculture department apart from the existing initiatives can encourage recording the traditional crops and methods of farming and standardizing them for the benefit of the state. The Housing and Urban affairs departmentcan explore climate resilient housing solutions

for communities of Assam especially settled in char-chapori areas, slopes of hills and in the river island of Majuli. The chang ghar which is constructed by many communities settled near rivers can be considered a prototype. It can be further improvised and adopted by other relevant communities as well (PwC & ORF 2023).

Separate ground personnel/community level committees/workers to overlook the implementation of the local action plans for climate change may be further helpful. Like the ASHA workers appointed under NHM, Jeevika Sakhis for NRLM and Anganwadi workers for ICDS, there should be certain identified climate warriors who can look after the implementation of climate action plans, link the district and state officials to the local governance structures and help in overall decentralization of climate adaptation efforts.

#### References

- Ayers J. & Forsyth T.(2009) Community-based adaptation to climate change. Environment: Science and Policy for Sustainable Development, 51 (4). pp. 22-31. ISSN 0013-9157. http:// eprints.lse.ac.uk/24188/
- Climate Cell, Environment division. Assam Science, technology, and environment council (2011). Recommendations for State of Assam's strategy and action plan on climate change.First draft. http://www.indiaenvironmentportal.org.in/files/climate \_change.pdf
- Government of Assam (2023) 'Green Budget 2023-2024'. As presented in Budget Session. https://finance.assam.gov.in/sites/ default/files/swf\_utility\_folder/departments/agriculture\_ com\_oid\_2/portlet/level\_1/files/goa\_green\_budget\_2023-24.pdf
- Lindwall C (Oct 24, 2022) 'What are the effects of climate change'. NRDC.org
- Mohanty, Abinash & Wadhawan, Shreya (Oct 2021) Mapping India's climate vulnerability: A district level assessment. CEEW The Council, India Climate Collaborative & EdelGive Foundation.

https://www.ceew.in/sites/default/files/ceew-study-on-climatechange-vulnerability-index-and-district-level-risk-assessment.pdf

- PwC &ORF (2023 March) Climate, Community, Cooperation: An Indian approach to adaptation in the global south. https:// www.orfonline.org/wp-content/uploads/2023/03/Climatereport\_Raisina.pdf
- Santha D. S (2020) Climate change and adaptive innovation-A model for social work practice. Routledge. ISBN 9780367195557 (hardback) | ISBN 9780429203138 (eBook)
- Sarma, Anirban (2023, 17 August) Cursed by the rain gods? Assam's climate challenge. Observer Research Foundation. https://www.orfonline.org/expert-speak/cursed-by-the-rain-gods-assams-climate-challenge/

 $\circ \circ \circ$ 

### Reading Amitav Ghosh's *The Great Derangement* (2016) in the Anthropocene: Climate Crisis and the Need for Sustainable Living

**Payel Ghosh** Research Scholar, Department of English Cooch Behar Panchanan Barma University West Bengal

#### Introduction

The term eco-criticism is derived from two Greek words, Oikos and Kritis. The meaning of "Oikos" is "household", a tie of threenature, human, and spirit. And the other word, "Kritis" means to judge, "the arbiter of taste who wants the house kept in good order" (Howarth: 163). Basically, it is the interdisciplinary reading of a literary text relating to ecology and the environment. It is the scientific analysis of the environmental issues and to find out a possible way out for the development of the environmental ambiance. The term eco-criticism was first used by William Ruckert. In the 1990s, two seminal books entitled The Ecocriticism Reader (1996) by Cheryll Glotfelty and Harold Fromm and The Environmental Imagination (1995) by Lawrence Buell published and practically heralded the terminology 'Eco-criticism'. In America, Cheryll Glotfelty is the acknowledged proponent of Ecocritics. Ecocriticism has initiated the interest for the last three decades as it is coupled with the interrelations between human beings and the natural environment. But the last part of the twentieth century has aroused a new universal hazard that is green disparity and ruin. Ecocriticism is the result of this new idea and awareness that in the recent future there will be scarcely anything attractive in the natural world to converse about unless we are cautious, careful from right now about our mother earth.

Of late, earth is approaching a catastrophe as the spectre of the climate crisis is hanging over our head relegating all of us to a mode of emergency where the utmost criteria is to save ourselves anyhow from this ordeal. The flora and fauna on the earth are finding a massive setback as climate change has been approaching towards its acme which is irredeemable. Earth is slowly dying down as several species are going to be extinct, the temperature of both the air and the water is soaring day by day, plastic pollution has choked the throat of the environment and slowly and silently we are approaching in the Handcuffed to Nature 105 direction of another world war and that will be fought among us due to the dearth of water and other natural resources. Different species of the next generation will face an imminent crisis of survival. To gain profits, greed-mongering and politically motivated powerful business tycoons are bringing crisis by destroying the climate and this environmental slaughter has never been properly assessed.

Till now, the authors, novelists are not vocal about global warming and its impact on life on this planet probably because the authorial imagination doesn't capture the storms, thunders, cyclones, tornadoes, floods as because they don't make a plausible ground for the emotional endeavour. The stories of these natural calamities do not come into the periphery of serious literary fiction and are relegated to the other literary genres as fantasy writing and science fiction, rather the limitations of the 'literary novel' are to highlight 'individual moral adventure' thereby dissociating the mental state from the susceptibility of its physical state, as it hardly allows the climate to aggressively encroach upon the customary routine and normal concern of a human being it prefers to portray. Here the author contends that the contemporary novel by utilizing the narrow parameter of time and space which could rarely surpass more than a human's lifespan. But Amitav Ghosh is a distinguished writer and a climate change activist. He has got a different outlook and is seriously concerned about the imminent danger and his non-fiction The Great Derangement: Climate Change and the Unthinkable (2016) is proof of that. This entire work is concerned with climate change, the shocking effect of the changing weather patterns of the world and with a cutting insight, he analyses the limitations of history, politics, and literature to grab the magnitude of this climate change. This nonfiction The Great Derangement: Climate Change and the Unthinkable (2016) began as a collection of lectures in the name of the Randy L. and Melvin R. Berlin Family Lectures and was delivered at the University of Chicago in 4 parts, starting from 29th September to 7th October 2015. Basically, the topic of degradation and destruction of the environment and the position of Asia in world history have woven the context of Ghosh's fiction. It concentrates on the nexus between economic imbalance and annihilation of the ecology and environment.

#### Objective

The objective of this paper is to make a detailed study of the ecocritical aspect of The Great Derangement: Climate Change and the Unthinkable.

#### Analysis

The analysis will focus on how Amitav Ghosh's eco-narrative portrays the description of "greening post colonialism" as propounded by Graham Huggan and Helen Tiffin in Postcolonial Ecocriticism. This nonfiction highlights within the sphere of postcolonial eco-criticism and provided a different method of eco-narrative in contrast to ecoactivism, eco-tourism, etc. Moreover, Material Eco-criticism focuses on the material phenomena which are tied to a great chain of profitgaining business agencies and can be read and understood as forming a story or a narrative. "Developing in bodily forms and in discursive formulations the stories of the matter is a material mesh of meanings, properties, and processes, in which human and non-human players are interlocked in networks that produce undeniable signifying forces" (Io vino, 1-2).

Amitav Ghosh's non-fictional enterprise is certainly an example of post-colonial eco-criticism that concentrates on the preservation of the bio-diversity and the hypocritical hollow rhetoric of eco-business. It also "highlights how postcolonial literature is rich in discursive formulations and the stories of narrative matter replete with their material mesh of meanings that can serve as signifying forces" (Vincent 2). Amitav Ghosh reasserts a new space of postcolonial identity through eco-narrative. This nonfictional prose enables us to identify and articulate resistance against colonialist and materialistic power. Ghosh ponders over the fact that the present generation is deranged. Here the author has probed the incapability of the current generation to understand the extent and aggression of the climatic degradation and postulates that it should be mirrored in the current literary texts, politics, and history. Amitav Ghosh posits his ecocritical fiction on the face of natural peril and peculiarity of the weather and shows that fiction is the best medium to deal with the pressing task of our time troubling the issue of climate change out of its scientific arena of meteorological studies to much broader areas of human culture and studies. Amitav Ghosh delves deep into the snarled nexus of the carbon economy and unfolds the reason behind the climatic change as an over-dependence on fossil fuels. It's a kind of derangement for us to say we desire a new different world but hardly try to change the deeds to make it realized perfectly. As per Handcuffed to Nature 107 Ghosh, the 'derangement' alluded to in the title means an advancement towards climatic disaster without any attempt to mitigate it and we just can't imagine what the unprecedented future holds, some portion of the essay is devoted to the imagination with a connection of rationalistic approach of the twentieth century novel with a scientific temperament.

The first part is a long chapter entitled "Stories" where he indicates the literary community for their collective failure to claim the issue of climate change as the 'principal preoccupation' of serious novels. He assumes that global warming will affect in such a massive way that the sea level will rise and it will devour the Sundarbans and the low-lying cities like Kolkata, Bangkok. Today's unthinkable connoisseur of art and literature will have to face an entirely transformed world for the legacy of the inheritors. And failing to search those, he thought what could be their expressions; rather they would conclude that ours was a time when most of the art and literary forms were tied to the means of suppression and cover-ups that barred all of us from identifying the reality of the actual predicament. These folks, as per Ghosh's vision of the 'readers and museum-goers' looking for and to understand how the authors of today deliberately hide away from the realities that certainly led to their descendants' terrifyingly bleak and dreary planet. With this viewpoint, Amitav Ghosh investigates the 'customary frames that literature has applied to "Nature" (32) and ended up with utmost sorrow, that events like the transformation of climate change are too powerful, uncanny, serious, and dangerous to vie with the refined and sophisticated fictional language. Moreover, the essential terminologies are uncouth to listen to. Vocabulary like 'petroleum', 'fossil fuels', 'bitumen', 'naphtha' and 'tar', evoke a kind of nauseating feeling. Ghosh's ultimate winding up is that a new fusion of literary style will materialize and that may change the very act of reading. Here his revelation is that like 'the vast majority of human beings,' (54) his life is steered not only by cause and motive but by 'the inertia of habitual motion (54).' Despite this, "Stories" is a captivating literary contemplation about the environment and the canons of literary and science fiction including western classics as well as less known works of art from around the world.

This first part of this nonfiction engages on the motif of the climate crisis with the following views on non-human interlocutors like rising seas, storms, etc. Then these non-human aspects influence the thought process of the human beings which grows a massive interest to re-centre these non-human aspects. Then the uncanny intimacy of the humans with the non-humans is discussed, and then comes the instability of human existence. Then the author analyses the perplexity of the predator, the realization of the European Enlightenment along with the middle-class expectations and revisions of thought process. Amitav Ghosh's contention is to analyze the conversion of the attitude towards nature and it is exemplified by the fact that human beings have started believing that planets and asteroids were inert merely three centuries ago. We are forced to awake "to the recognition of a presence" (6). It had moulded our lives. He writes that "the energy that surrounds us, flowing under our feet and through wires in our walls, animating our vehicles and illuminating our rooms, is an all-encompassing presence that may have its purposes about which we know nothing" (6-7). Awareness was forced upon us to be near to the non-human presences with the portents of alteration especially in the landscape "in the receding shoreline and a steady intrusion of saltwater on lands that had previously been cultivated" (7) or in the escalating level of toxic carbon in the air and atmosphere was "rewriting the destiny of the earth" (8) in this 21st century. Amitav Ghosh asserts that the landscape is "demonstrably alive" (7) as the protagonist in a "stage for enactment of human history." (8)

Part two of the book exemplifies the historicized psyche captured in a world that keeps on historicizing itself, in this circumstance the past is persistently being outdated and human beings depend on the flawed technology to make out the sense of things. The historicized psyche naturally confesses the importance and priority to history and designates the superiority of historical division and knowledge. This has been exemplified by the terms which Ghosh uses like 'arc', 'trajectory', 'pattern' and 'process'. One has to remember how we came into existence and where we exactly are. In this part of the book, he tries to identify capitalism as a principal driver of climate change. Ghosh widens and intensifies the argument by staying away from the usual Eurocentrism with a Handcuffed to Nature 109 warning: 'the continent of Asia is conceptually critical to every aspect of global warming: its causes, its philosophical and historical implications, and the possibility of a global response to it (87).' It directs us to a remarkably callous and inconsiderate situation including saline water having devoured up more than a million acres of fertile agricultural ground in Pakistan because of the massive exploitation of the Indus resulting in its obstruction and free-flowing to the sea. India is on the

brink of disaster where the country's most fertile land of nearly six thousand square kilometers may be inundated due to the rise of the sea-water level resulting in the forced migration of about 50 million people and the same may cause havoc in Bangladesh as well resulting in the evacuation and resettlement of approximately 75 million people. Apart from these perils, another concern of desertification of the arable lands in India and China has been cited by the author. China has incurred an annual loss of \$65 billion due to the desertification of the fertile land (89). Moreover, the author emphasizes the acute and accelerating water crisis in the Asian continent as 47% of the world's total population resides here. Amitav Ghosh shows the essential disparity between the drying up of Ogallala Aquifer in the US and those that exist in north China and shows that only 2 million people depend on the Ogallala in the US, whereas the dependency of people in China is almost about 214 million. He not only mentioned the Water Diversion scheme from North to South but was designed to change the dependency on groundwater in the North and to lessen its dryness and barrenness. He referred to these statistics only to emphasize the comparative impact of the two dams as per dependency of the population.

These are a few instances of the crisis of global warming. Ghosh emphasizes by saying that only in the beginning of 1980s, Asia's swelling process of industrialization 'brought the climate crisis to a head (91) [as] the only continent where the magnitudes of the population are such that they can move the planet (92).' The callous reality of Asia makes it plain and simple that: "every family in the world cannot have two cars, a washing machine, and a refrigerator ... because humanity would asphyxiate in the process. Asia has also laid bare, through its silence, the silences that are now ever more evident at the heart of global systems of governance. (92)

In 1928, Gandhi also had anticipation of this and warned that if we had the three hundred million industrialized as the west has, then "it would strip the world bare like locusts (111)" again U Thant, the Burmese statesman, grieved over the fact that 'smog across our poisoned waters' since we 'ran out of foresight and air and food and water and ideas [and] went on playing politics' until the world collapsed (113). Ghosh is distressed and bewildered about the cultural world's lassitude or incapability to bring in the limelight, the concern of the transformation of the climate, but he is fully aware of whom to lay blame for its happening. Every person who is ever born on this earth has a contribution to climate change which according to him is "the terminus of history". The reasons for this climate change like hurricanes, floods, desertification are 'the distillations of all of human history: they express the entirety of our being over time (115).' The author caught in between this historicized perception, employs the term 'Anthropocene' which means the 'age of man' as an idiomatic use to designate the annihilation of terrestrial and climatic disorders. This coinage signifies a new geo-historical epoch and by using it Ghosh assigns to an account of augmentation of human expropriation of this earth. Anthropocene is the current geological age, viewed as the period during which human activity has been the dominant influence on climate and the environment. It is the latest historicization that formulates the existence of humans as a thing of the past. "Anthropocene presents a challenge, not only to the arts and the humanities, but also to our common sense understanding and beyond that to contemporary culture in general" (135).

In the last part, numbered III, "Politics", Amitav Ghosh again mulled over the shocking reality of apathy by the creative community to introspect on the imminent danger of earth and atmosphere, we are already put in. Only a handful of writers like Margaret Atwood, Doris Lessing, Barbara Kingsolver, Mc Carthy, Boyle have evoked something about the world environment. Amitav Ghosh sensed this apocalyptic doom and includes himself among this category of writers. With a morose heart, he observes that the issues relating to religion, gender, caste have been taken up for discussion with priority but the issue of environmental disaster has been relegated to the rear as a political issue in South Asia. He questions whether the reason is for individual concern rather than the collective moral Handcuffed to Nature 111 adventure. Ghosh uses the word 'trapped' (135) in an individualizing imaginary as we are the dwellers of the Great Derangement. Here, the prevailing importance of numerous politicians is given to connect strategies to control or to wage a war against climate change as an assault on 'our way of life' (137). The crazy happening continues with endless consumption of oil as fuel making the debate more political than realistic. Present-day politics has almost no command to duly address 'the commonweal and to preoccupy in joint action for the sake of humanity's survival. According to him, 'extreme weather events (floods, droughts, heave waves) will increasingly disrupt food and energy markets, exacerbating state weakness, forcing human migrations, and triggering riots, civil disobedience, and vandalism' (140).

Ghosh cites that only America's military front which is the single biggest consumer of fossil fuels is now vigorously seeking and searching for an alternative energy route. Perhaps, Ghosh tries to point out if the army front has considered all aspects of the transformation of climate activism and appropriated its strategy to form a policy of action by using vigorous campaigning to bring about ideological change regarding climate, then why not we? Moreover, in this calamitous condition, "Ghosh finds a ray of hope and, astonishingly, it is Pope Francis' letter, Laudato Si: On Care for Our Common Home, which he contrasts favourably with the Paris Agreement on climate change. Both are published in 2015 and are grounded in an acceptance of the science of climate change" (Abbott 371).

Climate change is wearing away conceptions of indisputable human authority over the earth and propelling us to mete out the possibility of universally achieving the belongings of materialistic middle-class life. 'This conception of human flourishing into which we have been beguiled is consuming itself' (Leskanich). In this part, Ghosh condemns the narrow opinion of political concern and Ghosh doesn't merely advocate a technocratic 'fix'. In searching for a vague hope in the 'sacred', he thinks that the 'religious world views' might inspire mass movements and will subsequently rise above any individual and nation-state.

In all his writings, Amitav Ghosh explores the challenge that

civilization is confronting in the age of Anthropocene, a new geological era that dawns on humanity a new role to play for reshaping and reorganizing the globe and preserving it for the generations to come. According to him, human beings as ecological agents change the most basic physical processes of the Earth and at the same time, Anthropocene presents a challenge to our commonsense and understandings. Still, we find it hard to deal with climate change. Amitav Ghosh argues that "the climate crisis is also a crisis of the culture and that of the imagination". He desires that the authors of the present generation should discover fresh types of literature and art that divulge the dilemma at hand. Ghosh while presenting his understanding and experience says, "..... these are, of course, nothing other than instances of exception.....it is through this mechanism that worlds are conjured up, through everyday details, which function 'as the opposite of narrative''' (183) and again he is reminded of the fact that "we are confronted suddenly with a new task: that of finding other ways in which to imagine the unthinkable beings and events of this era" (197). Ghosh's literary output is related to the schemes of environmental and social advocacy and serves as "a catalyst for social action and exploratory literary analysis into a full-fledged form of engaged cultural critique" (Huggan and Tiffin 12). The Great Derangement tells us about our relationship with the earth which cannot be entirely and truly described within the traditional western scientific paradigm. We, as the readers meet an array of voices that articulate the troubles and tribulations that the globe is confronting today and determine an abundance of topics that vociferates the urgent need to emphasize and implement a "green" paradigm free of racial and social prejudices and injustice.

#### Conclusion

This attempt to mingle up environmental advocacy and aesthetics of imaginary fiction is one of the attributes of the postcolonial ecocriticism that looks for an endorsement of environmental and societal integrity and justice in the postcolonial world today. This non-fiction is an anxious and upsetting reminder that without a pressing, sustained, and universal change in human attitude and behaviour, we, the illfated species on the earth will be doomed and will be the survivors with immeasurable horror and dismay. Amitav Ghosh envisions the "postcolonial Green" that Handcuffed to Nature 113 campaigns for the transformation from 'red' to 'green' politics and the need to play the role of responsible inhabitants with a belief in global justice and sustainability on our planet.

### Bibliography

- Abott, Elizabeth. "The Great derangement: Climate Change and the Unthinkable," International Journal of Environmental Studies, 75:2 (2017), 368-371. Web. 9 Dec 2020.
- Ashcroft, Bill; Gareth Griffiths, Helen Tiffin. The Empire Writes Back: Theory and Practice in Post-Colonial Literature, New York: Routledge, 2002. Print.
- Ghosh, Amitav. The Great Derangement: Climate Change and the Unthinkable. London: University of Chicago Press, 2016. Print.
- Howarth, W. Some Principles of Ecocriticism. New York: Viking. 1996. Print.
- Huggan, Graham and Helen Tiffin. Postcolonial Ecocriticism: Literature, Animals Environment. London: Routledge, 2010. Print.
- Iovino, Serenella. Material Ecocriticism. Bloomington: Indiana University Press, 2014. Print.
- . "Steps to a Material Ecocriticism: The Recent Literature about the 'New Materialisms' and Its Implications for Ecocritical Theory." Ecozon@: European Journal of Literature, Culture and Environment, 3:1(2012): 134–145, Print.
- Leskanich, Alexandre. Rev of The Great Derangement: Climate Change and the Unthinkable, by Amitav Ghosh. LSE Review of Books, 20 July 2017. Web. 10 Dec 2020.

- Mukherjee, Upamanyu Pablo. Postcolonial Environments: Nature, Culture and the Contemporary Indian Novel in English. Basingstoke: Palgrave Macmillan, 2010. Print.
- Parry, Bentia. Postcolonial Studies: A Materialist Critique. New York: Routledge, 2005. Print.
- Pius, T K. "Climate Crisis and Fiction: A Study based on Amitav Ghosh's The Great Derangement: The Climate Change and the Unthinkable" IOSR Journal of Humanities and Social Science, 21:10 (2016), 19-28, Web. 14 Dec 2020.
- Rueckert, William. "Literature and Ecology: An Experiment in Ecocriticism." The Eco-critical Reader: Landmarks in Literary Ecology. Ed. Cheryl Glotfeltry and Harold Fromm. Athens U of Georgia Press. 1996. Print.

 $\circ$   $\circ$   $\circ$ 

### Green Finance: A study of Green Banking Practices in Electric-Vehicles segment of India

#### **Dr Ratul Dutta**

Assistant Professor, Sibsagar Commerce College, Sivasagar, Assam

Mr Ankur Das Assistant Professor, Sibsagar Commerce College Sivasagar, Assam

#### Introduction

Collective wisdom won out, and the world community recognized the seriousness and gravity of the concerns related to climate change, global warming, and sustainable development (Ali et al., 2021). This was demonstrated by the Paris Agreement and the 2030 Sustainable Development Goals (SDGs) Agenda. Since then, there have been numerous and complex tactics, tools for policymaking, and legislative initiatives to encourage climate action to meet the goals of sustainable environmental development. Green finance (GF) is one of the crucial moving parts toward the directions of sustainable development. The latter describes any structured financial activity that guarantees a more favorable outcome for a sustainable environment. Green funds both increase the likelihood of green and environmentally beneficial initiatives and enable projects to have unfavorable environmental effects (Zimmerman et al., 2019). Additionally, green credit policy

*Climate Change in North East India* ▶ 123

tools are essential for achieving carbon neutrality and the carbon peak since they support green businesses (Ding et al., 2022). Globally, the demand for GF has expanded at an unprecedented rate. However, it is crucial to identify and assess the factors that contribute to Green Finance growth, particularly in emerging and developing nations.

Depending on the context, the terms "sustainable finance" and "climate finance" are interchangeable with the more general word "green finance." According to the UN Environment Program, "green financing" aims to boost financial flows from the banking, microcredit, insurance, and investment sectors from the public, private, and nonprofit sectors to priorities for sustainable development. The G20 refers to "green finance" in a broad sense as the considerable change in financial flows required to fund programs that benefit the environment and society by reducing pollution or addressing climate change.

According to Berensmann and Lindenberg (2019; Ozili, 2021a), "green finance" is the acquisition and use of funds for projects that both safeguard the environment and provide a reasonable return to investors or lenders. In order to achieve the Sustainable Development Goals, green finance aims to enhance the volume of financial flows from financial institutions to economic agents engaged in projects and activities that protect the environment (Lee and Baral, 2017; Force, 2015).

#### Literature Review

The need to reduce the damage to the environment brought on by fossil fuel emissions has prompted calls for divesting from fossil fuel operations and a shift to investing in low-carbon initiatives and activities that protect the environment sustainably (Bergman, 2018; Cleveland and Reibstein, 2015). This call has both domestic and global implications. At the national level, numerous nations, including Canada, Japan, Mexico, and the United Kingdom, have released policy declarations to raise citizens' understanding of the hazards associated with climate change and the detrimental consequences of fossil fuel emissions on the environment. Internationally, nations have ratified the Paris Agreement, a legally binding agreement on reducing global warming (Dimitrov, 2016; Blau, 2017). (Rogelj et al., 2016; HoeghGuldberg et al., 2018) The Paris Agreement aims to keep global warming to below 2 or 1.5 degrees Celsius. The participants of COP26, also known as the United Nations Conference of the Parties on Climate Change, have also pledged to cut greenhouse gas emissions. A significant amount of financial resources must be raised in order to fulfill the Paris Agreement goal and the COP26 mission (Tollefson, 2018). Green finance and green financial instruments are frequent names for these financial resources. To support the demands of a modest but expanding green economy, the shift to "low carbon" or "environmentally friendly" economic activity calls for unique finance (Dikau and Volz, 2021; Lamperti et al., 2019; Sachs et al., 2019a). Green economy proponents have suggested "green finance" as a way to meet the financing needs of individuals, organizations, and governments involved in initiatives and endeavors that sustainably protect the environment (Mohd and Kaushal, 2018; Falcone and Sica, 2019; Soundarrajan and Vivek, 2016). For people, businesses, and governments eager to pay and participate in environmentally friendly or low-carbon activities, green finance is a recent concept that provides an alternative funding channel (Huang et al., 2019). The distribution of funds for environmental preservation (Wang and Zhi, 2016), the flow of funds to sustainable trade and investment activities (Eyraud et al, 2013), low-risk financing (Taghizadeh-Hesary and Yoshino, 2019), and the creation of green investment and financing instruments (Sachs et al, 2019a) are some advantages of green finance. Despite these benefits, it's important to understand that green financing is only one part of sustainable finance for sustainable development. Other possibilities for sustainable financing exist besides green finance, including social finance, blue finance, and digital finance (Ozili, 2021a).

#### Objectives

The objective of the paper interelia discusses the following objectives:

- 1. To study about the status of Green Financing in India
- 2. To analyse the practices of Green Financing in the electronic vehicle segment of India

#### Methodology

The research is based on secondary sources and relevant data and information are collected from different government agencies and banks published reports on green financing. Moreover data are also collected from different journals published research articles.

#### **Definitions of green finance**

There are several ways to define green finance. Green finance, according to Lindenberg (2014), involves the financing of both public and private green initiatives., according to Ozili (2021a), is the funding of initiatives that advance environmental sustainability while producing economic returns. Green finance is defined by Wang and Zhi (2016) as financing that combines economic growth and environmental preservation. According to Lindenberg (2014), green finance includes all investments in products and services that benefit the environment as well as investments in initiatives that lessen harm to the environmental protection or the reduction of environmental harm (Lindenberg, 2014). Green finance, according to Bahl (2012), is the funding of projects that lessen pollution as well as environmentally beneficial activities and green technologies.

#### **Components of Green Finance**

Public and private green financing investment encompasses of government initiatives that support projects for environmental mitigation and adaptation of .Green Bonds and other structured green instruments are among the green investment funds and products available.

Green banking techniques include online banking, which uses the internet to offer financial services to users. It encourages transactions done without paper or currency. For a green mortgage, the financing allowed for either the acquisition of a green building or the conversion of an existing structure to a green building. Energyefficient equipment can be purchased and installed at home with the help of a green home equity loan... For the purchase of non- or lowemission automobiles, green car loans provide lower interest rates.. Loans for alternative fuel cars and fuel infrastructure are available and some financial incentives are offered and loans for converting current vehicles are also available to use cleaner and more environmental friendly energy. Green insurance, specifically for automobile sector the cost of the premium is determined by the number of miles driven by the automobile. This reduces the needless use of private vehicles and helps to safeguard the environment. Green business insurance includes financial incentives for business owners to replace or rebuild damaged structures using eco-friendly materials. Eco-friendly house insurance offers insurance coverage as well as technical and maintenance support for renewable energy power systems. By giving a portion of the premiums collected for programs aimed at reducing carbon emissions, green travel insurance makes up for the environmental harm caused by the carbon dioxide emissions that occur while a person is traveling. A portion of the insurance company's proceeds from green life insurance will be donated to environmental programs. Carbon protection provides protection from weather-related dangers for the planted woodlands.

#### Source of Green Finance

Governments as in the apex level, the state and local levels generally contribute to the green financing by providing subsidy to the green product beneficiary. Financial firms and banks that prioritize environmental protection and community improvement in order to offer financing as green finance extended low rate loans to the customer of green products. Here, non-profit organizations with an emphasis on the environment protection seek to encourage green company investments, thus they'll also provide green financing.

#### Green finance research in India

According to Jena and Dhruba (2020), there is an increasing need to educate India's banking industry on the value and advantages of green financing. In addition, they contend that a concerted, marketdriven cooperative effort is required, beginning with a clear definition of green finance, to speed up the flow of green money into India. Making rules to encourage green finance and enacting penalties for investments with high carbon footprints are other attempts.

#### India's Policy on Electric Vehicles

In order to lower the price of hybrid and electric vehicles and promote their uptake on the market, the National Electric Mobility Mission Plan (NEMMP) 2020 was established in 2012 and includes the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) incentive program, which was introduced in 2015. The FAME program provides a discount off the sticker price of passenger automobiles. For light hybrids, these subsidies vary from INR 11,000 to 24,000, for strong hybrids, from INR 59,000 to 71,000, and for electric cars, from INR 60,000 to 1,34,000 (about). Buses, lightcommercial vehicles, two-wheelers, and three-wheelers can all receive subsidies.

The subsidy provided by the FAME plan is not the only incentive program that affects the Indian market for hybrid and electric cars. Hybrid and electric cars receive preferential treatment under tax incentives from the Central Government of India and various state governments, including the National Capital Territory of Delhi (NCT of Delhi). According to recent comments made by finance minister Nirmala Sitharaman during the presentation of the union budget 2020, the government has increased the import duty on them in order to boost the development of electric cars in India.

#### **Overview of the India Electric Vehicle (EV) Financing Market**

Equated Monthly Installments (EMIs) are a sort of loan that allows consumers to select the electric vehicle (EV) of their choice and pay for it over the course of a defined duration. Customers may purchase an electric vehicle (EV) for personal or commercial usage using finance. On the registration, though, the owner or business must be named. The lifespan of an EV loan is quite flexible, allowing customers to choose the period that best suits their needs. A car loan for an electric vehicle might have a period of between 12 and 96 months. India Electric Vehicle (EV) Financing Market Pros and Cons

**Deepening Penetration of Electric Vehicles** 

One of the largest markets for EVs has emerged: India. The domestic EV market in India will expand at a 49% compound annual growth rate (CAGR) between 2022 and 2030, reaching 10 million sales annually by that time, according to the Economic Survey 2023. In 2022, India registered more over half of its three-wheelers, demonstrating how common EVs have become. The primary driving force behind the expansion of India's electric vehicle (EV) financing business is now being identified as the growing demand for EVs.

High Cost Associated With Electric Vehicle Financings

In India, the EV finance market is unregulated and has variable interest rates. Additionally, loans for electric scooters have interest rates that are 4% higher than loans for equivalent devices powered by gasoline. Higher interest rates, shorter loan periods, lesser penetration, and larger monthly payments are a few of the main negatives of electric car financing that keep customers from choosing this choice. This poses a serious obstacle to the growth of the electric vehicle (EV) finance business in India.

## Indian Electric Vehicle (EV) Financing Market Impact of COVID-19

The industry for financing electric vehicles (EVs) in India saw a growing slowdown because to the extraordinary COVID-19 outbreak. India has mostly experienced economic disruption and mortality as a result of the corona virus outbreak. In FY2021, India's GDP decreased by 5.5% as a result of the epidemic. Due to a labor scarcity and a drop in consumer spending power, the production and sales of vehicles, including EVs, fell dramatically during the epidemic. As a result, the demand for EV financing declined significantly, which had a detrimental impact on market expansion. India Electric Vehicle (EV) Financing Market – By Type

- New Vehicle
- Used Vehicle

The market for financing electric vehicles (EVs) in India is divided into two types: new cars and secondhand cars. The finance market for electric vehicles (EVs) in India is dominated by the new car category. The benefits of buying a brand-new car include the newest safety and fuel-efficient technology, such as navigation systems, collision warning sensors, etc. The cost of buying new electric vehicles is made more reasonable by the incentives offered by many firms that finance electric vehicles for new car loans as well as other advantages like low or zero percent interest rates.

Market for Financing Electric Vehicles (EV) in India - By Source

- OEMs
- Banks
- Credit Union
- Financial Institution



According to the source, banks, credit unions, OEMs, and financial institutions make up the majority of the India electric vehicle (EV) finance industry. The largest market share belongs to the banking sector. Banks are the preferred source of EV financing for Indian consumers because to their cheap interest rates when compared to other options. Prior to visiting an EV dealership, customers may be able to save more money by contacting a bank directly because doing so allows them to compare financing rates. A dealer is less likely to raise the loan rate as compensation for its aid in the transaction if financing is arranged in advance.

India's Market for Electric Vehicle (EV) Financing, By Vehicle

- Passenger Cars
- Commercial Vehicles
- Two-wheelers
- Three-wheelers

The passenger car, commercial vehicle, two-wheeler, and threewheeler segments make up the India electric vehicle (EV) finance market. The market for financing electric vehicles (EVs) in India is dominated by the two-wheeler category. The category is rapidly expanding as a result of India's strong and growing demand for twowheeled electric vehicles. 3,27,900 electric two-wheelers (E2W) were sold worldwide in 2021–2022. The Society of Manufacturers of Electric Vehicles (SMEV) reported statistics showing that in FY2023, 1.2 lakh low-speed (LS) e-scooters with peak speeds under 25 km/h were sold.

#### **Competitive Landscape**

State Bank of India, Union Bank of India, ICICI Bank, Axis Bank, IDFC FIRST Bank, Tata Motors, Poonawalla Fincorp Limited, Karur Vysya Bank, Hero Electric Finance, and Mahindra Finance are significant participants in the India electric vehicle (EV) finance sector. These businesses use a variety of tactics, such as partnerships, joint ventures, license agreements, mergers and acquisitions, and the introduction of new products, to increase their market dominance even more.

#### The Financing Market for E-Vehicles in India

During the forecasted period of 2023 to 2029, increasing EV adoption and the accessibility of EV financing alternatives are anticipated to drive the growth of the India EV financing market.

#### **Recent Developments**

RevFin, a financing company for individual EV drivers with headquarters in Delhi, announced in October 2022 that it has secured

USD 10 million in investment in a Series A round using a combination of debt and equity money.

EV Financing Market in India: Industry Trends & Forecast Report, 2029

The market for financing electric vehicles (EVs) in India was projected to reach USD 1.94 billion in 2022. The India electric vehicle (EV) finance market is anticipated to develop at a CAGR of 15.54% between 2023 and 2029, reaching a value of USD 5.25 billion by that year. Rising consumer interest in electric vehicles (EVs) and various awareness efforts around the country conducted by numerous important industry players are major growth factors for the India EV finance market. Customers prefer more costly automobiles, and those searching for discounts are favorably impacting the demand for financing for these vehicles as the nation's EV sector gets more structured.



#### In the first eight months of CY2023, India's EV sales reached a record 965,868 units.

India EV Inc. expects to break CY2022's record sales of 10, 24,781 units in the first two weeks of September and reach a million units for the second year in a row. The difference by the end of August 2023 was only 58,913 units. PVs, CVS, and retail sales of electric two- and three-wheelers are all disclosed with company-specific statistics.

In every passing month India's electric car growth narrative gets stronger. According to the government's Vahan website's most recent retail sales data as of September 4, total sales are just 58,913 EVs short of the record-breaking 10,24,781 EV sales for the full calendar year 2022. Total EV retail sales from January to August 2023 will total 965,868 units, a significant 65% year-over-year increase from January to August 2022's total of 585,781 units.

The first year when EV sales in India surpassed one million units was CY2022. Given that the country sold 4,024 EVs per day on average from January to August 2023, or 120,733 units per month, the CY2022 record should be surpassed in the first two weeks of September 2023, which is less than nine months into the current year and a sign of the nation's accelerating EV demand. This is despite the fact that India's holiday season has already begun and that numbers should continue to rise in the coming months.

The 126,466 retail units sold in August 2023 was the 12th consecutive month that EV sales exceeded the 100,000-unit threshold. The sales momentum continued after the milestone was first reached in October 2022 (117,200 units), and it continued through all eight months of CY2023, reaching a peak in May 2023 (158,369 units). It also continued in November (121,602) and December (105,003). The sales have increased this year, sustaining significant double-digit growth, as seen in the data table below.

Category	Jan	Feb	Mar	Apr	Мау	Jun	July	Aug	Total
2Ws	64,688	66,083	86,328	66,855	1,05,494	46,028	54,508	62,455	5,52,439
3Ws	34,332	36,033	45,285	38,052	44,637	48,026	53,726	56,746	3,56,837
PVs	3,442	4,768	8,842	6,029	7,714	7,953	7,708	6,750	53,206
Goods	137	163	340	304	227	219	219	264	1,873
Buses	96	87	74	84	271	200	133	247	1,192
Others	172	81	25	9	26	3	1	4	321
Total	1,02,867	1,07,215	1,40,894	1,11,333	1,58,369	1,02,429	1,16,295	1,26.466	9,65,868

#### RETAIL SALE OF THE INDIA ELECTRONIC VEHICLE INDUSTRY IN THE FIRST 8 MONTH OF CY2023

The 126,466 retail units sold in August 2023 was the 12th consecutive month that EV sales exceeded the 100,000-unit threshold. The million-sale milestone is anticipated to be reached in September.

Monthly EV sales in the past 10 months had fallen to their lowest in June (102,429 units), but the recovery is underway as seen in the improved July (116,295 units) and August (126,466 units) numbers. This is evidence that the maturing Indian EV market, particularly for electric two-wheelers, has absorbed the sharp 25% reduction in the FAME II subsidy for e-two-wheelers, which kicked in from June 1.

#### Conclusion

Automobile or vehicle segment in India is a very well structured and giant component of India's Industry sector. It has deepest penetration in all across the country. But, however majority of this segment run and operated by petrol, diesel and other gasoline products, which means a large amount of carbon emission to the environment. To achieve the goal of sustainable development low carbon emission utilities must have a preferable chance for promotion and development. The green financing concept adopt the policy preferably invest and finance the utilities having low carbon emission rate or it tries to curb the tendency of higher emission. India's electronic vehicle segment was showing a positive growth rate in recent years but not as per expectation. The E- Vehicle sector in India generally confined to low cost commercial and personal vehicle, however some metros tries to ply heavy busses operated through E-System. Oil India Limited recently tries to procure E-Buses for their usages. The tendency of procuring low cost electronic vehicle may not the ultimate solution. Customers must have the choice. In this respect Indian e-vehicle producers shall try to lowering down the high cost luxurious e-vehicle or government and other statutory bodies may arrange some sort of incentives and relaxation in registration or taxation process to motivate the e-vehicle procurement tendency.

#### References

- Ali, S., Xu, H., & Ahmad, N. (2021). Reviewing the strategies for climate change and sustainability after the US defiance of the Paris Agreement: An AHP–GMCR-based conflict resolution approach. *Environment, Development and Sustainability, 23*, 11881-11912.
- Bahl, S. (2012). Green banking-The new strategic imperative. Asian Journal of Research in Business Economics and Management, 2(2), 176-185.
- Berensmann, K., & Lindenberg, N. (2019). Green finance: Across the universe. In *Corporate social responsibility, ethics and sustainable prosperity* (pp. 305-332). Beijing.
- Bergman, N. (2018). Impacts of the fossil fuel divestment movement: Effects on finance, policy and public discourse. *Sustainability*, 10(7), 2529.
- Blau, J. (2017). The Paris Agreement: climate change, solidarity, and human rights. Springer.
- Cleveland, C. J., & Reibstein, R. (2015). The path to fossil fuel divestment for universities: climate responsible investment. *Available at SSRN 2565941*.
- Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives and the promotion of green finance. *Ecological Economics*, *184*, 107022.
- Dimitrov, R. S. (2016). The Paris agreement on climate change: Behind closed doors. *Global environmental politics*, *16*(3), 1-11.
- Ding, X., Jing, R., Wu, K., Petrovskaya, M. V., Li, Z., Steblyanskaya, A., ... & Makarov, V. M. (2022). The impact mechanism of green credit policy on the sustainability performance of heavily polluting enterprises – based on the perspectives of Technological Innovation Level and Credit Resource Allocation. *International Journal of Environmental Research and Public Health*, 19(21), 14518.

- Eyraud, L., Clements, B., & Wane, A. (2013). Green investment: Trends and determinants. *Energy Policy*, *60*, 852-865.
- Falcone, P. M., & Sica, E. (2019). Assessing the opportunities and challenges of green finance in Italy: An analysis of the biomass production sector. *Sustainability*, *11*(2), 517.
- Force, G. F. T. (2015). Establishing China's green financial system. People's Bank of China & United Nations Environment Programme: Beijing, China.

Green Finance : Financing a Sustainable Ecosystem

- https://icmai.in/GS-2023/assets/Presentation/Tech\_Session\_u4/ SK\_Gupta.pdf
- Hoegh-Guldberg, O., Jacob, D., Bindi, M., Brown, S., Camilloni, I., Diedhiou, A., ... & Zougmoré, R. B. (2018). Impacts of 1.5 C global warming on natural and human systems. Global warming of 1.5 C. An IPCC Special Report. Geneva, Switzerland.
- Hoegh-Guldberg, O., & Bindi, M. (2018). Impacts of 1.5 °C global warming on natural and human systems 2. *Notes*, 41.
- Huang, Z., Liao, G., & Li, Z. (2019). Loaning scale and government subsidy for promoting green innovation. *Technological Forecasting and Social Change*, *144*, 148-156.

India Electric Vehicle (EV) Financing Market.

- https://www.blueweaveconsulting.com/report/india-electric-vehiclefinancing-market#:~:text=India%20e lectric%20 vehicle% 20(EV)%20financing%20market%20size% 20was% 20estimated%20at, USD%205.25%20billion%20by%202029.
- Lamperti, F., Mazzucato, M., Roventini, A., & Semieniuk, G. (2019). The green transition: Public policy, finance, and the role of the state. *Vierteljahrshefte zur Wirtschaftsforschung*, 88(2), 73-88.
- Lee, C. F., & Baral, P. (2017). Green Finance Opportunities in ASEAN.

- Li, C., Solangi, Y. A., & Ali, S. (2023). Evaluating the factors of green finance to achieve carbon peak and carbon neutrality targets in China: A delphi and fuzzy AHP approach. *Sustainability*, *15*(3), 2721.
- Mohd, S., & Kaushal, V. K. (2018). Green finance: a step towards sustainable development. *MUDRA: Journal of Finance and Accounting*, *5*(1), 59-74.
- Ozili, P. K. (2021). Digital finance, green finance and social finance: is there a link? *Green Finance and Social Finance: Is There a Link*. Financial Internet Quarterly, 17(1), 1-7.
- Rogelj, J., Den Elzen, M., Höhne, N., Fransen, T., Fekete, H., Winkler,
  H., ... & Meinshausen, M. (2016). Paris Agreement climate
  proposals need a boost to keep warming well below 2
  C. *Nature*, *534*(7609), 631-639.
- Sachs, J. D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (2019). Importance of green finance for achieving sustainable development goals and energy security. *Handbook of green finance: Energy security and sustainable development*, *3-12*.
- Singh, S., Sharma, N., Chandrakant, S., & Singh, S. (2021, March). Electric vehicles in india: A literature review. In 7th International Conference on "New Frontier in Energy, Engineering and Science (NFEES) (pp. 19-20).
- Soundarrajan, P., & Vivek, N. (2016). Green finance for sustainable green economic growth in India. *Agricultural Economics*, 62(1), 35-44.
- Sushma, B. S. (2021). Green Finance-An Effective Tool to Sustainability. *International Journal of Creative Research Thoughts*, 9(1), 4256-4263.
- Taghizadeh-Hesary, F., & Yoshino, N. (2019). The way to induce private participation in green finance and investment. *Finance Research Letters*, *31*, 98-103.

- Tollefson, J. (2018). IPCC says limiting global warming to 1.5 [degrees] C will require drastic action. *Nature*, *562*(7726), 172-174.
- Wang, Y., & Zhi, Q. (2016). The role of green finance in environmental protection: Two aspects of market mechanism and policies. *Energy Procedia*, 104, 311-316.
- WEF What Is Green Finance and Why Is It Important? | World Economic Forum. https://www.weforum.org/agenda/2020/11/ what-is-green-finance/ (accessed on 5 December 2022)
- Zimmerman, R., Brenner, R., & Llopis Abella, J. (2019). Green infrastructure financing as an imperative to achieve green goals. *Climate*, 7(3), 39.
- EV sales in India hit record 965,868 units in first 8 months of CY2023https://www.autocarpro.in/analysis-sales/ev-sales-inindia-hit-record-965868-units-in-first-8-months-of-cy2023-116643

0 0 0

### Impact of climate change on the livelihood of beekeepers: A Case Study in Golaghat district, Assam

#### **Bhairab Talukdar**

Research Scholar, Department of Economics Birangana Sati Sadhani Rajyik Vishwavidyalaya, Golaghat, Assam

#### Dr Jitu Saikia

Assistant Professor, Dept of Economics Birangana Sati Sadhani Rajyik Vishwavidyalaya, Golaghat, Assam

#### Introduction:

Climate change refers to unexpected change in weather condition. When temperature and weather patterns change unexpectedly not favourable to the nature or living organisms it's known as climate change. Climate change is not confined to a particular area or region. Its impact spreads over the world. Climate change also impacts on the livelihood of beekeepers. Those who practice apiculture are known as beekeepers. Unexpected change in weather condition deeply affects the life of bee which results in the adverse affect on the livelihood of beekeepers.

In the 2022 report, the IPCC asserts that intensifying climate change has already pushed millions of people into acute food insecurity and predicts that agrifood systems will also be affected in the longer

term due to, among others, drought stress, altered seasonality, heavy rain events and increasing mean temperatures (IPCC, 2022). These are examples of direct effects of climate change on agricultural systems, whereas indirect effects are felt through the climate changeinduced fluctuations in other (plant and animal) species that are key for (agricultural) biodiversity, such as pests and their natural enemies, soil organisms, and pollinators (FAO, 2015, FAO, 2019). Indeed, more than a third of global crop production depends on insects for pollination (Powney et al., 2019), with bees being key pollinators and honey bees (*Apis mellifera*) being commonly used for agri- and horticultural crop pollination (Potts et al., 2016) besides the production of apiary products such as honey, pollen, royal jelly, and beeswax.

Climate change can affect the beekeeping sector in a variety of ways, and a common impact is the altered availability of food resources. Rising temperatures can cause disruptions in the flowering seasons of many floral species, by either shifting the starting date or by shortening/lengthening the blooming period (Bartomeus et al., 2011; Langowska et al., 2017; Medina-Cuéllar et al., 2018). Since the foraging activity of honey and wild bees is also regulated by temperature, these shifts may cause temporal mismatches between the pollinators' activities and their floral food resources (Memmott et al., 2007). Furthermore, certain areas may become unsuitable for certain types of plants, leading to spatial mismatches between plants and (honey) bees (Castellanos-Potenciano et al., 2017). While honey bees are foraging generalists - i.e., they feed on a wide range of floral resources (Valido et al., 2019) -, their survival could be threatened by spatial and temporal mismatches as well. This is because the quality and quantity, but more importantly, the diversity of their pollen supply greatly influences their health and survival (Donkersley et al., 2014; Montoya-Pfeiffer et al., 2021). In addition, more extreme weather events - be it severe droughts or heavy rainfall - reduce the overall floral abundance, decrease pollen and nectar production and availability, and/or deplete the available pollen's nutritional quality (Le Conte and Navajas, 2008; Newman et al., 2021; Phillips et al., 2018), exacerbating this problem. Moreover, some pollinators - including

honey and wild bees - may experience difficulties in adapting to these changing environments, e.g., due to the fragmentation of landscapes in the North Temperate Zone (in which most of Europe is located) (Vasiliev and Greenwood, 2021). Consequently, certain types of honey are at risk of disappearing as a result, such as acacia honey in specific regions (Novelli et al., 2021).

Golaghat is a well known district in Assam. Assam is a beautiful north-eastern state of India out of the eight states. It is full of natural beauty. The world famous Kaziranga National Park is situated in this state. Golaghat is an unavoidable part of this park. A lot of foreigners visit Golaghat every year because of the Kaziranga National Park. Being under this park Golaghat district is well known inside and outside Assam as well as India. Initially all of the beekeepers were farmers but later some of them started practicing apiculture. During the practice of agriculture their living condition was of very low standard. They became unable to meet their basic needs. They are marginal farmers. Almost all of them have less than one hector land. But later some of them started practicing apiculture leaving agriculture which accelerates their income. This assists in improving their living standard. In the context of the impact of climate change on the livelihood of beekeepers, this case study shows how beekeeper's livelihood gets adversely affected. Due to climate change living environment required for the living of bees decline which results in the death of bees. As a result honey production decreases which leads to decline in income of beekeepers. Consequently their livelihood gets adversely affected.

#### **Objectives:**

- 1. To know the existing scenario of livelihood of beekeepers in the study area.
- 2. To explore the impact of climate change on the livelihood of beekeepers.
- 3. To investigate problems faced by beekeepers.

### Literature Review:

Study on the impact of climate change on the livelihood of

beekeepers is rare. Most of the climate change related studies or researches are confined to agricultural production. Vercelli, Monica, et al in their article "A qualitative analysis of beekeepers' perceptions and farm management adaptations to the impact of climate change on honey bees" described about beekeeper's hurdles with impact of climate change. Malisa, G., and P. Yanda In their article "Impacts of climate variability and change on beekeeping productivity" explained the impact of climate change on beekeeping productivity. Landaverde, Rafael, Mary T. Rodriguez, and Jean A. Parrella n their article "Honey Production and Climate Change: Beekeepers' Perceptions, Farm Adaptation Strategies, and Information Needs" explained about the impact of climate change on honey production.

No any study was conducted on the impact of climate change on the livelihood of beekeepers in Assam. This study will add knowledge to the existing worldwide scenario of the impact of climate change on the livelihood of beekeepers.

#### Methodology and Statistical Analysis:

This study is based on the case study approach. Both primary and secondary data were used in the analysis. Bases on the convenient sampling 100 beekeepers were considered for primary data collection. Primary data were related to climate change, honey production, age, sex, livelihood etc. Probit model was used to analyze the impact of climate change on the livelihood of beekeepers. Data were collected using closed-ended questionnaire.

#### **Discussion:**

#### **Existing Scenario of the livelihood of beekeepers:**

The state of Assam has 31 districts. All districts aren't rich in beekeeping. Only a few districts are rich in apiculture. Golaghat district in Assam secures the second position in honey production after Jorhat district. Golaghat district plays an important role in honey production which has a major contribution to Assam's honey production. This district is mostly rural based and full of forest. This district becomes an ideal before the rural people of the state.

#### Table 1: Approximate honey production of all districts in Assam

Name of Districts	Approximate Annual Production in metric tons
Jorhat	84
Golaghat	79
Baksa	68
Tamulpur	75
Bongaigaon	69
Udalguri	54
Dima Hasao	46
Kokrajhar	53
Chirang	49
Nalbari	67
Barpeta	70
Sivasagar	65
Tinsukia	51
Dibrugarh	61
Kamrup Metro	25
Nagaon	69
Hojai	53
KarbiAnglong	58
Karimganj	62
Darrang	48
Karbi Anglong West	56
Lakhimpur	43
Dhemaji	55
Tejpur	69
Hailakandi	64
Name of Districts	Approximate Annual Production in metric tons
-------------------	---
Dima Hasao	72
Goalpara	67
Biswanath	70
Majuli	56
Charaideo	69
Kamrup	59
Cachar	73
Chirang	69
Dhubri	50
Bajali	56

#### Source: Govt. of Assam

The table shows that the district Golaghat secures second rank in honey production after Jorhat. Initially all of the households of this district exercised cultivation as the source of livelihood. They highly cultivated rice. Beside this, they cultivated vegetables mainly for domestic purpose. Still some of the total population practice agriculture to meet the domestic need. During the practice of agriculture, people in this district couldn't afford their minimum needs which led to their poverty. They practiced cultivation using traditional strategies. They faced different problems in agriculture such as lack of adequate irrigation facility, lack of HYV seeds, not getting institutional credit facility, improper use of fertilizer, lack of market, not cultivating cash crops for commercial purpose etc. Besides they don't have knowledge on modern agricultural practice. These led to less productivity. They are also marginal farmers. They don't have adequate land for cultivation. To increase income, they later start practicing apiculture instead of agriculture. This increases their income as well as improves their living standard. Apiculture is considered more profitable for them than agriculture as honey is a high demanding product. Consequently a majority of the people have started practicing apiculture.

#### Impact of climate change on the livelihood of beekeepers:

Due to adverse climate the life of bee becomes challenging. The number of bee deaths increases day by day with the climate change. Weather becomes warmer due to climate change which harms the living of bees. As a result honey production gets lessened. This leads to decline in the livelihood of beekeepers. Every beehive consists of a queen which is the central organ itself. With adverse changes in rainfall, temperature, pressure and humidity bee's life is at risk. The probit model was used to analyze the adverse impact of climate change on the livelihood of beekeepers–

# Table2: Impact of climate change on the livelihood of beekeepers

#### **Parameter Estimates**

			95% Wald Confidence						95% Wald Confidence	
			Interval		Hypothesis Test				Interval for Exp(B)	
		Std.			Wald Chi-					
Parameter	В	Error	Lower	Upper	Square	df	Sig.	Exp(B)	Lower	Upper
(Intercept)	2.225	.3338	1.571	2.880	44.430	1	.000	9.256	4.811	17.807
VAR00001	-1.148	.2160	-1.572	725	28.255	1	.000	.317	.208	.484
(Scale)	1ª									

Dependent Variable: VAR00002 Model: (Intercept), VAR00001 a. Fixed at the displayed value.

## **Categorical Variable Information**

			N	Percent
Dependent Variable	VAR00002	Decline in livelihood	75	75.0%
		No decline in livelihood	25	25.0%
		Total	100	100.0%

Source: Survey

In the model livelihood was considered as binary dependent variable (VAR00002) where 0 represents decline in livelihood and 1

represents no decline in livelihood. The impact of climate change was considered as independent variable (VAR00001). In the context of independent variable 1 was taken as high impact while 2 represented low impact. About 75% of the beekeepers were agree with decline in livelihood. The negative coefficient value (-1.148) of independent variable shows it that the climate change has negative impact on livelihood of beekeepers. This means that livelihood declines with the climate change. The model shows that one unit increase in the independent variable leads to 1.148 decrease in the dependent variable. It may be said that climate change has direct negative impact on livelihood.

## Problems faced by beekeepers:

Beekeepers in this district have been facing different problems except facing climate change. Problems are explained below-

- Lack of adequate number and size of wooden box: They don't have adequate number of wooden boxes. Besides the size of boxes is also not adequate. They need adequate number of boxes with proper size favorable for bees. But these are not adequately available for them.
- Not having knowledge about disease of honeybees: Beekeepers are practicing apiculture without having knowledge of different diseases of honeybees. They are not aware of their diseases. This leads to decline of honey production.
- Lack of scientific knowledge: Beekeepers do not have enough scientific knowledge about apiculture. Most of them do not even know how bees produce honey, what they need for honey production etc.
- Lack of government intervention: Government intervention is required to develop apiculture. Policies, strategies, measure etc taken by the government are very essential to develop and encourage apiculture. But the government doesn't respond enough to apiculture.

• Lack of institutional credit facility: They don't have access to institutional credit facility which is very essential to start and develop apiculture. Due to lack of fund a good number of people don't able to start beekeeping. Besides existing beekeepers also fail to develop beekeeping only because of this reason etc.

These are different problems or issues faced by beekeepers. If these problems are lessened or taken into consideration apiculture will highly develop in this district as well as in the state of Assam or the country. There's a high potential in this district for the development of honey production. Non-beekeepers also gradually start beekeeping in the inspiration of beekeepers. High income earning from apiculture attracts people a lot to do practice beekeeping leaving the practice of cultivation as agriculture generates a very low earning. Consequently beekeepers gradually increase in number in this district day by day. It's notable that in the context of Assam the natural scenery is very rich and favourable for apiculture. This is a significant blessing for the state.

## **Conclusion:**

From the above study it can be said that apiculture will play an important role in Assam Economy. Assam is famous for its tradition of honey bee rearing and honey usages. It has vast resources for development of apiculture and honey processing which can provide an alternative source of livelihood option to the farmers. Besides, there is a vast scope for developing apiculture-based food processing industry. A major portion of the honey produced in Assam is used in medicine and the rest are utilized for food. Still apiculture has to develop rapidly in Assam. This is apparently due to lack of adequate number and size of wooden box, lack of awareness and scientific knowledge about disease of honeybees, inadequate policies, poor marketing system and lack of government intervention etc. Inspired by such achievement in the beekeeping business many youths in the locality have come forward to emulate this success.

#### **References:**

- Das, Jayanta Kr. 2020. "Honey Bee (Hymenopteral: Apidae) and Its Products Used as Nutritive Food." 8(9): 2199–2204.
- Deori, Biswajyoti Bikomiya, Panna Deb, Hilloljyoti Singha, and Manabendra Ray. 2016. "*Traditional Honey Harvesting by the Pnar Community Of.*" Our Nature 14(December):13–21.
- Saharia, D. 2016. "Important honey bee plants of Ganakpara village, Udalguri, btad (assam)."Indian Journal of Plant Sciences ISSN: 2319–3824(Online) 5(4): 23–27.
- Sharma, Suraj, and Dhanjit Das. 2018. "Factors Affecting Adoption of Beekeeping and Associated Technologies in Kamrup ( Rural) District, Assam State, India." BiodiversityInternational Journal Research Volume 2 I(May): 279–84.
- Sharmah, D, Amrita Khound, S Rahman, and P Rajkumari. 2015. "Significance of Honey Bee as a Pollinator in Improving Horticultural Crop Productivity in N. E. Region, India/ : A Review." Asian Journal of Natural & amp; Applied Sciences 4(March): 62–69.

000

## Impact of Climate Change as Migration, in Assam with reference to the phenomenon of Land-slides

Anwesha Hazarika Ph.D Research Scholar, Department of Political Science Cotton University, Assam

#### Abstract

The 'climate change event' is a grave issue of the 21st century's environmentalists, ecologist, researchers, policy makers and the victims of the phenomenon. Climate Change is regarded as a problem because apart from a few positive impacts, it has negated the suitable climatic conditions for the survival, wellbeing and longevity of human lives. One of the greatest single impact of it could be-Human Migration. The term 'climate refugees', in context of climate change has not attained a definition regarding whom to consider and recognize as climate refugees with regard to their causes and consequences. Although sometimes they are regarded as migrants, because of their act of migration from an unusual climatic conditions in their homeland to other convenient climatic places, but according to International Organization of Migration(IOM), there would be around 200 million climate migrants by 2050. Assam is not an exception to this. It is one state in India, where meteorological causes like steep temperature rise and pre-monsoon rainfall along with

anthropogenic factors like deforestation, inadequate urban land use planning and the demand for agriculture and housing has led to destabilization of hill slopes. In such context, the climate change, ecological sensitivity and the carrying capacity of the landscape is undermined and the rising problem of landslide has displaced around 1500 hundred people every year, rising in the landslide prone areas of Assam to safer places. This paper, shall ponder upon the impact of climate change in Assam by studying migration due to landslide, taking Guwahati, as the area of study, based on primary method of data collection.

**Keywords-** Climate Change, Landslide, Migration, Hilly areas, Anthropogenic factors

#### Introduction

When discussion is made regarding the term 'climate change', the topic stimulates different responds from different countries. The history of discussion on climate change goes back in time than one might think (Saymour, 2008). Climate change was conceptualized in ancient times, with knowledge of the subject growing as the technology to study it improved over time (Weart, 2007). However, generally speaking, Climate Change refers to long-term alterations in the Earth's average weather patterns and climate systems. It is primarily driven by human activities, particularly the emission of green house gases such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). The gases trapped in the Earth's atmosphere causes global warming, melting ice and rising sea levels, bio-diversity loss, ocean acidification and most importantly transformation of a 'natural hazard' to a 'natural disaster' causing havoc on the lives and property, as phenomenon like flood and landslides. Efforts have been made to address the issue of Climate change in the Paris Agreement, which aims to limit global warming to less than 2 degree Celsius pre-industrial level (IPCC, 2020). A landslide is a geological phenomenon characterized by the movement of a mass earth, rock, or debris down the slope. Landslides can occur suddenly or gradually and are triggered by various factors like (Britannica, 2023)-

- Excessive Rainfall- It saturates the soil by reducing its stability and causing it to become more prone to sliding
- Earthquakes- Tectonic plates shaken due to seismic activity can loose soil and rocks, leading to landslides
- Volcanic Activity- It can trigger landslides by rapidly altering the landscapes or by generating pyroclastic flows.
- Human Activities- The human activities like mining, construction, deforestation and irrigation can disturb the natural balance of slopes, making them susceptible to landslides.

Landslides pose a recurrent hazard to human lives and livelihood in most parts of the world, especially in some reasons that have experienced rapid population and economic growth. Hazards are mitigated mainly through precautionary means for example, by restricting or even removing people from areas where landslides have occurred in the past, by banning certain types of land use where slope stability is in question, and by setting up early warning systems based on the observation of ground conditions like strain in rocks and soils, slope displacement, and groundwater levels. The use of chemical agents to reinforce slope material, the installation of piles and retaining walls, the grouting of rock joints and fissures, the redirection of debris pathways, and the rerouting of surface and underwater drainage are some additional direct methods for preventing landslides. Cost, landslide size and frequency, and the number of at-risk human settlements all place restrictions on such direct solutions( Hemlata & Manisha, 2015).

India is physiographically diverse. The hilly-mountainous areas of the North-India and North-East India bearing states like Jammu Kashmir, Uttarakhand, Himachal Pradesh, and the eight states of North-east India are most susceptible to landslides, in the whole country. Those states have bore the brunt of climate change in reality due to the incessant rainfall, leading to frequent landslides and flash flood in the Indian Himalayan states and towards its North-East side. The immediate action by the government or the victims themselves is migration to a safer plain areas, either permanently or temporarily. Instances like unexpected heavy monsoon rains triggered a massive landslide, leading to death of 78 persons. Dead and the rest villagers vacate their place of origin in the Maharastra's Irshalwadi district in July 2023(Al Jazeera, 2023). Risk of Landslides drove migration for the nomadic tribes of the Union Territory of Jammu and Kashmir, the Guijars and the Bakarwal's, after the death of their livestock due to extreme cold on the mountains, thus, ending them as homeless, impacting their lifestyle and occurring economic losses, even after they migrated to the plains( Sharma, 2016). Moreover, the recent natural calamity in Himachal Pradesh, leverage the meaning of 'climate change' due to which the entire state is affected terribly. The state has witnessed 116 landslides within 55 days of the beginning of the monsoon this year. National Disaster Management Authority has declared around 17, 120 landscapes as prone to landslides. As suspected, according to notable geological expert, Professor Virender Singh Dhar, the extensive cutting of hill slopes for construction, widening of roads, blasting of tunnels, and hydro-projects are the main reasons behind the increasing landslides (The Outlook, 2023). Therefore, mostly due to the influence of the anthropogenic factors, the impact was again being faced by the people, when around 65,000 people had to migrate or were relocated in rehabilitation centers or the relief camps by the government (NDTV Report, 2023).

#### Landslide as a driver of migration in Assam

Although landslides are not new for the North-East of India, but changing precipitation pattern and destruction of hills for construction of roads and railway tracks are aggravating the problem. Very heavy rainfall in a short period of time is becoming normal rather than the continuous light drizzle that the region is known for. Moreover, the existing infrastructure of the region is not fit for heavy construction activities, so huge destruction is witnessed during landslides. The recent construction of roads, bridges and flyovers in Assam are also prone to environmental hazards. Since, the implementing agencies are also hurriedly constructing the transport facilities, it shall mostly ignore the environmental aspects in their rush to meet the deadlines (Deccan

Climate Change in North East India ▶ 152

Herald, 2022). When looked at holistically, states like Meghalaya and Manipur, due to the Jhum Cultivation, resulting in clearing out the forests and farms, also loosens the soil and make it prone to massive landslides. But still there is a yawning gap between the scientific knowledge and application of risk management( Sengupta & Nath, 2020).

According to the National Landslide Atlas of India, released by the National Remote Sensing Centre of ISRO, Assam is located in a higher risk seismic zone, where the risk of twin disasters, flood and landslides, looms with large chances. Assam has a rugged terrain for which post disaster rescue and rehabilitation becomes an enormous challenge for the local authorities. Huge cost is required in mobilizing men and equipment for rescue operation and for providing compensation to the affected families for rehabilitation (Das, 2022). Climate change and rising temperature are expected to trigger more landslides, especially in mountainous and hilly areas of Assam. In May 2022, flash flood in Assam, it was noticed that surface communication in the state has been affected where more than 9 spots in mountainous territory have been wrecked by flash floods and subsequent landslides cutting the train and road communication. The Indian Air Force(IAF) and North-East Frontier Railways (NFR) evacuated around 2000 passengers from the affected areas. Over 25 trains services to Tripura, Mizoram and South Assam has been canceled(Borah, 2022).

Generally, in today's period, climate change has become a noticeable phenomenon triggering Global Warming, causing marine heat waves and intensifying the water cycle. The recent 'Code Red Report', of the inter-governmental panel on Climate Change caused the variability of monsoon precipitation in South Asia likely to increase. But besides such meteorological impacts of climate change, the subsequent disasters that are prone in the Assam are due to deforestation, massive encroachment on hills for construction and settlements. From 2016 till date, Karimganj has reported 19 landslides, Hailakandi 17, Cachar 9, Dima Hasao 5, Karbi Anglong 5 and Kamrup Metro 72 cases, owing to incessant rainfall where mudslips have caused people to shift to safer areas( TOI, 2022).

The consequence of a natural disaster is always tragic and full of casualties. The aftermath of the crisis seen among st the affected populations, pushes them to the margins of rehabilitation centers, relief camps and sometimes, into the clutch of the traffickers, who takes advantages of their crippling state of life affairs. The UNHCR, has no mandate for so, for the universal recognition of the problem. As a few districts of lower Assam like Dhubri, Barpeta, Goalpara and Kamrup Metro are regarded as 'hotspots of climate change', thus for the people living in those areas, migration to safer places is unavoidable and permanent. Migrations were mostly internal rather than external (Roy Choudhury, 2018). The environment degradation and climate change are the root causes for the migration in Assam. Disasters triggered by natural hazards caused twice as many new displacement in 2015 as conflict and violence. Over the past eight years, there have been 203.4 million displacement by disasters." (IDMC, 2016). Moreover, the NDMA's report (2016), said that whenever incidents like landslides happen, the authorities resort to "quick-fixes" instead of systemic correction of flaws. The report says that while such systemic corrective steps might seem expensive at first, their benefit will outweigh the cost.

## **Statement of the Problem**

The state of Assam and especially the only metropolis city of North-east India, Guwahati, located in the state, is vulnerable to the impacts of climate change. The extreme occurrence of landslides not only leads to loss of lives but put a lot of financial stress on the state's economy. The subsequent scenario of migration that follows takes the affected one's to an unpredictable future of loss, despair and rights violations.

## **Objectives of the Research study**

- Understanding climate change from the frequent occurrence of landslides in Guwahati, Assam
- Determining the alternative possible solution against landslide other than migration, in Guwahati

## Hypothesis of the study

To fulfil the above objectives, the following hypothesis are formulated-

- Extreme weather events due to global warming caused by deforestation, triggers the early monsoon precipitation thereby, loosening the soil and causing landslides.
- The increase in the unorganized settlement in the 'landslide prone areas' within Guwahati, has simulated migration

## **Research Questions-**

- How the climatic is conditions changed in Guwahati in the recent times?
- How has landslide impacted the shift of population in the city?
- What are alternative mechanism on hand by the stakeholders for addressing the issue of landslide and ensure people's safety?

## **Research Methodology**

## Area of the study:

With regard to the area of the study, the one and only sprawling city of Assam, Guwahati, is selected, for it is physio graphically been surrounded by the hills of Meghalaya and itself like Nilachal, Kharguli, Khanapara hills. Moreover, it has also numerous sites within it, which are prone to landslides, when rains heavily. Moreover, being an urban space, it attracts migrants to settle down in an unorganized manner, questioning the carrying capacity, devastating the environment and ecology, which has repercussions on them, itself.

## Sources of data collection:

The data for the study shall be collected from the primary sources basically from the Kamrup (Metro) District Disaster Management Authority (DDMA) and the victims of landslides, originally residing in areas like Kharguli, Maligoan and Geetanagar. The DDMA under the chairmanship of the Deputy Commissioner was constituted as per the Section 25 of DM Act 2005.DDMA acts as the planning, coordinating and implementing body for DM in the District and take all measures for the purposes of DM in accordance with the Guidelines laid down by the NDMA and SDMA.

The secondary reliant sources are government reports, Research study, newspaper reports etc.

## Sample of the study:

Sample of the study is a small set of people chosen or selected by the investigator from a large population to collect the data for the study. In the present study, the two sets of target population arefirstly, the officials of DDMA and secondly, the aggrieved population of landslides in the selected three areas within the city who have migrated to different places after they are forced to vacate their houses due to landslides.

## Tools of data collection:

The tools that are used to collect information are questionnaire and semi-structured interview methods. Questionnaires are used gathering information from the victims of landslides and semistructured interview are conducted to get data from the officials of DDMA.

## Findings from the study

Generally, an overview of the climatic condition of Guwahati is that the city falls under the humid sub-tropical climatic region characterized by warm humid climate with heavy rainfall in summer and a relatively cool winter with scanty rainfall. The monsoon season starts from June and continues till September- receiving an average annual rainfall of 1065mm. The normal rainfall that the city records is around 1600mm. But the recent unusual and pre-monsoon rain is the main cause of the devastation through flood, erosion and landslide in the city.

Firstly, after interviewing the officials of DDMA, the findings that are gathered, states that for assessing the most vulnerable sites of landslides, they are dependent on the circle officers of the concerned circled division. The listing of the most vulnerable landslide prone zones and asking people "to move to safer places", cannot be done

*Climate Change in North East India* ▶ 156

by the DDMA themselves. According to them, the pre-monsoon rain that is taking place within the state in recent times, is due to mostly anthropogenic factors. However, as a precautionary measures for the public, they take cognizant of the regular sites of landslides and issue notice accordingly to the residents to move to safer places. However, area specific report of 2021 gathered from them, reveals that there are 366 landslide prone areas in Guwahati, 77 are in Sunsali hill, 40 in Noonmati, 37 in Kharguli, 33 in Khanapara, 32 in Narangi, 25 in Kahilipara, 14 in Narakasur hills, 8 in Maligaon, 6 in Nabagraha and Gotanagar and 2 in Jalukbari/Lankeshwar area. The year 2022, affected the city worse, where incidents from various sites landslide prone areas reports death due to trapped under debris and damage of the houses. Kamrup (Metro) DDMA, has put forwarded their estimates behind the rising cases of landslide in Guwahati as due to the haphazard, unscientific and unplanned earth cutting and earth filling. But it also mentioned that it has collaboration with GMCA, GMC in matters for issuing authority for construction activity within the city. In 2022, according the DDMA project officer, claiming from the report of Indian Meteorological Department, Guwahati recorded over 455 mm rainfall, which is 138% more than the normal of 187mm. As per their survey conducted in regular interval of time in Guwahati to determine the landslide incidents, in 2014 the cases were 9, in 2015 -16 a rise in the cases happened with 11 and thereon in this latest period 17 cases are on-record.

Secondly, the magnitude of a landslide could be determined well with regard to how it impacts human lives. Here, special focus was given on the phenomenon of migration as a great impediment of landslide in Guwahati. After assessing the questionnaire filled by the victims of landslide from the three selected areas, it was found out that, those people were new settlers who migrated mostly from the rural areas to Guwahati in search of employment and economic opportunities. Due to lack of any prior notice from the concerned bodies regarding the settlement in today's recognized landslide prone areas, they have started to convert those areas as their suitable living environment. By doing so, they constructed pacca houses and kattacha houses sometimes, without taking cognizance of the soil quality. But the people from the three areas, have claimed the similar thing that due to unawareness about the probable occurrences of landslides in there areas, they are being the victims of migration to the rehabilitation centers and sometimes permanently to a safer place, with a complete new beginning of life. People from Kharguli and Geetanagar, are worst affected victims due to their location on hilltop, which is anyway susceptible to landslide, and got more so, after settlements are made by cutting down the hills and reducing the water retention capacity of the soil. Victims from Maligoan, expressed the grief that they would one day would become 'environmentally displaced' migrants. Whenever, incidents of landslides happens, the evacuation by the GMC, DDMA and other district authorities, although shifts them to some safer areas but barely alerts the residents of the areas prior to any such incidents with early warning, when its likely to occur. About 55% population in Kharguli, 30% in Maligaon and 45% in Geetanagar, are people who are daily wage earners and live in houses of mud and mortar on the hills. Therefore, they find the alarm from the Disaster district authority to not come out from the houses during landslides, unless emergency, as lucid. The fund received from the State Disaster Response reach out partially to them and are insufficient for compensating the loss of their loved ones and the destruction of infrastructure. Their demand is for Situational analysis by the Zonal Engineers and DC, similarly vulnerability assessment by ASDMA and DDMA. Besides, they are less concerned about the rise in landslides in their areas as due to climate change and their contribution in topographical changes in the areas. The victims of the Geetanagar has expressed disappointment for the sub-minimal conditions in which their rehabilitation is facilitated which make themselves feel as 'refugee' in their own state.

## **Analysis and Interpretation**

From the findings it could be interpreted that, Guwahati is located geologically in a seismic prone and high rainfall zone which plays a vital role in occurrence of landslide within the city. Moreover, geomorphologically, the city has large number of dissected hill, which are highly erosive in nature, the slopes of the hills are moderate but are vulnerable due to the low vegetation cover. As a result of a decline in forest cover, the area is now classified by NRSA as Forest Blank. These forests have relatively little vegetation, which has left the upper layer vulnerable to erosive forces. Rock fall landslides can also occur on areas of land where there are no scrubs. Among the most significant triggering elements that has a landslide to occur in the area as a result (Das, 2014). No doubt, climate change has triggered population displacement but unlike any other displaced population due to disturbances in their home state, 'climate refugees', till date has not been recognized as vulnerable refugee group who are in that state of loss and despair due to forceful environment causes. Guwahati is a looming city, where rapid and haphazard settlements, improper drainage system, construction work and prolong rainfall has caused to slope failure in the city.

Today, there is enough evidence to support the impact of climate change on humans. The dynamic nature of climate change brings along with it enormous uncertainties. Therefore, it is the state's responsibilities to not just conduct relief operation post disasters, but also to enhance adoptive capacities for the vulnerable communities. But since there is no institutional support for the 'environment migrants', they are placed within the category of Internally Displaced People(IDP's) in India(RoyChoudhury,2022). The Criminal Investigation Department of Assam, has revealed a mostly unnoticed yet striking point is the possible flesh trade of the people residing in the relief camps. Because in case of environment induced migration the rehabilitation is quite bleak.

The responsibilities of the DDMA of Kamrup (Metro) although has improved over time but still their dependency on the State Disaster Management Authority (SDMA), delay in quick response to any occurred or vulnerable landslide prone areas. Moreover, their collective efforts with GDMA, GMC in helping out the Kamrup Sub-division authorities to find out the most landslide hit areas or prone areas, is bleak. The man-power required after the tragic disaster take place is minimal for which rescue, evacuation and relief is poor within the city. By looking at the encroachments in the unsuitable human habitation space in Guwahati, it could also be inferred that DDMA is resilient in adopting Disaster Resilient Construction mechanism for disaster resilient future development.

"People can adapt to environmental problems in three ways: stay in place and do nothing, accepting the costs; stay in place and mitigate changes; or leave affected areas" (Reuveny, 2007). But the lack of concern for environment, gathered from the responses of the landslide affected victim, has diffused them by the environment induced displacement. Cities like Guwahati and Jorhat are experiencing a huge influx of migrants. But infrastructure has not been able to keep up with the requirements of the growing population. However, many a times in the case of environment induced displacement, migration becomes a necessity rather than a choice (DDMA, FY2022). When hazard analysis is made from the Guwahati Development Department(GDD), number of affected villages, number of affected households, number of affected people, number of deaths, and cattle loss has shown a steep rise in trend from 2020-2022, monsoon period.

#### **Suggestions and Recommendations**

Primarily, the concerned authorities of the state as well the district must take steps as part of administrative preparedness to combat any eventualities during and immediately after the disasters. The government's strategy for dealing with catastrophes has recently changed from a relief-centrist approach to one that emphasizes planning, prevention, preparedness, and mitigation. The emphasis on capacity building throughout all is given due emphasis by the Government for better management of disasters. But to reduce the vulnerability of the people from migration during landslide could be looked into through environmental management, site selection, urban planning. For as mitigation measures, structural and non-structural efforts through engineered approach and collective social approach respectively, can minimize the effects on people during landslides.

Now, climate change cannot be blamed completely for the loss of the human habitat and lives during natural calamities, but the

sensitization of people through awareness programs can at least, abstain them from settling down in beyond a hill slope. Besides this, community mobilization through institution institution building, Response Team, Constant Monitoring and Early warning can control the postdisaster destruction to some extent.

With regard to migration during any natural calamities, firstly, capacity building measures needs to be initiated to ensure that people from vulnerable communities can expand their income sources without being dependent on land. Next, disaster relief must not treat the victims as 'displaced' or 'migrated' populace but agents for their own recovery. Another responsibility on the part of the mostly landslide affected people is to cooperate with the state/ district disaster management authorities in creating sustainable mitigation strategies.

#### Conclusion

Climate change is a buzzword of today's news. In 1987, Brundsland Commission it was predicted that climate could be under threat in the future, so it fostered the idea of sustainable development. But today, the prediction is almost correct, where climate has taken a toll in itself and on those who are the contributors for its vulnerability. Excessive global warming, incessant rainfall, drought, landslide, extreme cold are some abnormal phenomenon seen in recent times, due to climate change. Disasters are inevitable, but the disaster caused due to human negligence can be avoided to some extent in future. Landslide in Guwahati city is mainly caused due to interference of human by disturbing the surrounding environment. Due to rise in population, the area under forest cover has decreased, which has exposed the top surface to weathering. However, by adequate response from the Disaster Management Authority and District administration through their immediate response measures been able to control most of the tragic incidents to occur, in the landslide prone areas of Guwahati, but it still has a long way to go to achieve zero casualty and death due to natural hazard in the city. Although there could be as a result several factors within the city stimulating Internal Displaced Migration(IDP), but the victims has no other option other

than to resort to migrating to temporary shelter houses or end up being homeless. Thus, in order to make the urban space more accommodative, safe and non-antagonistic towards migrants, construction of buildings, deforestation, development works etc, must be strictly ban for survival of human lives during natural hazards, like landslides.

## **Bibliography/References**

## **Journal Articles**

- IPCC. (2012). Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.https://www.ipcc.ch/report/srex/
- Guzzetti, F., Stark, C. P., & Salvati, P. (2013). Climate Change and Its Impact on Slope Stability: A Review. Engineering Geology, 175,7-18 https://www.sciencedirect.com/science/article/abs/pii/ S0013795213001750?via%3Dihub
- Kirschbaum, D. B., & Stanley, T. (2018). Landslides in a Changing Climate. Nature Geoscience, 11(5), 341-349 https://doi.org/10.1029/2019GL085347
- Balasubramanium, Muniyand; & Birundha, Dhulasi. (2012). Climate Change and its Impact on India, 14(8),31-40 https:// www.researchgate.net/publication/256034994\_Climate\_ Change\_and\_its\_Impact\_on\_India
- Stefano, Garriano; & Guzzeti, Fausto. (2016). Landslides in a changing climate, 162, 227-250 https://www.sciencedirect.com/science/article/pii/ S0012825216302458
- Saikia, Trishanki. (2018). Assam and the economic cost of climate change, 89, 22-29

https://www.teriin.org/article/assam-and-economic-costs-climate-change

- Das, Suman et.al. (2014). GIS Based Landslide Hazard Zonetion of Guwahati Region, Volume 2 Issue 4, 4005-4013 https:// www.ijedr.org/papers/IJEDR1404100.pdf
- Ray Chudhury & Sen. (2022). Climate change fueling climate migration. Observer research Foundation https://www.orfonline.org/expert-speak/climate-change-fueling-climate-migration/

## Books-

- Gates, Bill. (2021). *How to avoid a Climate Disaster(1st Ed.)*.Random House Large Print, New York
- Damodaran, A. (2010). *India, Climate Change and the Global Commons(1st Ed.)*.Oxford University Press, New Delhi

## **News paper Articles**

- Sharma, Chandan. (2023, 16th May). Climate Change and its impact on Assam. The Assam Tribune https://assamtribune.com/assam/climate-change-and-its-impact-on-assam-1476570
- Karmakar, Rahul. (2022, Spetember 16). Assam has 15 of India's 25 districts most vulnerable to climate change. The Hindu https://www.thehindu.com/news/national/other-states/assam-has-15-of-indias-25-districts-most-vulnerable-to-climate-change/article65898757.ece
- PTI. (2022, May 15). Three killed in landslide in Assam and flood alert issue. The Indian Expresshttps://indianexpress.com/ article/cities/guwahati/assam-killed-landslides-flood-alert-issued-7918298/
- Livemint. (2022, June 16th). Assam sees fresh landslides after heavy rain, orange alert issue for the next 2days. The Mint https:/ /www.livemint.com/news/india/assam-sees-fresh-landslidesafter-heavy-rains-orange-alert-issued-for-next-2-days-11655391358086.html

- Das, Mukut. (2022, Jun 21). Guwahati records 72 landslides in 5 days, families told to move to safety. The Times of India https://timesofindia.indiatimes.com/city/guwahati/city-records-72-landslides-in-5-days-families-told-to-move-to-safety/articleshow/92349734.cms
- India Today NE. (2023, Jun 17). Assam: One killed in landslide in Guwahati's Dhirenpara area. https://www.indiatodayne.in/ assam/story/assam-one-killed-in-landslide-in-guwahatisdhirenpara-area-580895-2023-06-17

## **Government Reports**

- Kamrup Metropolitan District. (FY 2022). District Disaster Management Plan(DDMP). https://kamrup.assam.gov.in/sites/ default/files/public\_utility/ddma\_plan-2022-23.pdf
- Government of Assam. (2020). Departmental Disaster Management Plan of Guwahati Development Department(GDD) https://asdma.gov.in/pdf/Guwahati%20Metro.pdf

0 0 0

Metaphoric Retelling of the Histories of Colonization and Extractive Industrialization in Amitav Ghosh's The Living Mountain (2022)

Meeraz Hoque Research Scholar, Department of English Cooch Behar Panchanan Barma University West Bengal

## Introduction

The core of "The Living Mountain" is a vision, or perhaps not even a vision, but an archetypal memory. Maansi, who recounts this memory, says, "When I fell asleep, I had the most horrible dream – except that I don't even know whether it's my own dream or a memory of a story that I heard from my grandmother."

The tale hails from a Himalayan valley, where numerous villages coexist beneath the imposing presence of the majestic snow-capped peak, Mahaparbat. These villages may feud amongst themselves, but they hold two sacred truths. Firstly, Mahaparbat is a living mountain, communicating with the adepts within the villages, and thus, it should never be climbed. Secondly, outsiders are forbidden from entering this valley. Once a year, the village residents engage in trade at the valley's entrance, exporting the nuts of their mystical tree and other goods while importing necessities for the entire year. During one such encounter, they encounter a representative of a different race – the Anthropoi – who meticulously records information about Mahaparbat and the valley's produce. A few years later, the Anthropoi return, armed with modern military equipment, and subjugate the valley's inhabitants. They dismiss the village elders and prevent the adepts from practicing their skills. The Anthropoi launch an assault on Mahaparbat, with the valley's residents providing support and labor. Under the Kraani soldiers' watchful eyes, they also toil in the fields to produce more food for the expedition.

#### The Anthropocentric Turn

As the Anthropoi ascend Mahaparbat, the villagers gradually lose their reverence for the mountain. "Gradually, as the spectacle took the place that the mountain had once occupied in our hearts, we burned with the desire to ascend those slopes ourselves." Encouraged by their elders, the villagers begin to defy the Kraani, at times refusing to cooperate. One day, the Kraani depart with their plunder, and the villagers set upon the mountain for its remaining treasures, even fighting among themselves for the labor needed for the assault. The destruction they inflict upon the mountain surpasses that caused by the Anthropoi.

As the villagers reach the summit, the Anthropoi savants signal them from the valley, and landslides and avalanches begin. With these disasters, the Anthropoi savants initiate dialogue with the villagers, explaining that the mountain's ice can only support a limited number of climbers.

The Anthropoi clarify that the disasters occur due to the villagers, as too many of them are climbing the mountain. "If you observe us carefully enough you will see that we are learning new ways to climb so that we tread lightly on the mountain. This is what you must do – you must start climbing in the old, bad way."

With the anticipation of more disasters, the Anthropoi join forces with the villagers to protect themselves. Their savants request, "there was some wisdom in your beliefs after all. Can you please tell us your old stories, sing us your old songs, show us your dances – so that we can determine whether your mountain really is alive or not." However, there are no adepts left, except for one.

#### Situating The Living Mountain in Ghosh's Oeuvre

Although "The Living Mountain" is a fictional work, it continues themes from two recent non-fiction books by Ghosh related to climate change and the environment: "The Great Derangement: Climate Change and the Unthinkable" (Penguin Allen Lane, 2016) and "The Nutmeg's Curse: Parables for a Planet in Crisis" (Penguin Allen Lane, 2021). Even in his earlier fiction, Ghosh intricately weaves in the ecosystems where the stories unfold. If the Gangetic plains feature prominently in some, the mangrove swamps of the Sundarbans appear in others.

Ghosh contends that a country's fossil fuel usage, military power, and carbon footprint are intrinsically linked. "The job of the world's dominant military establishments is precisely to defend the most important drivers of climate change – the carbon economy and the systems of extraction, production and consumption that it supports."

Here, Ghosh finds hope in renewable energy. The global expansion of renewable energy has the potential to disrupt this fossil fuel-driven global order and eliminate vulnerabilities in the transportation of oil, gas, and coal. "Energy derived from sources like the sun, air, and water, on the other hand, is imbued with immense liberatory potential. In principle, every house, farm, and factory could free itself from the grid by generating its own power. No longer would long power lines and gigantic, leak-prone tankers be needed for transportation of energy; no longer would workers have to toil in underground mines or in remote deserts and rough seas; there would be no need for the long supply chains required by fossil fuels.

As the villagers reach the summit, the Anthropoi savants signal them from the valley, and landslides and avalanches begin. With these disasters, the Anthropoi savants initiate dialogue with the villagers, explaining that the mountain's ice can only support a limited number of climbers.

The Anthropoi clarify that the disasters occur due to the villagers, as too many of them are climbing the mountain. "If you observe us carefully enough you will see that we are learning new ways to climb so that we tread lightly on the mountain. This is what you must do – you must start climbing in the old, bad way."

With the anticipation of more disasters, the Anthropoi join forces

with the villagers to protect themselves. Their savants request, "there was some wisdom in your beliefs after all. Can you please tell us your old stories, sing us your old songs, show us your dances – so that we can determine whether your mountain really is alive or not." However, there are no adepts left, except for one.

Although "The Living Mountain" is a fictional work, it continues themes from two recent non-fiction books by Ghosh related to climate change and the environment: "The Great Derangement: Climate Change and the Unthinkable" (Penguin Allen Lane, 2016) and "The Nutmeg's Curse: Parables for a Planet in Crisis" (Penguin Allen Lane, 2021). Even in his earlier fiction, Ghosh intricately weaves in the ecosystems where the stories unfold. If the Gangetic plains feature prominently in some, the mangrove swamps of the Sundarbans appear in others.

### Conclusion

Ghosh contends that a country's fossil fuel usage, military power, and carbon footprint are intrinsically linked. "The job of the world's dominant military establishments is precisely to defend the most important drivers of climate change – the carbon economy and the systems of extraction, production and consumption that it supports."

Here, Ghosh finds hope in renewable energy. The global expansion of renewable energy has the potential to disrupt this fossil fuel-driven global order and eliminate vulnerabilities in the transportation of oil, gas, and coal. "Energy derived from sources like the sun, air, and water, on the other hand, is imbued with immense liberatory potential. In principle, every house, farm, and factory could free itself from the grid by generating its own power. No longer would long power lines and gigantic, leak-prone tankers be needed for transportation of energy; no longer would workers have to toil in underground mines or in remote deserts and rough seas; there would be no need for the long supply chains required by fossil fuels."

#### References

Ghosh, Amitav. The Living Mountain. Penguin. 2022.

#### 0 0 0

*Climate Change in North East India* ▶ 168

## Climate Change and Health Risks for Slum Dwellers in Assam

## Dr. Pallabi Devi

Asst. Professor, Department of Sociology Dikhowmukh College, Sivasagar, Assam

## Introduction

Climate is associated with risks such as floods, extreme temperature conditions (hot and cold), heat waves, prolonged rainfall, droughts and landslides are some of the hazards. The intensity, frequency, magnitude, impact, and severity of each climate risk vary. Climate change is relating to atmospheric CO2 levels and global temperature, sea level, the expense of ice, the fossil record and the distribution of species. Climate change presents an enormous development challenge to urban slums or informal settlements in the developing world.

A good health is always related to the proper care of the human body. Therefore, one needs to understand and realize the close relationship between climate and health especially in the urban slums of developing countries like India. World Health Organization defines 'health' as "*a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity*" (WHO, 1946 p.100). The idea of health goes hand in hand with the issues related to sickness, medical treatment, epidemic, and so on, if not considered carefully. For instance, in the context of slums, the dwellers are frequently been conceptualized as social clusters that produce a distinct set of health problems. In the case of women residing in slums, they suffer more from the seasonal and other infectious diseases and malnutrition etc. as a result of existence under unhygienic conditions. In other words, the unsafe health conditions of slum dwelling women are common in urban areas as well, whereas the health problems like malnutrition, child delivery related complications, infant mortality and morbidity represent as a whole the complicated life style of slum dwellers.

As is already known, climate change affects everyone in the globe. All people suffer the consequences of climate change. However, the most vulnerable groups, such as those in informal settlements, mostly slum areas, often known as the urban poor, are at greater risk. This is so because such groups are already disadvantaged due to limited access to basic and social amenities and structures such as sewerage systems, transport networks, and water sources.

In many sociological surveys, it has been reflected those studies related to health of individuals specially living in slums undergoes different health disparities, which again is an outcome of factors like fluctuating employment patterns, high illiteracy rates, low availability of health services, and also people adhering to the traditional rituals and customs. Due to the lack of basic education, they possess low skill and minimum work experience, which later on results in, they, succumbing to informal sector for better work opportunities. But the new industrial job market did not employ them for such activities. Therefore, they have engaged to low paid works like construction work, or becoming domestic maid or servants, or also casual workers in different factories. With respect to their meagre income, they were forced to live in slums where they could not maintain a better life. Apart from this, the poor sanitation, lack of spaces in order to built bathrooms, the overcrowding environment, occupational hazards etc. are intimately correlated with their survival in slums area.

## **Objectives of the Study**

1. To explore the different health problems raised by climate change in slums.

#### Methodology

The study is based on primary and secondary sources of data, primary data are collected from different slums collected data via interview schedule and secondary data based on different books, journals and case studies.100 respondents are collected from 3 towns of slums in Jorhat, Tinsukia and Dibrugarh.

## Discussion

Seasonal Problems Occurred by Climate Change: Summer season is known for frequent rainfall and severe flood from the last month of April to August. In urban areas, flooded rainwater creates inadequacy of housing structure, causing great difficulties for the slum dwellers. In this complex situation, most of the respondents are of the view that if the underground drain system would have been properly constructed, then people would not have to go through water logging problem. Lack of underground drainage system is more responsible for the dumping place. Water logging is a very common problem in Jorhat. The river Bhogdoi and natural streams are heavily polluted by people. So, it becomes problematic to drain out the storm water directly to the river. Increasing number of urban settlements and industries produce more garbage and also misuse natural resources, making some areas waterlogged in rainy season. These problems have become more complex in the last few years. For this reason, water supply is also disconnected due to heavy rain fall and flood during that time. Therefore, crisis of pure water comes up in the slum dominated areas. The slum children also suffer from various diseases during this period. Besides this, contaminated water carries with it fungus and bacteria which affects the slum life. Lack of experimental water creates cholera, diarrhoea and many other diseases. Regarding the seasonal background of winter, it has been observed that mosquito breeding takes place on a large scale in the logged water. In this study, the respondents who live in besides of Jorhat and Tinsukia slums respondents face problem in Extreme hot and cannot stay at home in day time, as a result they face sleeping problems in at night then face difficulties in load sheading and attack different types diseases because of warm temperature in summer season.

**Garbage collection problems in slums:** For the maintenance of hygienic environment in everyday life, garbage disposal system plays an important role. Littered garbage creates many problems in the urban environment. In every urban and rural area, it has been seen that there is a way to dispose the garbage like use of disposal box, dumping of garbage in the street, burning the dumped garbage and collection of garbage by the municipalities in urban areas. So, the provision of garbage disposal is one of the major aspects of cleanliness in the environment so far. According to the 49<sup>th</sup> round NSSO (1993), 35% of urban slums do not have any arrangements for garbage disposal (NSSO, 1993). By 2009, remarkable improvements have taken place, 65% of garbage in the urban slums is removed by Municipal Corporation; and another 7% of slum garbage is removed by the residents themselves. Around 11% of slum arrangements for garbage disposal go to another category.

**Problems of health and sanitation:** The unsafe health conditions of slum dwelling women are common in urban areas as well, whereas the health problems like malnutrition, child delivery related complications, infant mortality and morbidity represent as a whole the complicated life style of slum dwellers. The dusty environment and pollution create skin problems among the people residing in urban areas. Skin disease is one of the common problems and it basically occurs during the summer season. Out of 321 respondents, 35 suffer from the skin disease i.e. 10.90%; and it is also observed that these diseases mainly happen during the summer season in the slums.

The main causes of infant mortality in slums are mostly pneumonia, prematurity, diarrhoea, diarrhoea and pneumonia and various infections among the children. The parents state that pneumonia is very common among the infants and they have no treatment for it. They opt for self-prescribed medicines. But it is never completely cured and it is one of the major causes of infant mortality. Infection is also a dangerous cause for infant mortality, and in the slums, they have no treatment for this disease.

## Causes and Treatment with Responses of Child Health Problems

Problems	Causes	Treatment
Malaria/Dengue	Open garbage/open dirty drain	Yes
Weakness	Lack of adequate food/workload/ Low immune	No
Tuberculosis	Weak immune system	Yes
Indigestion	Seasonal	Yes
Leukoderma	Skin disorder	Yes
Physically disable	Natural	Yes

## Source: Based on field visits

Above table reveals the health problems, its causes and treatment among children. Many a times, it is found that parents are not aware about their children's health in slums. There are many symptoms that are not noticed or examined by the parents and as a result, the children have to suffer from many internal diseases. They are left with no treatment for their children as they become too weak.

## **Response of Health Treatment**

In the present study it is found that children, both boys and girls, suffer from cough, indigestion, fever, weakness etc.; and they are treated by self-prescribed medicines or home remedies. In the primary observation, it is found that 80% of respondents have consulted the doctor in the government hospital whereas 20% of respondents have consulted the local doctor. Even though, primary health care centers are available yet they lack a sufficient number of doctors.

As a result, the most dangerous consequence takes place as a result of self-prescribed medicines. Without proper medical knowledge, 30% of respondents use self-prescribed medicines and overall, 50% of respondents do not take any care during the primary stage of the disease.

For the recovery of the diseases, pharmacies also play a vital role which provides the drugs. It is indicated that the slum dwellers

purchase medicines from local pharmacies, which too are not recognised by the government. Many pharmacies are located at the center of the city, which are indirectly involved with these stores. It is also observed that grocery stores also sell medicine, without being issued with a proper license. Accordingly, 10% of respondents have been taking these medicines from their nearest stores. Thus, from the observation, it is seen that they are not aware of the local medicines and pharmacy. These kinds of incidents are increasing day by day, thereby creating the worst living conditions, and also affecting the health status of the slum dwellers.

The slum dwellers do not portray common health seeking behaviour and show least interest in it. The symptoms are directly related to cough, fever, fat, breathing and diarrhoea, vomiting is also included; expectedly it signifies the common reason for less immune and weak child. Therefore, importance should be given to convince the authority to enhance hospitals and (OPD) Outpatient care facilities for children. However, slum dwellers are still not aware about the situation; hence no record of strong and healthy child is found in the field of observation.

#### Level of Awareness on Health Practices among Slum Dwellers

From the primary and secondary observation, it is evident that awareness of health practices depends on the environment, social and economic circumstances. Education and knowledge system are also responsible factors for the awareness through the civic society health issues. In the slum areas, the dwellers are not aware of the small and big health problems. Their attitude shows that they stay always happy and satisfied with their minimum facilities; this is why they cannot think about the further problems and prospects of health

### Conclusion

Urbanization makesclimate change-related health effects imperative as increasing migration; population expansion and the lack of adequate and affordable housing are turning cities into slums which increases the risk of disease emergence. The study reveals the impacts on larger implications of climate change on the health of slum dwellers in Assam. The study demonstrates a low awareness about climate change with the drivers of vulnerability in slums being poor quality housing and poor infrastructure and service provision.

## **References:**

- Goswami, S (2014). A study on women's healthcare practice in urban slums: Indian scenario. *Evidence Based women's Health Journal.*
- Rashid SF (2009) Strategies to Reduce Exclusion among Populations Living in Urban Slum Settlements in Bangladesh. *Journal of Health Population and Nutrition*27(4):574–586
- Ray, et al. (2016) Urban Poverty and Climate Change Life in the slums of Asia, Africa and Latin America.
- Kapadia, N. and Kanitkar, T (2002). Primary Health care in Urban Slums. *Economic and Political weekly, Vol 37*.
- Upreti, H.C. (2004). *Urban Slums and Dimensions of Poverty*. Jaypur: Pointer Publications.
- Zaman, et al. (2018) The Impact of Growth and Development of Slums on the Health Status and Health Awareness of Slum Dwellers. *International journal of medical Research & Health Sciences*.



'The Risks of Late Modernity': Understanding Climate Change Adaptation Experiences From Assamese and Zimbabwean Students' Narratives. A Comparative Analysis

#### Ngonidzashe Kafesu

Research Scholar, Dept. of Sociology Dibrugarh University, Assam

Dr. Upasona Sarma Associate Professor, Dept. of Sociology Dibrugarh University, Assam

#### Introduction:

#### **Understanding Students as Victims of Climate Change**

It is anticipated that developing countries will suffer the farreaching effects of climate change in relation to their ability to attain sustainable development. Among the sectors that will be significantly affected by these impacts are youth (Barreda 2018). It is the conviction of Barreda (2018) that youths are among the marginalised sectors of society that bears much of the environmental disasters such as solid waste mismanagement and water pollution. Neglecting youths in the disaster risk reduction process would threaten their safety and exclude a valuable resource for action-oriented risk reduction activities, risk communication education, and advocacy. This paper focused on the experiences of youth in the global south and how they are impacted by climate change. More specifically, the sampling frame was tertiary students in universities in North East India and Zimbabwe.

The nub of this paper revolves around the daily experiences of students regarding the impacts posed by climate change and their understanding of the same. The findings of this paper rather confirmed what Beck earlier stated. Beck aptly and precisely puts it: the overall consequences of both industrial and scientific development are risks and hazards. By definition, risks are probabilities of physical harm due to given technological processes (Beck, 1992); however, physical risks are created and perpetuated in society by organisations and institutions that are supposed to be managing and controlling those risk activities. And in this case, universities were the focal point, and students were purposely sampled.

Peck (2008) concurs with Barreda in that youth's knowledge, creativity, energy, enthusiasm, and social networks could be tapped in various phases of disaster risk reduction to help themselves and others. The Brundtland Commission's traditional definition of sustainable development includes consideration of the requirements of future generations. Hence, it is crucial to undertake a comprehensive investigation among the younger demographic, as they constitute a significant portion of the forthcoming generation, and their perspectives will yield a noteworthy contribution to the sustainable development agenda for the year 2030.

#### **Background and Literature Review**

## Youth and the Environment: Global Studies and the Roots of the Trivialization of Climate Change Issues

UNFCCC *The United Nations Framework Convention on Climate Change* (2007) states that education provides skills people need to thrive in the new sustainable economy, working in areas such as renewable energy, smart agriculture, and the design of resourceefficient and sound management of health ecosystems. The major fact is that educational institutions should invest more in inculcating sustainable production and sustainable consumption in their curricula. This flaw can be cleared by conducting research on this particular topic and establishing student comfort levels and willingness to take on climate change issues. The functions of higher education in society should, however, be guided by the pursuit of excellence in teaching, training, research, and institutional performance, as well as the perceived priority needs of society to address problems such as climate change.

Hart et al. (2015) postulate the development of an integrated conceptual framework for strengthening the capacity of universities to help society understand and respond to a wide range of sustainability challenges. With that in mind, the present research was conducted to have a comprehensive understanding of climate change awareness among youths (students) in Zimbabwe and North East India and to understand their daily experiences.

There have been a number of studies that have been undertaken on the level of understanding of climate change among students of various educational levels at schools and colleges, for instance (Aydin, 2010; Liarakou et al., 2011a; Artz et al., 2012; Bostrom et al., 2012; Wachholz et al., 2014; Ayeni, 2014; Rideout, 2014) in other countries. As a result of the fact that these studies took various methodologies and concentrated their attention on various factors, the findings of each one are, to a large extent, distinctive. On the other hand, and in line with the findings of the vast majority of these other studies, this research found that environmental education has a positive effect on individuals' levels of awareness. For instance, tree planting on campus and cleanup campaigns have shown significant impacts on students behaviour.

## **Objectives of the Paper**

- 1. To understand the climate change lived-experiences of students in emerging economies
- 2. To study tertiary students awareness about climate change and its impacts on them
- 3. To factor Ulrick Beck's Risk Society theory into understanding student climate change narratives

#### **Material and Methods**

A mixed-methods approach was used in data collection, tabulations,

and interpretations. The selection of Dibrugarh and the university was based on convenience sampling, which might be one of the weaknesses of the study. However, since the overall objective was to examine the contextual factors influencing environmental behaviour, the above sampling method did not have any significant impact on the collected data. The researcher was not interested in generalising the results but rather in getting an idea of the contextual differences and their significance to environmental consciousness. Then the statistics presented were buttressed by the respective narratives of students from both universities. For comparative reasons, all the statistics presented had the same sample size of 150 students for each university, and therefore the ultimate sample size for the entire study was 300, thus N=150 for each university and N = 300 for the entire study. Data was collected using a questionnaire with both open-ended and closed-ended questions. Again, the study made use of in-depth interviews. The data was sorted and analysed using SPSS version 26 and the Common Themes approach.

#### **Findings and Discussions**

Local communities face *Challenges* in their response to climate alterations.

The students in both North East India and Southern Africa, specifically the Assamese and Zimbabwe cases, were sure that the main environmental problems they were facing were too much air pollution, too much deforestation, bad solid waste disposal, polluted water bodies, a constant and excessive loss of biodiversity, and new health threats. All the above forms the physical and natural degradation of the environment, but this specific research was also interested in the human interference part, thus its crux centres on the role played by various local communities with regards to the natural processes happening and how they alter the changes, how they cope, adapt, and react to these changes. This clearly depicts the risks prevalent in present-day societies and the complex nature of such challenges in emerging economies that pose a risk to both humans and the natural environment. The diversity and complexity of the risks facing communities in the form of climate-induced environmental degradation are cumbersome.

There are particular environmental challenges that families living

in these communities face in addition to the general challenges. It is only when the family or household becomes the unit of analysis that acute community challenges can be envisioned. Naturally, individuals recall and vividly remember certain historical epochs and incidents they experienced at the extreme. The diagram below also shows and confirms what the survey responses have already alluded to. The first histogram shows the responses of Dibrugarh University (DU) students, and the second stands for the University of Zimbabwe (UZ).

## Fig. a) Major Challenges Faced by Families During Crisis Years





## Fig. b) Major Challenges Faced by Families During Crisis Years



## N=150 High crop yields were the biggest problem for 30% of the 150

students surveyed in Dibrugarh and 30.7% of the students surveyed at the University of Zimbabwe. This was also true for the other 27 students surveyed. This was followed by complete crop failure, with 24% for Dibrugarh students and 22% for University of Zimbabwe students. Family disputes and food shortages were some of the least challenging challenges faced by families of Dibrugarh students, with a valid percent of 2%, respectively, while the same responses had 4%, respectively, for University of Zimbabwe students. The ostensibly similar trend of family challenges as a result of climate variability in both cases suggests a unique trend for emerging economies and the typical challenges they have to grapple with in the global south. In short, the study findings are a confirmation that a social science understanding of natural hazards and the general human ecosystem remains justified and a necessity. In the case of Dibrugarh University students, they reported low crop yields of 30%, total crop failure of 24%, a lack of household needs such as food of 2.0%, a water crisis of 14.0%, not having enough money to cater for family needs of 9.3%, and lastly, increased family disputes of 2.0% as some of the challenges related to environmental hazards they faced, as shown by the diagram below.

Most of the students who participated in the survey at the University of Zimbabwe (30.7%) said that their families were having the hardest time because their crops weren't producing enough. This was followed by not having enough food (20%), water sources drying up (13.3%), not having enough money to meet their family's needs (4.0%), and family arguments (4.0%), as shown in the above histogram. Correspondingly, from the comparisons, DU students also mentioned lowered crop yields and crop failure as the most experienced climate change challenges faced in Assamese communities. Students at both institutions face the same problems, like crops failing and low crop yields. This is a sign of the economic situation in developing and middle-income countries. In this case, it follows that in both scenarios, the study areas have specific developmental phase similarities, namely that agriculture is still the backbone of the two regions and families still rely on subsistence cultivation for their survival.

# The Challenges of Emerging Economies as Depicted by Student Narratives

Again, the responses being so similar in some ways shows what developing countries have been through and the general trend of problems that come up with agricultural economies when climate zones change. The mention of family disputes by respondents also shows some unique findings from this research. The family forms one of the core societal institutions with the mandatory role of primary socialization. In line with Zeeshan et al.'s (2021) study of secondary school students in Jammu and Kashmir (Rajouri District), this study found that even though the students were more aware of climate change, they weren't doing anything to adapt to or deal with it on an individual level because most of them thought it was the government's job to do that. Beck (1992:2) made an important submission that explicitly stated that for modernization to successfully advance, there is a need for agents to shape the modernization process by freeing themselves from structural constraints. When students show lower engagement in climate change issues, yet it is one of the pressing social challenges facing their communities, then it clearly shows that indeed we are living in a risky society as envisioned by Beck. In fact, the basic tenets of modernization, namely individualization, self-interest, and rationality, have been downtrodden by the same modernity.

Referring to the challenges and the daily experiences faced by their communities, Miss Kuda, (Pseudonym) a UZ student who resides in Manicaland, stated that

Cyclone Idai affected us, and we were informed to stay at home since it was heavily raining. By that time, rumours and news pertaining to death due to drowning and being swept away by floods scared us. It was a tough time. It was equally impossible to move out of the house, and there was no way you would think about school work. I remember that same time I was writing my dissertation and I could not make it, and I could not concentrate, watching the scary videos of people drowning circulating on WhatsApp and Facebook. That same year in our home, our potato yield was affected, and the same affected me as we failed to pay fees on time.

Again, Brian, (Pseudonym) another UZ male student from the Crop Science department under the Faculty of Agriculture, also echoed similar sentiments regarding their experiences with extreme weather conditions. He commented that

(Socially, as students, the fluctuations are draining for many students, especially those with outdoor practical. Far from schoolwork, the frequency of cyclones from the Indian Ocean and this Mozambique channel and the associated prolonged rainfall period in the months of February and March also affect school-going children, especially in primary schools in rural areas where they go to school on foot. You won't be settled here at the university when you hear your siblings are not going to school for a week. Our road infrastructure in rural areas is in shambles. Again, considering the CALA system and the digitalization of our elementary education, the need to charge mobile devices would be a big challenge. Early brightness is another problem due to these rains.

The same students who exhibited vast environmental change awareness through their lived experiences, learning processes, social media, and interaction with other students were not much involved in any adaptation and mitigation activities and lacked knowledge on handson adaptation initiatives. Most emerging economies are still grappling with many social challenges, such as corruption, poverty, mediaeval epidemics, inflation, and collapsing economies. From what the student mentioned, climate change issues become secondary issues and are usually treated casually.

# Modern-day Risks in Emerging Economies: The Trivialization of Environmental Issues in Tertiary Institutions

It is essential to take the above statistics and narratives into consideration whenever an understanding of adaptation to climate change in the developing world is required. There are indeed various ways in which human activities alter natural processes. These anthropocentric activities are of paramount significance to social environmental researchers and sociologists as they demystify the traditional stance of the natural sciences on environmental issues and their obsession with the physicality of processes and their quantitative aspects and consequences. Students do think the above are what they call the major challenges of environmental degradation and, more precisely, climate variability in their communities. It should be noted that it is these major causes that differentiate the lived experiences of the two localities.

Even though environmental science is a required topic for students in higher-level tertiary education, the vast majority of universities and colleges hardly ever incorporate any kind of activity that is related to environmental consciousness into the regular curriculum (Vedwan and Rhoades, 2001). Teachers and administrators in tertiary institutions do not put up a significant amount of effort to provide students with direct climate change experiences, such as the production of realworld knowledge or participation in environmental outdoor activities. In most cases, research on climate and the environment is limited to very few natural sciences courses and geography. As a result, little is known about the socio-cultural factors of the whole discourse.

Further, there is intentional trivialization of environmental issues in most third-world countries, as such issues are treated as the responsibility of international agencies, and policies do favour industrialization, manufacturing, and economic development measured on a limited scale, such as the famous GDP. As a result, the topic is frequently treated as something that merely needs to be studied in order to pass the tests and not significant issues to be addressed in both the academic and policy discourses. Despite this, students who participated in this survey demonstrated impressive levels of environmental awareness as well as a readiness to participate in actions and advocate for causes linked to environmental conservation. The same was confirmed by the narratives they shared and the observations made by the researchers at both universities.

According to Vedwan and Rhoades (2001), one of the first and most essential steps in the process of designing adaptation measures to reduce the negative effects of climate change is to gain an understanding of people's perspectives on climate change. However, having a comprehension of the perspective does not provide enough insights into the reasoning behind the actions taken by the general public. There is a need to understand holistically the lived experiences of the target population, and in most cases, these will be vulnerable groups such as environmental migrants, herders, farmers, and natural hazard victims. It is imperative to note that understanding a complex concept such as climate change does not only imply targeting vulnerable groups or already affected populations. In some cases, the experiences of modest groups matter, as their insights will shed more light on the respective corrective measures that can be taken based on their vantage point and privileged perspective. In this study, though, university students in Zimbabwe and Assam, India, were not treated differently because of their status or level of education. Instead, the problems and risks they faced every day because of the weather were given the most attention.

# Student Environmental Impression: 'A Reflection of a Deficit in Awareness'

The student impressions merely serve as a reflection of the respondents' awareness of the implications and a gauge of their level of comprehension. It is a reflection of the respondents' ability to link observable changes, like those in temperature and precipitation, to global changes that have wider significance. It also shows how aware they are of modern environmental problems, how much information they have, how much first-hand experience they have, and how well they understand how the likely changes and possible outcomes will affect people directly.

The level of perception that is found among the students in North-East India and Zimbabwe provides cause for optimism that relevant activities can be designed and implemented in the future for climate modelling and weather forecasting. It gives the impression that students, if given the proper guidance and given the opportunity to get a deeper understanding of the science behind climate change and the repercussions of it, might be able to contribute to the development of effective future adaptation methods.

On the other hand, in contrast to the educational systems of many industrialised nations, the study of environmental science in developing world tertiary institutions curricula appears to be approached in a rather casual manner. Instead, importance is given to other scientific courses that are of national significance, such as engineering, medicine, and other natural science disciplines. Environmental science curricula at tertiary institutions need to place a greater emphasis on providing students with opportunities to gain practical experience in the context of regional concerns such as climate change and natural hazards. The tertiary curricula need to be improved by giving due importance to various dimensions of the repercussions of climate change. This is necessary in order to get the native youth concerned and involved in the development of adaptation strategies that take into account the local traditional knowledge as well as the ecological, geological, and cultural uniqueness of the affected regions.

Also, where someone lives affects the kinds of direct and indirect experiences they have with environmental problems. This, in turn, affects the kinds of actions they take. For example, between students who live in cities and those who live in rural areas, their knowledge of the environment is very different through advocacy and action. It was also highlighted that gender plays an important role in environmental knowledge and involvement. This was seen to be the case in this study situation, where female students at Dibrugarh University were more proactive in becoming involved in activities that were better for the environment. The need for additional research of this kind to be conducted in various parts of the world in order to better formulate policies that will encourage environmental awareness among students. This will be made possible by way of their educational system and will have a greater influence on those 'areas' environments and their responses to climate change adaptation. This leads us to the necessity of understanding various intersectionality with regards to adaptation to both natural and social changes.

## Students' Experiences with Environmental Degradation and the Intersectionalities

#### The Dominance of Natural Sciences in Climate Change Issues

An important observation by Ulrick Beck is that discussions and debates centred on environmental issues such as GMOs, water pollution, resource conflict, global warming, and emissions that result in the overall destruction of the environment are still conducted predominantly and exclusively by the natural sciences. At the same time, using naturalistic methods creates an epistemological vacuum in the understanding of the nexus between society and the environment. There is a deliberate ignorance of the political, cultural, and social meaning of such scientific observations and conclusions. That is an academic fissure that requires epistemological filling through enhancing social science and interdisciplinary engagements on complex environmental issues such as climate change. Again, Ritzer (2011) comments that the pith of intersectionality theory is that the pattern of intersection itself produces a particular experience of oppression, not merely the salience of any one variable and the working out of one vector.

There exists a strange dominance of physical sciences in the whole discourse of environment-society relations. The existence of such an epistemological hegemony still exists, though sociologists and social scientists are now warming up to the debate. What is evident from this particular research is that sociologists and most social sciences still lack distinct methodological orientations and clear theoretical frameworks guiding environmental research. Rather, in most cases, sociologists often rely on their theoretical base to explain the environmental problems occurring, not specifically a developed theoretical approach or guiding principle directing socio-environmental research. Traditionally and 'procedurally' research on environmental issues is supposed to be the focus of geographers, zoologists, biologists, and other science subjects, and that is the norm. This was also stated by one lecturer who happened to be one of my key informants, Sir De (Pseudonym). The same narrative was also shared by several students at Dibrugarh University, and that alone shows a dearth of understanding of environmental issues, even by the very people that are supposed to be at the forefront of raising climate change awareness.

"I think your topic is supposed to be conducted by geography students. What and how is climate change connected to sociology? I understand sociology deals with people in groups and their minds, if I am not mistaken, not climate change. Anyway, I believe if you are looking for other candidates to interview, I would rather suggest you visit the Department of Geography or Life Sciences, as they are better placed to discuss those issues.

Such sentiments from one of the key informants do not only reflect a lack of appreciation of the role of social sciences and the potentialities of sociology in the whole discourse of climate change, even among the elite and educated segments of society. Such is the case with many students when they are asked to offer a brief explanation of climate change and its effects. The above depicts a general understanding of people's views regarding climate change and other environmental issues. What is basically lacking in academia is a holistic understanding of social problems and how to tackle them. The same is the case when it comes to environmental challenges. It is a common trend that environmental issues should be solely the focus of natural science subjects, particularly geographers, and epistemologically, conclusions from the social sciences remain at the fringes of policy formulation as quantitative research is preferred.

#### The Significance of Context and Situational Factors

Students of both institutions were cognizant of the major environmental hazards both locally and regionally. In this research, the focus was more on the impact of such events on local communities and the nature of the challenges their families faced or were currently tackling. Thus, it was observed that the frequency of geographical weather fluctuations was seen to have a direct bearing on both the perceptions of students and their understanding of the changes occurring. Their experiences were constantly shaped and reshaped by the local natural hazards within their vicinity. The more the students experienced certain natural hazards, such as a cyclone in the case of the University of Zimbabwe and floods in the case of Dibrugarh students, the more they became more vested in understanding the consequences of climate change.

## Modern-day risks in emerging economies. Potential Entry Points for Sociologists

The role of contemporary sociologists in the above scenario, however, is to understand the various prevalent structural factors behind the different experiences of agents in the same locality. What is more important are not these structural factors, but rather the differences they make in society. Again, how such factors shape our experiences over time and, lastly, how individuals perceive and conceptualise certain common terms and issues is of greater significance to our understanding of environmental hazards. This paper's position regarding the prevailing social issues and problems is indeed influenced by our specific situated experiences, as evidenced by the statistics above. The human agent is a product of the social environment in which they live and the prevailing social processes occurring at a given time.

The situated differences expressed by the students clearly explain their standpoint when it comes to their understanding of pressing environmental problems such as climate change. Borrowing from the works of a feminist scholar, Patricia Hill Collins 1998b (224–225), a standpoint is the view of the world shared by a group characterised by a "heterogenous commonality," and by shared, Collins just like Marx meant 'circumstances directly encountered, given, and transmitted from the past. Therefore, the group standpoint is constituted by the recognition that 'we are in this bag together' and not out of some essentialism.

Students from the same university can be referred to as a group, and their standpoint can be evaluated, examined, and understood in

their specific context. In as much as students recall weather fluctuations and in as much as that reflects their understanding of environmental hazards and climate change issues, the same should not be treated in isolation, but rather the existing causal relationship is more significant. This is so because it reflects the nature of the nexus and any confounding variables in the phenomena under study. To a greater extent, the climatic challenges or environmental hazards faced by their families and communities collectively are a reflection of an in-depth interlink between the natural environment and society. This depicts how difficult it is to understand human-induced environmental challenges without examining human-environment interactions. Society, that is, collective communities, does not live in a vacuum; its existence is constantly shaped and reshaped by the prevailing political environment, economic situation, social norms, and lastly, but more significantly, natural capital or the natural environment. The impact of climate change as well as the ensuing environmental degradation differ, but these differences only become significant when one draws a comparative conclusion.

The experiences of different geographical regions, when compared, often give meaningful and reliable information regarding the phenomenon under study. It is important to note that changes in the physical environment do have an immediate effect on the natural landscape, and such changes are visible and can be evaluated by the natural sciences with no doubt. The results of such changes to communities form the fulcrum of the crux of the social sciences. As a sociologist, the researcher was more interested in the impacts of climate change on students and the communities in which they reside. It was observed in this research that changes in the natural environment are always apparent, but the impact on societal functioning and wellbeing is always hidden and thus remains at the fringes of climate change policy formulation.

In this study, it was observed that students often portray knowledge of the natural changes occurring or those that occurred in the past, but they are not in a position to explain the connection between those changes and social problems and their impacts on community relations. Hence, from the students' narratives of their personal daily experiences, it was noted that the social impacts of climate change on communities are poorly understood among tertiary students in both study areas. Yet it is those same social impacts that have long-term devastating consequences for communities and henceforth require immediate intervention. It therefore remains valid to claim that a social science understanding of the impact of naturally occurring events on human communities is substantial.

Though based on a different age cohort with distinct socialcultural settings, the conclusions by Zeeshan (2021) are noteworthy as they reflect that awareness alone without action is meaningless as it translates into nothing where action is needed. Zeeshan et al. (2021) suggest that more attention should be given to climate in formal education with appropriate changes in curricula and pedagogy and the opportunity for hands-on exposure to inspire the students to be more proactive in adaptation and mitigation efforts. According to Smith and Wandel (2006), climate change studies do not often link socioeconomic variables with people pertinent to policymaking and strategic adaptation mapping. In agreement with the above, the sentiments overhead raise important facts about gaps in risk perception literature, as most research contributes much to understanding of climate change and its impacts, mostly at the global and regional levels, but falls short when it comes to the local, national, and individual levels. What this study thus establishes from such conclusions is that the epicentre of all climate debates should be individual and local homegrown adaptation as the way forward.

## Conclusions

It was observed that lived experiences play a pivotal role in shaping perceptions and the general behaviour of individuals, and the same has a direct bearing on climate awareness. It is crucial to note that the two universities' students showed and shared discrete narratives and had distinct statistics, which, however, suggest the need for further inquiry into the localised and context-specific or community climate traditional narratives, their lived climate change experiences, and how they fall within the scientific understanding of climate change.

In this paper, it was also observed that analysing South Asia and Southern Africa through the prism of climate, livelihoods, adaptation, and education provides useful insights into the underlying trends shaping the entire region and the risks posed by current long-term trajectories. It is essential in the social sciences for researchers to acknowledge the role of lived experiences whenever the unit of analysis is the individual 'agent'. Again, it is important to note that in this study, an appreciation of the daily lived experiences and climate impacts on students was done.

While the precise impetus of climate change on students, farmers, women, and other vulnerable populations in the global south is still the subject of scientific inquiry and debate (Bhattacharyya and Werz 2012), the range of issues facing the region calls for a comprehensive assessment of climate change and its impact on both traditional and human security. The researcher is hopeful that this research paper will be a jumping-off point for more empirical research establishing the realities of students experiences in regions marked by climatedriven livelihoods, vulnerability, resource depletion, natural resource conflict, migration, and mixed identities in South Asia and Southern Africa. The paper presents the study findings with reference to sociological theories, and much of the discussion followed Ulrik Beck's theory of the risk society. Hence, the narratives of students and their experiences were categorised into various risks posed by late modernity and how the global south is caught up in a fix of environmental hazard complexities versus development goals.

## References

- Adams, R. M., & Peck, D. E. (2008). Effects of climate change on water resources. *Choices*, 23(1), 12–14.
- Artz, N., Chene, D., & Wachholz, S. (2012). Warming to the challenge: are business students learning about climate change?. In *Competition forum* (Vol. 10, No. 1, p. 191). American Society for Competitiveness.

- Aydin, F. (2010). Secondary school students' perceptions towards global warming: a phenomenographic analysis. *Scientific Research and Essays*, *5*(12), 1566-1570.
- Ayeni, A. O., & Olorunfemi, F. B. (2014). Reflections on environmental security, indigenous knowledge and the implications for sustainable development in Nigeria.
- Barreda, A. B. (2018). Assessing the level of awareness on climate change and sustainable development among students of Partido State University, Camarines Sur, Philippines. *Journal of sustainability education*, *17*, 1-17.
- Beck, U. (1992). *Risk society: Towards a new modernity* (Vol. 17). sage.
- Bhatasara, S. (2015). Debating sociology and climate change. *Journal* of Integrative Environmental Sciences, 12(3), 217-233.
- Bostrom, A., O'Connor, R. E., Böhm, G, Hanss, D., Bodi, O., Ekström, F., ... & Sælensminde, I. (2012). Causal thinking and support for climate change policies: International survey findings. *Global Environmental Change*, 22(1), 210-222.
- Haites, E. (2011). Climate change finance. *Climate Policy*, *11*(3), 963-969.
- Hart, P. S., Feldman, L., Leiserowitz, A., & Maibach, E. (2015). Extending the impacts of hostile media perceptions: Influences on discussion and opinion polarization in the context of climate change. *Science Communication*, *37*(4), 506-532.
- Jang, S. M., & Hart, P. S. (2015). Polarized frames on "climate change" and "global warming" across countries and states: Evidence from Twitter big data. *Global environmental change*, *32*, 11-17.
- Liarakou, G., Kostelou, E., & Gavrilakis, C. (2011). Environmental volunteers: factors influencing their involvement in environmental action. *Environmental Education Research*, *17*(5), 651-673.
- Rideout, B. E. (2014). The Liberal Arts and Environmental Awareness:

Exploring Endorsement of an Environmental Worldview in College Students. *International Journal of Environmental and Science Education*, *9*(1), 59-76.

- Seroussi, D. E., Rothschild, N., Kurzbaum, E., Yaffe, Y., & Hemo, T. (2019). Teachers' Knowledge, Beliefs, and Attitudes about Climate Change. *International Education Studies*, 12(8), 33-45.
- Vedwan, N., & Rhoades, R. E. (2001). Climate change in the Western Himalayas of India: a study of local perception and response. *Climate research*, *19*(2), 109-117.
- Zeeshan, M., Zhang, H., Sha, L., Palingamoorthy, G., Phyo, Z., Chen, Z., ... & Azeez, P. A. (2021). Environmental Change Perception and Engagement of Mountain-Dwelling People in the Western Himalayas, at Rajouri District, Jammu and Kashmir, India. *Weather, Climate, and Society*, 13(4), 847-857.

0 0 0

# The Role of Digital Libraries in Sustainable Development

**Mrs. Bornali Chutia** Librarian, Jengraimukh College, Majuli, Assam

#### Introduction

The notion of sustainable development has grown in popularity in recent years as the world faces environmental difficulties, economic inequities, and social injustices. The United Nations' Sustainable Development Goals (SDGs) emphasize the importance of innovative solutions in achieving a balanced and sustainable future. One such innovation is the digital library, which has the potential to transform information access while also promoting environmental and social sustainability. Digital libraries are collections of digital content, such as books, articles, and multimedia, that are available electronically. Unlike traditional libraries, they do not require physical space, printed materials, or transportation, hence considerably reducing their environmental effect. Furthermore, digital libraries can reach a global audience, ensuring equal access to knowledge and resources and promoting sustainable growth on several fronts.

## Objectives

The aims of this study are:

• To investigate the function of digital libraries in improving environmental sustainability by minimizing the reliance on physical resources.

- To determine the impact of digital libraries on educational accessibility and social fairness, particularly in underprivileged areas.
- To investigate the potential of digital libraries to promote the United Nations' Sustainable Development Goals (SDGs).
- To identify the issues and constraints related with digital libraries in terms of sustainable development.

## **Research Methodology**

This study follows a theoretical research technique, analyzing existing literature and case studies on digital libraries and sustainable development. The methodology includes: A review of scholarly articles, books, and reports about digital libraries, sustainability, and the SDGs. A comparison of traditional and digital libraries' environmental, social, and economic implications. Examining case studies in which digital libraries have been successfully deployed and their impact on sustainability. Identification of gaps in the literature and potential areas for further investigation.

## Discussion

1. Environmental Sustainability: Digital libraries help to improve environmental sustainability by eliminating the need for paper, ink, and other resources connected with printed literature. Eliminating physical books reduces deforestation, water use, and carbon emissions associated with their creation and transit. Furthermore, the absence of physical infrastructure, such as buildings and storage facilities, decreases libraries' environmental impact. Environmental education is essential for raising awareness about environmental issues and promoting sustainable practices. Digital libraries provide access to a vast array of resources on environmental topics, including climate change, biodiversity, pollution, and conservation. These resources can be used by educators, students, policymakers, and the general public to increase their understanding of environmental issues and the actions needed to address them. For example, the United Nations Environment Programme (UNEP) has developed a digital library that offers access to publications, reports, and multimedia content on various environmental topics. This resource is invaluable for promoting environmental awareness and education, as it provides users with the information needed to make informed decisions and take action to protect the environment. Digital libraries also facilitate the sharing of best practices in environmental protection and sustainable development. By providing access to case studies, reports, and other resources, digital libraries enable organizations, communities, and individuals to learn from the experiences of others and adopt successful strategies for environmental management. For instance, the International Institute for Environment and Development (IIED) digital library provides access to a wide range of publications on sustainable development, including case studies on community-based natural resource management, sustainable agriculture, and climate adaptation. These resources are valuable for practitioners and policymakers seeking to implement effective environmental strategies.

2. Educational Access and Social Equity: One of the most important achievements of digital libraries is their potential to enable universal access to information. In areas where traditional libraries are few or non-existent, digital libraries provide an important resource for education and lifelong learning. Digital libraries promote social fairness and inclusivity, which are critical components of sustainable development. Digital libraries have the potential to bridge the educational divide by providing equitable access to educational resources. In many regions, access to quality education is hindered by factors such as poverty, gender inequality, and geographic isolation. Digital libraries can help overcome these barriers by providing remote access to educational materials and resources. For instance, initiatives like the World Digital Library (WDL) and Khan Academy offer free educational content that can be accessed by anyone with an internet connection. These platforms provide valuable resources for students in underserved communities, helping to level the playing field and promote educational equity.

On the other hand, research is also essential for understanding environmental challenges and developing effective policies and solutions. Digital libraries provide researchers and policymakers with access to scientific literature, datasets, and other resources that are crucial for environmental research and decision-making. Platforms like the Global Environment Facility (GEF) Knowledge Management Platform and the Intergovernmental Panel on Climate Change (IPCC) digital library offer access to a wealth of information on environmental issues, including reports, research papers, and policy briefs. These resources support evidence-based decision-making and the development of policies that promote environmental sustainability.

The digital divide refers to the gap between individuals and communities with access to digital technologies and those without. This divide can exacerbate existing social and economic inequalities, particularly in the context of education, employment, and access to information. Digital libraries play a crucial role in bridging the digital divide by providing access to digital resources and services in underserved communities. For example, community-based digital libraries, such as the Rural Digital Libraries initiative in India, provide access to digital content, internet connectivity, and training programs in rural areas. These initiatives help bridge the digital divide and promote social inclusion by ensuring that all individuals have access to the resources needed to participate in the digital economy.

**3. Supporting the SDGs:** Digital libraries are consistent with several SDGs, including Goal 4 (Quality Education), Goal 10 (Reduced Inequalities), and Goal 13 (Climate Action). By delivering quality educational resources to a global audience, digital libraries assist to minimize knowledge inequities and contribute to climate change by lowering the environmental effect of traditional libraries. The report explores particular examples and programs in which digital libraries have helped to advance these goals.

## Supporting Quality Education (SDG 4)

One of the most direct contributions of digital libraries to sustainable development is in the realm of education. SDG 4 emphasizes the need for inclusive and equitable quality education and the promotion of lifelong learning opportunities. Digital libraries provide access to educational resources that can be used by students, educators, and researchers worldwide, regardless of geographical location. This democratization of knowledge helps bridge the educational divide between urban and rural areas and between developed and developing countries.

Case Study: The World Digital Library, an initiative by UNESCO and the U.S. Library of Congress, offers free access to thousands of books, documents, and artifacts from around the world. By making this information accessible to a global audience, the World Digital Library supports educational initiatives and fosters a deeper understanding of different cultures and histories.

## Promoting Environmental Awareness (SDG 13)

Digital libraries also play a critical role in promoting environmental awareness, a key component of SDG 13, which focuses on combating climate change and its impacts. They provide access to a wealth of information on environmental issues, including scientific research, policy documents, and educational materials. This information is essential for informing policy decisions, educating the public, and supporting grassroots environmental movements.

Example: The Global Environment Facility's (GEF) digital library provides access to documents related to environmental projects, research, and policy initiatives around the world. This resource supports environmental education and advocacy efforts by making information easily accessible to stakeholders, including governments, NGOs, and the public.

## Facilitating Cultural Preservation (SDG 11)

Cultural heritage is an important aspect of sustainable development, as it fosters a sense of identity and continuity in a rapidly changing world. Digital libraries play a vital role in preserving and disseminating cultural heritage, particularly in regions where physical cultural assets may be at risk due to conflict, natural disasters, or neglect.

Case Study: The Digital Public Library of America (DPLA) aggregates content from libraries, museums, and archives across the United States, making it accessible to a global audience. By digitizing and sharing cultural artifacts, the DPLA helps preserve cultural heritage and promotes cultural understanding.

## Ensuring Equitable Access to Information (SDG 10)

Inequality in access to information is a significant barrier to sustainable development. Digital libraries help reduce this inequality by providing free or low-cost access to a wide range of resources. This access is particularly important in developing countries, where traditional libraries may be scarce or poorly funded. Example: The African Digital Library (ADL) provides free access to digital books and resources to people in Africa. This initiative helps to level the playing field by ensuring that individuals in developing regions have access to the same information as those in more developed areas.

## **Challenges and limitations**

Despite their numerous benefits, digital libraries confront obstacles such as the digital divide, data security, and digital material preservation. The study addresses these problems and proposes potential solutions to ensure that digital libraries continue to effectively support sustainable development.

## Conclusion

Digital libraries represent a huge step forward in the pursuit of sustainable development and balancing environmental footprint while boosting educational accessibility and social fairness, making them an effective instrument for achieving the SDGs. To fully realize their potential, digital libraries must solve the issues that come with technical access and information preservation. Future study should focus on establishing solutions to overcome these issues, as well as investigating the role of digital libraries in sustainable development. However, to fully realize the potential of digital libraries in sustainable development, it is essential to address the challenges related to technological infrastructure, digital literacy, sustainability, intellectual property, and preservation. By overcoming these challenges, digital libraries can continue to be powerful tools for advancing sustainable development and ensuring that knowledge and information are accessible to all. As the world continues to face complex and interconnected challenges, the role of digital libraries in sustainable development will only become more critical. By providing access to the information and resources needed to address these challenges, digital libraries can help to build a more sustainable, inclusive, and equitable future for all.

## References

- Borgman, C. L. (2000). From Gutenberg to the Global Information Infrastructure: Access to Information in the Networked World. MIT Press.
- Brown, A. (2006). Digital Preservation: Sustaining Culture and Knowledge into the Future. Facet Publishing.
- Fox, E. A., & Marchionini, G. (1998). Digital Libraries: A Look Back at 30 Years of Research and Development. Communications of the ACM, 41(4), 29-32. United Nations. (2015). Transforming our world: the 2030 Agenda for Sustainable Development.
- Lesk, M. (2005). Understanding Digital Libraries. Elsevier. Arms, W. Y. (2001). Digital Libraries. MIT Press.
- Rayward, W. B. (2003). Electronic Information and the Functional Integration of Libraries, Museums, and Archives. New Library World, 104(11/12), 433-445.
- Sturges, P., & Neill, R. (1998). The Quiet Struggle: Information and Libraries for the People of Africa. Mansell Publishing.
- Willinsky, J. (2006). The Access Principle: The Case for Open Access to Research and Scholarship. MIT Press.

0 0 0

## Impact of climate change on livelihood and lifestyle of people residing in Guwahati

## Parashmita Bora

Department of Statistics, Gauhati University, Assam

## **Arpita Buragohain**

Department of Environmental Science Gauhati University, Assam

#### Abstract

Climate change is a global reality which is highly evident in the city of Guwahati. Naturally, the geographical location of the region makes it highly prone to extreme weather events profoundly flood, landslide etc. due to excessive rainfall. Added to this, the unplanned and rapid urbanization in different zones of the city combined with various other anthropogenic intervention such as deforestation, destruction of wetlands, shifting cultivation in the hills, unplanned unscientific land use patterns and pollution has aggravated the disaster activities even further. An increasing trend of population curve from 2001 (26,655,528) to 2011 (31,205,576) of the city can be seen. This occurs due to the presence of opportunities related to job, education and luxurious lifestyle. The increase can be viewed as a surge of risk of susceptible individuals and also detoriated natural environment of the city.

This paper is an attempt to understand the various problems associated with the huge migration of population from various parts

of the state and also understand the various livelihood malfunctions associated with the occurrence of hazardous events related to changes. For purpose of the study survey is conducted for 120 households which are selected with the help of random sampling in the areas with previous disaster records. A relationship is formulated among the various parameters of the investigation by execution of statistical processes of chi square test and correlation coefficient.

**Keywords:** Flash Flood, Landslide, Climate Change, Guwahati, Chisquare test.

#### Introduction

Natural hazards are those events which cannot be prevented from occurring but their impacts can be reduced if effective measures are taken to reduce their severity, frequency and possible size (Mili, et al. 2013). But now-a-days anthropogenic interventions are responsible for prompting disasters to greater dimensions. In the recent scenario, climate change is a major environmental and social issue outstretched all over the world. It refers to a broad array of environmental degradation which results in an increased level of global warming, alteration in precipitation, change in level of sea and more extreme weather conditions like heat waves, cold waves, and even loss of human lives, droughts, floods, landslides etc. Climate change in many circumstances becomes disaster which threatens the life and livelihood of the dwellers. As by definition disaster is "a, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area" (Sarmah and Das 2021). The Earth's climate has varied considerably in the past, as shown by the geological evidence of ice ages and sea-level changes, and by the records of human history over many hundreds of years. The causes of past changes are not always clear but are generally known to be related to changes in ocean currents, solar activity, volcanic eruptions and other natural factor (ISDR, 2008).

The North Eastern region of India too is extremely vulnerable to natural hazards such as earthquakes, floods, landslides etc. Every year during the monsoon season, the region experiences worst fury of nature in the form of flood and erosion along its banks, devastating hefty areas of habituated landform and damaging agricultural lands.

The Guwahati city of Assam is no exception. Each year the city experiences worst impact of disaster in the form of flash floods due to its unscientific development and rapid urbanization. Guwahati being the largest urban center and a hub of major activities in the region faces most severe impacts of these floods. (ASDMA, 2014). Various adaptation measures have been under taken across societies to fight the impacts of climate change. One of the most common methods of adaptation is migration (Das, 2015). The gradual increase of population deficit land for settlements which further leads to advances of population in hilltops and wetlands. Thus, these encroachment rise the risk of disasters such as urban floods which in turn deteriorates the natural environment of the city. From the late 90's, the pace of development picked up rapidly leading to casualties and economic losses during floods. During flash flood a vast majority of this population residing in the adjacent areas are also affected. The construction activities on the hills in Guwahati have resulted in the removal of vegetation cover in the forest area thereby exposing the surface. The problem of soil erosion is evident from several environmental issues such as water logging, flashflood, siltation, decrease in the ground water table and the dusty environment on sunny days. The climate of the region is characterized by a warm and humid atmosphere and as monsoon brings heavy rain to the city as of the average annual rainfall is 1688mm. Guwahati being the major city of the North-East has developed road, rail and air connectivity with the rest of the country. But during monsoon and because of urban floods these road and rail connectivity to the rest of the North-East region is hampered thus hampering the daily lives of the local people.

#### **Objective of the Study**

1. To understand the causes of disaster and its effect livelihood of the population.

2. To compute the mitigation measure adopted by the affected population.

## **Database and Methodologies**

#### Database

The study is based upon both primary and secondary data sources. The primary data are collected through schedules from affected households of the study area and secondary data are collected from various journals, books, publication, articles etc.

#### Methodology

For proceeding the study, schedules are prepared for survey. Related journals, books and publications are reviewed for the fulfilment of considered objectives. As the study also relies on primary database, a total of 120 households are considered by the method of simple random sampling using randomized design table, within the effected areas of Guwahati City. From the selected data set graphical representations are formulated.

For further research, a statistical test is formulated to find the relations between the variables taken for finding the various factors effecting the livelihood of the population on the bases of change in the climatic condition. Chi-Square test for independent is performed which is a statistical hypothesis test used to determine whether two categorical or normal variables are likely to be related or not. The Chi-square test statistic is given by the following formula:

$$X^2 = \sum_i \frac{(x_i - \mu_i)^2}{\sigma_i}$$

Where; Xi = Observed values;  $\mu i = Expected$  values

#### **Description of the study area:**

Located in the north eastern state of Assam Guwahati is the largest city of the situated on the flood plain of the mighty Brahmaputra. The city is known for its captivative landscape and its glorious history. The entire city is surrounded by lush green vegetation and peaks and it lies within the geographical extension of 26.1158° N, 91.7086° E

(source: Google). The natural positioning makes it highly prone to meteorological hazards such as flood and landslide. During monsoon the area receive extreme rainfall. Due to its low gradient and anthropogenic intervention flash floods is common in the area. Along with flash flood extensive rainfall, deforestation and encroachment in the hills makes the population vulnerable to landslide as well. The total area of Guwahati Municipal Corporation (GMC) is 216 Sq. Km and the population as per 2011 census is 963,429 (source: Google). This study is an attempt to understand the recent disaster due to urbanization with special reference to Guwahati city.

#### **Results and Discussion:**

Flash flood and landslide turned as common natural hazards in the recent scenario of the Guwahati city. The increased frequency of tropical cyclone such as Fani (2019), Amphan (2020) etc. characterized by excessive rainfall and wind is major example of climate change in the region. The other evidences of climate change can be observed in the altering weather conditions, changes in precipitation patterns etc. of the city. Monthly rainfall trends inferred that the rainfall in the monsoon months (June and August) recorded an increasing trend of 4.4 and 3.5 mm/year, respectively. July and October were recorded with a slightly increasing trend, while the month of September decreased to -0.141 mm/y rainfall (Gogoi and Rao, 2022).

During the study, it was found that, Guwahati is consecrated with abundance of opportunities as majority of the headquarters and offices are concentrated in the metropolitan due to the existence of Assam's capital, Dispur. So, a higher affinity of folks can be observed towards the city. Though

Guwahati has an area of 99.87 sq.km, but the city has a population density of 4400/sq.km portraying a population boom in the city. High rise buildings, malls, over bridges, highly developed roads etc. are common in the region. These unplanned and unscientific constructions leads to lack of empty spaces and grounds which results in encroachments at hill tops and wetlands. Further, the combination of such factors induces flash floods and landslide which are some of the undesirable feature of the cosmopolitan. During the survey, an attempt has been made to understand the causes of disaster from the perspective of the affected population.



Fig: Graphical representation of the various causes of disaster.

The above representation indicates that according to the affected population most of the disasters in Guwahati is due to Clogging of drainage system in the city followed by haphazard and unplanned urbanization.



Fig: Graphical Representation of Disaster prone population of Guwahati

Among the disasters in the region, flood covers 71% of the list, followed by landslide. Other types of disasters accounts for only 14% of the count.

Climate Change in North East India ▶ 207



Fig: Graphical Representation Showing Percentage of population facing problems with the type of disaster

#### Effects of Disasters on Livelihood

- Impacts on Communication: One of the major effect of disaster faced in the city is glitches in communication and transportation. Guwahati is the major interaction hub for businesses, economical activities and official work of the entire state. Any disaster in the zone can cause adjournment of such works leading to huge economic loss of the entire state. This further leads to price hike, inflation in the markets, lack of necessary commodities etc. Other than this, schooling, emergency services as well daily lifestyle is also hampered.
- Lack of Power Supply: Whenever there is a disaster, power-cuts is a common practice for safeguarding people from electrification. However, these power-cuts causes problem among the public as the residents of Guwahati is highly reliant on devices and machines for drinking water, work practices, communication etc.
- **Food Scarcity:** Due to disasters, food shortage occurs and sometimes relief cannot reach the victims.

• **Damages and Destruction:** Every disaster causes damages from minor to severe. Sometimes these disasters even leads to death of the victims.

## **Mitigation Measures Adopted**

- Cleaning the existing drainage system, for removing the clogs.
- Opt for sustainable development and construction
- Reduce plastic pollution and develop technologies for recycling of the existing plastic.
- Reduce deforestation and encroachment in the biodiversity sensitive zones such as wetland, hill, and forest areas.
- Increase the number of open areas for infiltration of rainwater
- Promote awareness among the public.

## **Conclusion:**

Guwahati is a city of beautiful landscape however the consistent hazardous in the city hampers the growth and development of the region. Climate change has imposed further aggravation of the situation. Government has adopted several measures to reduce the impacts of the disasters but, these measures remain inadequate and problems persists in the affected zones.

## References

- Mili, N et al. (2013), "Impact of flood and river bank erosion on socio economy: A case study of Golaghat revenue circle of Golaghat district, Assam", Volume 3, Issue 3, page no: 180-185. http:// www.cibtech.org/jgee.htm
- Das, D (2015), "Changing climate and its impacts on Assam, Northeast India", Das Bandung J of Global South, Volume 2, http://10.1186/ s40728-015-0028-4
- Sharma, T and Das, S (2017), "Urban Flood Disaster Assessment for

Guwahati City", International Symposium on Water Urbanism and Infrastructure Development in Eco-Sensitive Zones. https:// /www.researchgate.net/publication/328996349

Gogoi, K and Rao, N (2022), "Analysis of Rainfall Trends over Assam, North East India". Curr World Environ, Volume 17, Issue2, http://dx.doi.org/10.12944/CWE.17.2.15

0 0 0

## Flood and it's effects on people and livelihood of the Lower Subansiri sub-basin at Lakhimpur District of Assam

## Arpita Buragohain<sup>1</sup> & Dr. Sangita Devi<sup>2</sup> Department of Environmental Science Gauhati University, Assam

#### Abstract

Flood, erosion and sedimentation are some of the chronic problemsassociated with Lakhimpur district of Assam. The district is fed primarily bySubansiri and its tributaries which happens to be the largest tributary of Brahmaputra. The population residing within the river basin ishighly dependent on it for various economic, social and cultural aspects. Problems arise during monsoon when the river transforms into its gigantic form and causes heavy flood and erosion. The flood associated with Subansiri is characterized by greater magnitude and frequency which potentially causes major damages and destructions in the region. Due to the current scenario of climate change and global warming, intensity of these disasters has aggravated manifolds. The consecutive flood episodes has further handicapped the region, thus depriving it from growth and development.

In this paper, an attempt has been made in order to understand the some of the socio-economic factors associated with flood. The study is performed among the flood affected population taking into

Climate Change in North East India ▶ 211

account a minimum of 70 households residing in the catchment area."Chi-square test for independence" is conducted in order to obtain the relationship between required parameters. From the observations it is evident that the consecutive flood events has imposed great deformations in the regular status of the area.Loss of property, agricultural land, damage of crops etc. are some of the major issues associated with Subansiri flood. Therefore, the research is done from a perspective to understand the socio-economic parameters associated with flood and formulate better mitigation and management strategies by combining the scientific approach with the indigenous knowledge.

**Keywords:** Subansiri, Lakhimpur, Flood, Climate Change, Chi-square test for Independence, Socio-economic.

#### Introduction:

Floods are one of the most destructive natural hazards which affects seriously on the socio-economic environment (Das et.al, 2017). Flood andriver bank erosion are dynamic and natural processes which have an adverse impact on livelihood ashomesteads are destroyed, cultivatable lands are wiped out and employment opportunities are reduced (Mili et.al., 2013). It is a recurring and natural phenomenon in the rivers. However, with the advent of climate change and global warming, flood scenario has turned into a catastrophe.

Flood is defined as the "inundation of nearby dry landmass by upsurge of water levels due to meteorological events or climate change". Naturally, flood can be triggered by heavy rainfall, rapid snowmelts or storm upsurge from tropical cyclones or tsunami in coastal regions. Anthropogenic reasons for the occurrence of flood can be changes in the river regime, damage and destruction of major hydraulic structures such as dams, spillways, embankments etc., deforestation, urbanization and unscientific landuse and farming practices. The range of consequences that flood brings about includes political, social, psychological, ecological and environmental damage to cultural heritage (Pistrika, 2010). Among the different naturalhazards effecting India, the impact of flood tobe the mostrecurring, disastrous and widespread (Lahon, 2019)

The Brahmaputra belongs to the Himalayan river system covering the states of Assam and Arunachal Pradesh in India. The river and its tributaries is also one of the longest (3848km) river system of the World. The basin is dependent mainly on precipitation, while the upper part of the basin depends on meltwater from glacier and snow melt (Mishra et al, 2019). Floods, flash floods, riverbank erosion and deposition of sandare the most frequent water-induced hazards in the easternBrahmaputra basin in Assam (Das et.al., 2009, Bora, 2019). According to the reports of Rastriya Brah Ayog the flood prone areas of the state of Assam is 31,500.00 sq.km which is about 39.58 % of the total land area of the state. Among the worst flood hit regions of the state is the Lakhimpur district, which experiences severe flood every year which handicaps the growth and development of the region. The district comes under the influence of the Subansiri river which the largest and a major tributary of the mighty Brahmaputra. The river contributes to approximately 11% of the total discharge of Brahmaputra at Pandu (Gogoi, 2013). The Subansiri river flows from the Eastern Himalayas and brings about fertile alluvial soil which is deposited in the low-lying plains of Lakhimpur district. The extensive and fertile plains support large agrarian base (Gogoi and Goswami, 2013). Hence, huge settlements are observed in the lower-Subansiri catchment. People migrate to the plains for various agricultural practices. The study is an attempt to understand theimpact of the annual consecutive episodes of flood and climate change on the various socio-economic aspects of district.

## **Objectives of the Study:**

The primary objectives of the study are as under:

- Analyze the relationships between annual flood frequency and various required parameters such as loss of Agricultural land, selection of occupation, etc.
- Understand the effects of flood on the livelihood and healthof the affected population.

## **Database and Methodologies:**

## Database:

The current study is based on both primary and secondary database. For the collection of primary database, questionnaire and schedules are constructed in relevance to the study. The secondary data is based on different sources such as journals, books, census, Official publications from various Government and private organizations etc.

## **Methodologies:**

The study is a combination of both qualitative and quantitative analysis of the collected data and the entire study is completed in 3 stages:

- **Pre-field and Library Work:** Selection and identification of the study area, preparation of schedules and questionnaire for collection of the required primary data.
- Field work and Data Collection: Visiting the affected sites and enquiring the households using the questionnairesin order to obtain relevant demographic data and other flood related information. Schedules are used to obtain data from the unfeasible regions and also for a greater reach.
- **Post-field Work:** Tabulation, classification and editing of collected data for analysis and computation using statistical methodologies such as Chi-Square test for independence and graphical representation by using bar diagrams, pie charts, etc.

The analysis of data is done by employing Chi-Square test for Independence. During the survey, 70 families are taken into consideration which are affected by Subansiri flood water. The villages are selected by employing Simple Random Sampling using Randomized Number Table.

Chi-Square test for independence is performed in order to understand the relationship between twocategorical or normal variables. The test is performed to compute the relationship between the occurrence of flood and various other variables. Chi-Square variate is given by the formula:

$$\chi^{2} = \sum_{i} \frac{(X_{i} - \mu_{i})^{2}}{\sigma_{i}}^{2}$$

Where: 
$$X_I = \text{Observed values}$$

 $\mu_i$ =Expected values.

## **Description of the Study Area:**

Flood and river bank erosion are some of the recurring and chronic issues in the Subansiri catchment. The river is a major trans-Himalayan tributary of Brahmaputra which flows through the districts of North Lakhimpur and Dhemaji in Assam. The river extends geographically to26°54'14"N - 28°55'24"N and 91°33'09" E -95°04'38"E (Devi, 2016) and the length of the river from origin to its outfall is about 468 km (Gogoi, 2015). The major drainage of the river in Assam is through the Lakhimpur district, hence major damages are caused in the region by the river especially during the monsoon. The district is a culturally, economically and environmentally significant area as it is surrounded by many beels (wetlands) along with verdant green undulated regions, supporting a wide range of flora and fauna. However, problem arises during monsoon as water in the river surges above the saturated levels which further hampers the region's growth and development. The entire Lakhimpur district is divided into 3 subdivisions viz. North Lakhimpur, Narayanpur-Bihpuria and Dhakuakhana. The Assam Disaster Management Authority report (2015) shows that of the total geographical area of 2277 sq.km, of Lakhimpur district, 1535.27 sq.km, comes under the influence of flood which accounts for 67.42% of the total geographical area. According to the census of 2011, the total population in the area is 1,042,137 of which 53% are male and 47% are female.

For the current study, theflood inundated areas of the district are considered. The study is conducted on 10 flood affected villages on the Subansiri catchment and are divided on the basis of flood frequency (as per the residents) i.e. once a year, twice a year and more than 2 times.


Fig 1: Location map of the Study Area

#### **Results and Discussion:**

The damage and destruction associated with flood can have social, environmental as well as economic repercussions. Rivers are extremely important for thriving of humanity as they bring about fertile alluvium for agriculture, irrigates land and also regulates the hydrological cycle of the zone. However, they can be extremely hazardous during monsoon as they are responsible for causing disastrous flood. The Lakhimpur district is drained throughout by Subansiri and its tributaries making it vulnerable to flood, erosion and siltation. It is perennial and is fed by snowmelt and monsoon rainfall. Each year the river turns into its humongous form and cause disastrous flood in the district leading to huge damages to life and property. Some of the examples of major flood events associated with the river are 1972, 1996, 2012 and 2020 floods.

From the study, it was evidentthat most of majority of the population are dependent on agricultural practices. The high flood frequent zones faces major loss of fertile cultivable landmass due to erosion. Continuous erosion of the bank and increased in annual flood frequency caused sedimentation as well as removal of the top fertile layer necessary for agricultural practices. Therefore, this loss of agricultural land due to flood and erosion shows a major shifting of occupation to fishing and other small scale businesses on the areas affected by consecutive flood waves i.e. more than twice a year.



Fig 2: Graphical Representation of the relationship between Loss of Agricultural land and flood frequency





Climate Change in North East India ▶ 217



# Fig 4: Graphical Representation of the occupations of the flood affected population

From the investigations it was also evident that the fishers were previously farmers but due to the loss of agricultural land, as a result of erosion, increasing discharge and flood waves, the population was forced to adapt to other occupations.

#### **Effects of Flood on Livelihood:**

Flood bring about major havoc within the affected population. The study reveals the following effects of flood at Lakhimpur District of Assam:

• **Population displacement:** Each year severe flood and erosion occurs in the Lower Subansiri catchment results in loss of cultivable land, shelters as well as occupational options, making the population susceptible to poverty. They are bound to led a limited lifestyle with marginal resources and are forced to migrate to other places for shelter and occupational options. Example of such migration are evident in areas such as Katori Sapori, were people migrated to other part of the district in search of shelter and occupation. Another example can be seen at 1 No. Hindu Gaon where the flood affected population of Ghagar area has been allotted plots for settlement by the government.

- Lack of Resources: The consecutive flood episodes causes huge damages to infrastructures and public amenities leading to interference of communication and transportation in the affected areas. The population has to survive on limited resources and facilities. Severe damages to roads are highly visible in the region.
- Lack of Education: Collapsing of educational institutions, irregular classes, damages to schools are some of the issues which is witnessed every year during monsoon. These circumstances constrains the periodicity of academic activities leading to deprivation from education.
- Price hike and crop failure: The unpredictable weather conditions as well as siltation has caused limitation in the crop production. Added to this, erosion of the river bank causes huge loss of agricultural land and crops, resultingin an increasing market price of food and limitation in supplies.
- Effects on tourism: The beauty of the region is greatly overshadowed by flood and erosion and tourism remains underdeveloped in the region. The Dulung reserve forest, Bordoibam Beelmukh Bird Sanctuary, Satajaan Bird Sanctuary, Pabha or Milroy Wildlife Sanctuary etc. are some of the important protected areas in the region but do not attract much tourist.

#### Effects of Flood on Health:

Flood water brings about many diseases along with it. During the survey, it was observed that people affected by flood suffers from a combination of water-borne diseases, skin infections, respiratory infections and psychological issues. However, it is seen that there is a difference in the percentage of diseases during and post flood, which is represented as under:



*Fig 6: Graphical representation of Infection During Flood by various types of Diseases among the flood affected population* 



Fig 7: Graphical representation of Infection Post Flood by various types of Diseases among the flood affected population

Apart from the infection occurring from various type of diseases, the flood affected population are deprived of emergency services and has reported the lack of medical aids within the required time frame. Sometimes the healthcare services are also affected by flood which adjourn the services and at other times lack of communication system and denial of the stakeholders plays the role. Temporary shelters which are created for the flood victims lacks proper sanitation and hygiene which causes another trouble for the sufferers.

#### **Conclusion:**

The Lakhimpur district is seriously prone to flood, erosion and sedimentation. The need of the hour, isa proper mitigation and management for reducing the impending impact of such hazards. The natives adopts traditional measures to cope with such disaster such as building Chang ghars and Bharals, preparation of banana rafts and boats, movement to highlands such as embankments etc. in order to cope with the problem. The government has tried to implement flood prevention measures but all these has proven to be inadequate to tackle the current scenario. Climate change has further aggravated the flood levels and new areas are inundated every year. Therefore, implementation of more scientific approaches combined with indigenous knowledge is highly required for a sustainable development in the region.

#### **References:**

- Pistrika, A (2010) "Flood damage estimation based on flood simulation scenarios and a GIS platform" European Water, Volume 30, page no:.3-11http://www.ewra.net/ew/pdf/EW\_2010\_30\_01.pdf
- Mili, N et al. (2013) "Impact of flood and river bank erosion on socioeconomic: A case study of Golaghat revenue circle of Golaghat district, Assam" International Journal of Geology, Earth & Environmental Sciences, Volume 3, Issue 3, Page no: 180-185, http://www.cibtech.org/jgee.htm
- Gogoi C and Goswami DC (2013) "study on bank erosion and bank line migration pattern of the Subansiri river in Assam using remote sensing and GIS technology" The International Journal Of Engineering And Science, Volume 2, Issue 9, Page no: 1-6, http:/ /www.jstor.org/stable/24102308

- Devi, S and Goswami, DC (2017) "A Comparative Study of Socioeconomic status and demographic pattern of Subansiri river Basin of Eastern Himalayas and Alakananda river Basin of Western Himalayas" International Journal of Research in Management and Social Science, Volume 5, Issue 3, Page No: 1-7
- Das et al. (2018) "Assessment of flood hazard in a riverine tract between Damodarand Dwarkeswar River, Hugli District, West Bengal, India", Spatial Information Research Volume 26, Page No: 91- 101, https://doi.org/10.1007/s41324-017-0157-8
- Lahon D (2019), "Flood and Its Impact on the Economy of Assam: ACritical Review", International Journal of Science and Research, Volume 8, Issue 5, Page No: 1073-1075, http://doi.org/ 21275/ART20197981
- Bora P (2019), "Impacts of Flood on Socio-Economic Activities ofRiverine People: A Case Study of Three SelectedVillages in Dibrugarh District, Assam", Journal of Energy Research and Environmental Technology, Volume 6, Issue 3, Page No: 215-219, http://www.krishisanskriti.org/Publication.html
- Mishra et. al, (2019). "Potential impacts of climate change on water resources and adaptation policies in the Brahmaputra River Basin", (p. 3), International Centre for Integrated Mountain Development GPO Box 3226, Kathmandu, Nepal.https:// www.academia.edu/download/61775332/icimod622\_ 13.1.202020200113-86472-b63sfn.pdf

000

জলবায়ু পৰিবৰ্তন আৰু দিচাংমুখ অঞ্চলৰ মিচিং জনজাতিৰ লোকসকলৰ সংস্কৃতি আৰু জীৱনশৈলীত ইয়াৰ প্ৰভাৱ

> **ৰাজলক্ষ্মী দিহিঙ্গীয়া** স্নাতকত্তোৰ চতুৰ্থ যাথ্মাসিক গুৱাহাটী বিশ্ববিদ্যালয়, অসম

## বিমূর্ত ঃ

জলবায়ু পৰিবৰ্তন হৈছে বৰ্তমান বিশ্বৰ এক উল্লেখনীয় পৰিঘটনা । সমগ্ৰ বিশ্বজুৰি জলবায়ু পৰিবৰ্তনে পৰিৱেশ তন্ত্ৰৰ ওপৰত এক বিৰূপ প্ৰভাৱ পেলোৱা পৰিলক্ষিত হৈছে। ইয়াৰ ওপৰিও এই পৰিৱৰ্তনে সমাজৰ সাংস্কৃতিক আৰু জনসাধাৰণৰ নিয়মীয়া জীৱশৈলীত বহুতো পৰিৱৰ্তমৰ প্ৰভাৱ দেখা গৈছে। সমগ্ৰ বিষয়ৰ লগতে উত্তৰ-পূৱ ভাৰততো জলবায়ু পৰিবৰ্তনৰ এই প্ৰভাৱ সমূহ দেখিবলৈ পোৱা যায় । এই অধ্যয়নৰ জৰিয়তে অসমৰ শিৱসাগৰ জিলাৰ দিচাংমুখ অঞ্চলৰ মিচিংলোক সকলৰ ওপৰত জলবায়ু পৰিৱৰ্তনে কেনেদৰে প্ৰভাৱ বিস্তাৰ কৰিছে তাক বিতংভাৱে আলোচনা কৰা হৈছে। দিচাংমুখ অঞ্চলৰ মিচিং লোকসকল হৈছে থলুৱা জনজাতীয় লোক। এই লোকসকলৰ স্বকীয় ৰীতি-নীতি, ভাষা সংস্কৃতি আৰু জীৱন শৈলী দেখিবলৈ পোৱা যায়। লগতে এই অঞ্চলৰ এক উল্লেখনীয় বিষয় বস্তু হ'ল অঞ্চলটো ব্ৰহ্মপুত্ৰ নদীৰ দক্ষিণ পাৰত অৱস্থিত আৰু দিচাং নদীখন আহি এই অঞ্চলতেই ব্ৰহ্মপুত্ৰৰ বুকুত পৰিছেহি গতিকে দেখা যায় যে এই অঞ্চলৰ লোকসকলে নদীক কেন্দ্ৰ কৰি জীৱন নিৰ্বাহ কৰি আছে, আৰু এক বিৰাট পৰিৱেশ তন্ত্ৰৰ মাজেৰে তেওঁলোকে নিজা সংস্কৃতি আৰু জীৱন শৈলী বৰ্তাই ৰাখিছে। কিন্তু বৰ্তমান সময়ত যি জলবায়ু পৰিবৰ্তন এই পৰিবৰ্তনে অঞ্চলটোৰ পৰিৱেশ তন্ত্ৰ পৰম্পৰা, কৃষিকাৰ্য, সংস্কৃতি, আৰু জীৱন শৈলীৰ ওপৰত বিভিন্ন প্ৰভাৱ পেলোৱা দেখা যায়। যিহেতু উত্তৰ-পূৱ অঞ্চলৰ প্ৰায় সংখ্যক লোকেই কৃষি কাৰ্য্যৰ ওপৰত নিৰ্ভৰশীল আৰু এই কৃষি কাৰ্যক কেন্দ্ৰ কৰিয়েই বিভিন্ন পৰম্পৰাগত সাংস্কৃতিক উৎসৱ পালন কৰে আৰু এই সমগ্ৰ কৃষি কাৰ্যটোৱে নিৰ্ভৰ কৰে পৰিৱেশ তন্ত্ৰ বা জলবায়ুৰ ওপৰত। সেইবাবে জলবায়ু পৰিৱৰ্তন হোৱাৰ লগে লগে কৃষি কাৰ্য আৰু পৰম্পৰাৰ পৰা আৰম্ভ কৰি জীৱন শৈলীত বিভিন্ন প্ৰভাৱ পৰিলক্ষিত হয়। এই প্ৰভাৱসমূহ বহল ভিত্তিত আলোচনা কৰাৰ বাবে এই অধ্যায়নটো কৰা হৈছে আৰু ইয়াৰ কাৰণসমূহ জানিবলৈ যত্ন কৰা হৈছে। লগতে এই লোকসকলে এই পৰিবৰ্তনসমূহক কেনেদৰে গ্ৰহণ কৰিছে সকলোবোৰ এই অধ্যয়নৰ জৰিয়তে আলোচনা কৰা হৈছে।

মুখ্য শব্দ ঃ জলবায়ু পৰিবৰ্তন, সংস্কৃতি, জীৱনশৈলী প্ৰভাৱ

## আৰম্ভণি ঃ

জলবায়ু পৰিৱৰ্তন আৰু সামাজিক, সাংস্কৃতিক পৰিৱৰ্তন ইটো সিটোৰ সৈতে সম্পৰ্কৃত। কিয়নো জলবায়ুৰ ওপৰতেই সমগ্ৰ মানৱ জাতি নিৰ্ভৰশীল আৰু সেই হেতুকে জলবায়ুৰ পৰিৱৰ্তনৰ লগে লগে এই দিশসমূহতো পৰিৱৰ্তন অহাটো স্বাভাৱিক কথা। বৰ্তমান সময়ত যি জনসংখ্যা বৃদ্ধি, বিশেষকৈ প্ৰযুক্তি-বিদ্যাৰ যিসমূহ সৃষ্টিৰাজি সেইসমূহে বিভিন্ন ক্ষেত্ৰত প্ৰদুষণৰ মাত্ৰা বৃদ্ধি কৰিছে আৰু তাৰ ফলস্বৰূপে জলবায়ু পৰিৱৰ্তন বা জলবায়ুৰ তাৰতম্য দেখা যায়। সময়ৰ পৰিৱৰ্তনৰ লগে লগে সমাজৰো পৰিৱৰ্তন ঘটিছে মানুহৰ ঘৰ-দুৱাৰৰ পৰা আৰম্ভ কৰি ৰাস্তা-ঘাট, দলং, বিভিন্ন উদ্যোগ আৰু ইয়াৰ উপৰি নগৰীকৰণ ইত্যাদিৰ আধুনিকিকৰণে পৰিৱেশৰ ওপৰত বাৰুকৈয়ে প্ৰভাৱ পেলাইছে। আমি যিমানেই আধুনিকতাক আদৰি লৈছো বা নগৰমুখী হ'বলৈ লৈছো এই সকলোবোৰে আটাইতকৈ বেছি প্ৰভাৱ পেলোৱা অংশটোৱে হৈছে প্ৰকৃতি বা জলবায়ু। আমি মানৱ সমাজে পৰিৱৰ্তনৰ নামত প্ৰকৃতিৰ ওপৰত যি ধবংস লীলা চলাইছো তাৰ পৰিপেক্ষিততে জলবায়ু পৰিৱৰ্তন হৈছে বা এই সকলোবোৰেই মূল কাৰণ জলবায়ু পৰিৱৰ্তন। উত্তৰ-পূৱ অঞ্চলটো হৈছে এটা নাতিশীতোষ্ণ মণ্ডল। য'ত মৌচুমী জলবায়ু বিৰাজমান যাৰ বাবে উত্তৰ পূৰ্বাঞ্চলৰ ৰাজ্যসমূহত গৰম ঠাণ্ডাৰ অনুভূতি মধ্যমীয়া হয় আৰু মৌচুমী জলবায়ুৰ বাবে প্ৰচুৰ পৰিমাণে বৰষুণ হোৱা পৰিলক্ষিত হয়। তাৰ বাবে সমগ্ৰ উত্তৰ পূৰ্বাঞ্চলখনেই সেউজীয়াৰে ভৰপূৰ। উত্তৰ-পূবৰ বিশেষকৈ অসমত জলবায়ুৰ ওপৰত ভিত্তি কৰিয়েই কৃষি কাৰ্য্যৰ লগতে বিভিন্ন সাংস্কৃতিক পৰম্পৰা পালন কৰা হয় আৰু সামাজিক অৰ্থনৈতিক এই সকলোবোৰ দিশতে জলবায়ুয়ে প্ৰভাৱ পেলাই। কিন্তু বৰ্তমান যি জলবায়ুৰ পৰিৱৰ্তন এই পৰিৱৰ্তনৰ বাবে অসমৰ সংস্কৃতিক, পৰম্পৰা, সামাজিক আৰু অৰ্থনৈতিক স্থিতি এই সকলোখিনিতেই পৰিৱৰ্তন আহি পৰিছে। এই পৰিৱৰ্তনে কেনেকৈ অসমৰ শিৱসাগৰ জিলাৰ দিচাংমূখ অঞ্চলৰ মিচিং জনজাতি লোকসকলৰ পৰম্পৰা, সমাজ-জীৱন আৰু অৰ্থনীতিত যিসমূহ পৰিৱৰ্তন দেখা পোৱা গৈছে এই

- অধ্যয়নৰ উদ্দেশ্য ঃ
- জলবায়ুৰ পৰিৱৰ্তন আৰু মিচিং সমাজৰ পৰম্পৰা আৰু সংস্কৃতিত ইয়াৰ প্ৰভাৱ সম্পৰ্কে আলোচনা কৰা ।
- ২) জীৱনশৈলীৰ ওপৰত জলবায়ুৰ পৰিৱৰ্তনৰ প্ৰভাৱসমূহ বিশ্লেষণ কৰা।
- কৃষি আৰু আৰ্থ-সামাজিক দিশত জলবায়ু পৰিৱৰ্তনৰ ভূমিকা সম্পৰ্কে আলোচনা কৰা ।
- অধ্যয়ন পদ্ধতি ঃ

উক্ত অধ্যায়টো কৰিবলৈ যাওঁতে প্ৰাথমিক আৰু দ্বিতীয়ক এই দুয়োটা পদ্ধতি ব্যৱহাৰ কৰা হৈছে। উদাহৰণস্বৰূপে প্ৰাথমিক পদ্ধতি দিচাংমূখ অঞ্চললৈ গৈ পোনপতীয়াভাৱে তথ্যসমূহ সংগ্ৰহ কৰা হৈছে আৰু আনহাতে দ্বিতীয়ক তথ্য হিচাপে কিতাপ, বাতৰি কাকত আৰু বিভিন্ন লেখাসমূহৰ পৰা তথ্যসমূহ সংগ্ৰহ কৰা হৈছে। তথ্য ব্যাখ্যা ঃ

## জলবায়ু পৰিৱৰ্তন আৰু মিচিং সমাজৰ পৰম্পৰা ঃ

মিচিং জনজাতি হ'ল অসমৰ দ্বিতীয় বহৎ জনজাতি। যাৰ আছে সকীয়া পৰিচয় আৰু নিজা পৰস্পৰা। এই জনজাতিটো অসমৰ বিভিন্ন স্থানত সিঁচৰতি হৈ আছে তাৰে ভিতৰত অন্যতম হ'ল শিৱসাগৰ জিলাৰ দিচাংমুখ অঞ্চলৰ মিচিং লোকসকল। যিহেতু দিচাংমুখৰ মিচিংলোকসকল বসবাস কৰে দিচাং নদী আৰু সমান্তৰালভাৱে ব্ৰহ্মপুত্ৰ নদীৰ কাষত সেইবাবে এই লোকসকলৰ এক সুকীয়া সাংস্কৃতিক আৰু পৰম্পপৰাগত জীৱন শৈলী দেখিবলৈ পোৱা যায়। বিশেষকৈ মিচিং লোকসকল যিহেতু নদী পাৰত বসবাস কৰে সেই বাবে এইলোক সকলে চাং ঘৰ সাজি জীৱন নিৰ্বাহ কৰে। চাং ঘৰ অৰ্থাৎ ওখকৈ বাঁহেৰে চাং সাজি তাৰ ওপৰত বসবাস কৰে কিয়নো নদীৰ কাষত প্ৰতিবছৰে বান পানী হোৱা দেখা যায় আৰু সেই পানীৰ পৰা ৰক্ষা পাবলৈ বা পানী যাতে ঘৰৰ ভিতৰত নোসোমায় তাৰ বাবে ওখকৈ বাহেৰে চাং বা চাং ঘৰ সাজি লয়। আৰু সেইটোৱে ক্ৰমাগতভাৱে পৰম্পৰালৈ ৰূপান্তৰ হয়। কিন্তু বাৰ্তমান সময়ৰ যি জলবায়ু পৰিৱৰ্তন সেই পৰিৱৰ্তনৰ বাবে নদী জলপৃষ্ঠ ক্ৰমাৎ বুদ্ধি পাবলৈ ধৰিছে যিয়ে বান পানীৰ পৰিমাণ বৃদ্ধি কৰাইছে আৰু তেওঁলোকে বসবাস কৰা চাং ঘৰৰসমূহতো বান পানী সোমাইছে সেই বাবে নদী কাষৰীয়া লোকসকলে সমতল ভূমি সাধাৰণ ঘৰ সাজি বসবাস কৰিবলৈ লৈছে নাইবা পূৰ্বতকৈও ওখকৈ চাং সাজিব লগা হৈছে। মিচিং সমাজৰ যি উৎসৱ 'আলি-আয়ে লুগাং' সেই লুগাং উদ্যাপন কৰে ফাগুণ মাহৰ প্ৰথমতো বুধবাৰে। এই উৎসৱ উদযাপন কৰাৰ মূল উদ্দেশ্য হ'ল সেই দিনটোৰ পৰাই শস্য সিঁচা আৰম্ভ কৰে আৰু তেওঁলোকে নাচি-বাগি আনন্দত আত্মহাৰা হয়। কিন্তু জলবায়ুৰ যি পৰিৱৰ্তন তাৰ বাবে শস্য সিঁচা সময়চোৱাত পথাৰখন বা কঠিয়াতলিখন কৃষিৰ বাবে উপযোগী হৈ নুঠে কিয়নো জলবায়ু পৰিৱৰ্তনে বৰষুণৰ পৰিমান হ্ৰাস বুদ্ধি কৰিছে বা সময় মতে বৰষুণ হোৱা দেখা নাযায়। হ'লেও কিন্তু মিচিং লোকসকলে 'আলি-আয়ে লুগাং' পালন কৰা ক্ষেত্ৰত কোনো দিনে অৱহেলা কৰা নাই। মুঠৰ ওপৰত চাবলৈ গ'লে জলবায়ু পৰিৱৰ্তনে প্ৰধানকৈ দিচাংমুখ অঞ্চলত বান পানীৰ পৰিমাণ বৃদ্ধি কৰিছে পূৰ্বতে সেই অঞ্চলটোত বছৰটোত

এবাৰহে বান পানী দেখিবলৈ পোৱা গৈছিল কিন্তু বৰ্তমান সময়চোৱাত এবাৰ নহয় দুবাৰ নহয় তিনিবাকৈ বান পানী হয়। তাৰ পৰিপ্ৰেক্ষিতত মিচিং লোকসকলৰ বাঁহৰ চাং ঘৰসমূহ সোনকালে জহি-খহি যোৱা দেখা যায়। কাৰণ তেওঁলোকে চাং ঘৰসমূহ নিৰ্মাণ কৰে বাঁহ আৰু কাঠেৰে আৰু সেই বাঁহ কাঠ সমূহ বছৰত তিনিবাৰকৈ পানীত তিতিলে সোনকালে ভাঙি পৰাটো স্বাভাৱিক। তাৰ পৰা পৰিত্ৰান পাবলৈকে বৰ্তমান বহুলোকে বাঁহ-কাঠৰ চাং ঘৰ এৰি শিল বালি চিমেণ্টৰে চাং ঘৰৰ সাজিবলৈ বাধ্য হৈছে। যিয়ে সেই অঞ্চলটোৰ মিচিং সমাজৰ পৰম্পৰা পৰিৱৰ্তন আনি দিছে। ইয়াৰ উপৰিও সামাজিক অৰ্থনৈতিক আৰু পৰম্পৰাগত খাদ্যভাস, ৰীতি-নীতিত ক্ৰমান্বয়ে পৰিৱৰ্তন আনি দিছে।

# ২) জীৱন শৈলীৰ আৰু জলবায়ু পৰিৱৰ্তন প্ৰভাৱ ঃ

জীৱন শৈলী বুলি ক'বলৈ গ'লে দিচাংমুখ অঞ্চলৰ মিচিং লোকসকৰ নিজা বৈশিষ্ট্য আছে এইলোকসকল যিহেতু নদীৰ দাঁতিকাষৰীয়া লোক সেই বাবে এইলোকসকলে নদীক কেন্দ্ৰ কৰিয়েই জীৱনশৈলী বৰ্তাই ৰাখে। এই অঞ্চলৰ লোকসকলৰ যাতায়াতৰ প্ৰধান আহিলা হ'ল নাওঁ বা দলং। তেওঁলোকে নদীৰ ওপৰেদিয়ে সকলোবিলাক কাৰ্য যেনে যাতায়াত, বেপাৰ-বাণিজ্য, শিক্ষা গ্ৰহণ কৰা প্ৰায় সকলোবোৰ কাম-কাজেই নদী পাৰ কৰিয়েই কৰিব লগা হয়। লগতে তেওঁলোকৰ খাদ্যভাস সাজপাৰ ক্ষেত্ৰতো এটা, সকীয়া পৰিচয় আছে। দিচাংমুখ অঞ্চলৰ মিচিং লোকসকলে বিশেষকৈ থলুৱা যিবিলাক খাদ্য সেই খাদ্যসমূহে গ্ৰহণ কৰে আৰু সাজপাৰৰ ক্ষেত্ৰত নিজে ঘৰতে বোৱা কাপোৰ পৰিধান কৰাটোত গুৰুত্ব প্ৰদন কৰে। এইখিনিতে এটা কথা ক'ব পাৰি যে মিচিং শিপিনীসকলৰ হাতত সঁচাকৈ তেওঁলোকে যিদৰে কাপোৰত ফুল তুলে হয়তো দ্বিতীয় গৰাকী আৰু নোলাব। জলবায়ু পৰিৱৰ্তন মিচিং জনজাতিৰ লোকসকলৰ জীৱন শৈলী মন কৰিলে তেতিয়া আমি দেখা পাওঁ যে পূৰ্বে যি খাদ্যভাস আছে সেই সকলোবোৰ লাহে লাহে জলবায়ু পৰিৱৰ্তনৰ লগে লগে সলনি হ'বলৈ ধৰিছে বৰ্তমান সময়ত থলুৱা শাকপাচলিৰ পৰিৱৰ্তে বজাৰৰ শাকপাচলিয়ে খোৱা আৰম্ভ কৰিছে। ইয়াৰ মূল কাৰণ হৈছে জলবায়ু পৰিৱৰ্তন। বতৰ তাৰতম্যৰ বাবে বহুতো থলুৱা পাচলি নোহোৱা হৈ পৰিছে বা কৃষি কাৰ্য্যৰ যোগেদি যিসমূহ পাচলি উৎপাদন হয় সেয়াও পূৰ্বৰ তুলনাত

হ্ৰাস হৈছে। তাৰোপৰি বান পানীৰ বাবে ধান খেতি কৰাটোও কঠিন হৈ পৰিছে ফলত চাউল পৰ্যন্ত বজাৰৰ পৰা ক্ৰয় কৰি খাব লগিয়াত পৰিছে। জলবায় পৰিৱৰ্তনে যেনেকৈ সমগ্ৰ বিশ্বতে উষ্ণতা বৃদ্ধি কৰিছে ঠিক তেনেদৰে দিচাংমুখ অঞ্চলটো উষ্ণতা বৃদ্ধি পাইছে। সাধাৰণতে দিচাংমুখ অঞ্চলটো যিহেতু নদীকাষৰীয়া সেই বাবে পূৰ্বতে সেই অঞ্চলটোৰ উষ্ণতা বৰ বেছি নহয় আৰু সেউজীয়াৰে ভৰপূৰ কিন্তু বৰ্তমান জলবায়ুৰ তাৰতম্যতাৰ বাবে এই অঞ্চলটোৰো উষ্ণতা বৃদ্ধি পাবলৈ ধৰিছে। পূৰ্বতে যেনেকৈ বাঁহৰ চাং ঘৰৰত সুন্দৰকৈ বসবাস কৰি আছিল সেই পৰিৱেশ এতিয়া নোহোৱা হৈ পৰিছে। বৰ্তমান অৱস্থাত গৰমৰ পৰিমাণ ইমানেই বৃদ্ধি পাইছে যে দিনৰ ভাগত চাং ঘৰত থাকিব নোৱাৰা অৱস্থাৰ সৃষ্টি হৈছে আৰু কাতি মাহলৈকে ফেনৰ ব্যৱহাৰ কৰিব লগা হৈছে । ইয়াৰ পৰিৱৰ্তে শীতৰ সময়চোৱাতো অধিক ঠাণ্ডা পৰা পৰিলক্ষিত হৈছে। পূৰ্বৰ তুলনাত উষ্ণতাৰ তাৰতম্যতাহে সাজপাৰৰ ক্ষেত্ৰতো বহুখিনি পৰিৱৰ্তন আনি দিছে। তেওঁলোক থলুৱা সাজপাৰৰ পৰিৱৰ্তে পশ্চিমীয়া সাজপাৰ পৰিধাণ কৰিবলৈ আৰম্ভ কৰিছে পুৰুষ-মহিলা উভয়ে। তাৰ উপৰিও বছৰি বান পানী আৰু বিভিন্ন অসুবিধা যেনে যাতায়ত, উচ্চ শিক্ষা আৰু বেপাৰ-বাণিজ্যৰ বাবে বহু মিচিং লোক দিচাংমুখ অঞ্চল এৰি নগৰ মুখী হোৱা দেখা গৈছে।

## ৩) কৃষি আৰু আৰ্থ সামাজিক দিশত জলবায়ু পৰিৱৰ্তনৰ প্ৰভাৱ ঃ

দিচাংমুখ অঞ্চলৰ মিচিং লোকসকল প্ৰধানকৈ কৃষিৰ লগত জড়িত প্ৰায়সংখ্যক লোকে কৃষি কাৰ্যৰ জৰিয়তে নিজৰ পৰিয়ালক পুহপাল দি আছে আৰু অৰ্থনৈতিক দিশটো টনকিয়াল কৰি তুলিবলৈ সম্ভৱপৰ হৈছে। এই অঞ্চলৰ লোকসকলে বিশেষকৈ ধান খেতি আৰু চাপৰিত শাকপাচলিৰ খেতি কৰা দেখা যায় আৰু প্ৰতিবছৰে এক বৃহৎ পৰিমাণৰ শাকপাচলি বজাৰলৈ উলিয়াই দিবলৈ সক্ষম হয়। যাৰ জৰিয়তে মিচিং লোকসকল আৰ্থিকভাৱে স্বাৱলম্বী হৈ পৰে। যেতিয়াৰে পৰা জলবায়ু পৰিৱৰ্তন হ'বলৈ আৰম্ভ কৰিছে তেতিয়াৰে পৰা এই অঞ্চলটোৰ লোকসকল কৃষিৰ ক্ষেত্ৰত বহুতো অসুবিধাৰ সন্মুখীন হৈ আহিছে। আগৰ আলোচনাত উল্লেখ কৰা অনুসৰি বৰ্তমান বছৰটোত তিনিবাৰকৈ বান পানী হ'বলৈ ধৰিছে যাৰ বাবে ধান খেতি কৰাতো অসম্ভৱ হৈ উঠিছে আৰু লোকসকলৰ ভঁৰাল খালী হোৱা দেখা গৈছে। যিসকল লোকে কেৱল মাত্ৰ কৃষি কাৰ্য্য ওপৰত নিৰ্ভৰ কৰিয়ে জীৱন নিৰ্বাহ কৰিছিল সেই লোকসকলৰ অৱস্থা অতি সচনীয় হ'বলৈ ধৰিছে লগতে পৰম্পৰাগত যি কৃষি পদ্ধতি সেই পদ্ধতি বৰ্তাই ৰাখিব নোৱাৰা হৈছে। বান পানী ফলত দিচাংমুখ অঞ্চলটোত যি গঢাখহনীয়াৰ সৃষ্টি হৈছে সেই ঘটনাই দিচাংমুখ অঞ্চলৰ মিচিং লোকসকলৰ প্ৰতি ভাবুকি সৃষ্টি কৰিছে। এই খহনীয়াই খেতি পথাৰৰ লগতে ঘৰৰ-বাৰী সকলোবোৰ উটুৱাই লৈ গৈছে যিয়ে অঞ্চলটোত মাটিকালি হ্ৰাস কৰি পেলাইছে। অৰ্থনৈতিক ক্ষেত্ৰলৈ যদি মন কৰা যায় সেই অঞ্চলটোৰ লোকসকল আর্থিকভাৱে বৰ বেছি টনকিয়াল নহয়। অঞ্চলটোৰ প্রায় লোকসকল কৃষি কাৰ্য, মাছ ধৰা, নাওঁ চলোৱা ইত্যাদি কামবোৰৰ জড়িয়তে অৰ্থনৈতিক উপাৰ্জন কৰিবলৈ চেষ্টা কৰিছে। পিচে এই সকলোবোৰতে বৰ্তমান বিধি পথালি হিচাপে থিয় দিছে জলবায়ু পৰিৱৰ্তন। ইয়াৰ কাৰণ হ'ল সময়মতে বৰষুণ আৰু সময়মতে পানী নহ'লে কৃষি কাৰ্য কৰাটো সম্ভৱপৰ নহয় আৰু এই সমস্যাই এই অঞ্চলটোৰ লোকসকলৰ বাবে কৃষি কাৰ্য সমাপন কৰি অৰ্থনৈতিক দিশ টনকিয়াল কৰাটো এক সমস্যাত পৰিণত হৈছে। বৰ্তমান লোকসকলে কৃষি কাৰ্যৰ পৰিৱৰ্তে বিকল্প চিন্তা কৰিবলৈ লৈছে আৰু অঞ্চলটো পৰা ওলাই আহি অন্য কামত নিজকে নিয়োজিত কৰিছে। ই অঞ্চলটোৰ পৰা লোকসকলৰ প্ৰব্ৰজনত সহায় কৰিছে যিটো মিচিং জনজাতিটোৰ বাবে শুভ

## সামৰণি ঃ

লক্ষণ নহয় ।

জলবায়ু পৰিবৰ্তন আৰু দিচাংমুখ অঞ্চলৰ মিচিং লোকসকলৰ সংস্কৃতি আৰু পৰম্পৰা পৰিৱৰ্তন উক্ত আলোচনাৰ পৰা বুজিব পাৰিলো যে বৰ্তমান সময়ত জলবায়ু পৰিৱৰ্তনে সেই অঞ্চলৰ লোকসকললৈ বহু সময়ত বিভিন্ন সমস্যা সৃষ্টি কৰিছে। যি জনজাতিটোৰ বাবে শুভ নহয় সমগ্ৰ বিশ্ব লগতে এই অঞ্চলটোত জলবায়ু পৰিৱৰ্তনে পৰম্পৰাৰ লগতে সামাজিক আৰু অৰ্থনৈতিক সকলো দিশতে প্ৰভাৱ পেলোৱা দেখা গৈছে। যিহেতু পৰিৱেশ আৰু পৰম্পৰা এই দুয়োটা ইটো সিটোৰ সৈতে সংপৃক্ত হৈ আছে। এটা পৰিৱৰ্তনে আনটোৰো পৰিৱৰ্তন ঘটায় আৰু বহু সময়ত এই পৰিৱৰ্তনে বহু জনজাতি সমাজলৈ আমূল পৰিৱৰ্তন আৰু বহুতো সমস্যা সৃষ্টি কৰে। আৰু আমূল পৰিৱৰ্তন এটা জনজাতি পৰম্পৰা ৰক্ষাৰ ক্ষেত্ৰত সু-বিষয় নহয় এই আমূল পৰিৱৰ্তনে এটা সময়ত এটা জনজাতিক ধ্বংসৰ মুখলৈ ঠেলি দিয়াত সহায় কৰে। সেয়েহে বৰ্তমান সময়ত সকলো সজাগ হোৱা সময় আহি পৰিছে আমি সকলোৱে পৰিৱেশ সংৰক্ষণ কৰা আৰু পৰিৱেশ বিনষ্ট কৰা পৰা দূৰত থকা উচিত। বৰ্তমান সময়ত আধুনিকতাক আকোঁৱালি ল'লেও আধুনিকতাৰ ধামখুমিয়াত পৰিৱেশ সংৰক্ষৰ পৰা অঁতৰি অহাতো ভুল হ'ব। পৰিৱেশ সংৰক্ষণ কৰিলেহে মানৱ জাতি জীয়াই থাকিব। এই সকলোবোৰ আলোচনাৰ পাছত এটা কথা নুই কৰিব নোৱাৰি দিচাংমুখ অঞ্চলৰ মিচিং লোকসকলে আজিও নিজৰ পৰম্পৰা সংস্কৃতি বৰ্তাই ৰাখিবলৈ চেষ্টা কৰিছে। জলবায়ু পৰিৱৰ্তনে প্ৰভাৱ পেলালেও তেওঁলোকে নিজৰ পৰম্পৰা ধৰি ৰাখিবলৈ চেষ্টা কৰাটো সঁচাকৈই প্ৰসংশনীয় দিশ ।

#### প্রসংগ ঃ

- Adger, W. N. Barnett, J., Brown, K., Marshall, N. & O'Brien, K. (2012). Cultural dimensions of climate change impacts and adaptation. Nature Climate Change, 302) 112-117, https://doi.org/10.1038/nchmee1665 AR4 Climate Change 2007: Synthesis Report-IPCC (2007), IPCC.
  - Bhasara, S. (2015). Debating sociology and climate change. Journal of Integrative Sciences, https://doi.org/10.1080/1943815 2015,1108342
  - 12(3).

217-233

Enironmental

Birkmuna, J., Jamshed, A., McMillan, J. M., Feldmeyer, D., Totin, E.,
Solecki, W., Ibrahim 2. Z., Roberts, D., Kerr, R. B., Puertner,
H. O., Pelling, M., Djalante, R., Garschagen, M., Leal Filho, W.,
Guha-Sapir, D., & Alegria, A. (2022). Understanding human

- Chakraborty, D., S. Saha, RK Singh, B.K.Sethy, A Kumar, US Sakia, SK Das B. Makdoh, Tasvina R. Borah A Noite Chan Watling P.S. Rolling Anal S Chowdhury and D. Daschaudhur Trend analysis and change point delection of mean temperature A spatiotemporal perspective of North-Eastern India Environ. Proc. 4, 937-967 (2017)
- Chakraborty, D.R.K Singh, 5 Saha A Roy, BK Sethy A Kur and S.V. Ngachan: Increase in extreme day temperaturs in hills of Meghalaya: Its possible ecological and bio-meteorological effect
- SK. Das B. Makdah, Tanvina R. Borah A Nomita Chanu, | Waling, P.S. Rolling Anal. S. Chowdhury and D. Daschaudhur Spatiotemporal trends and change paint deloction in rainfall in different parts of north-eastern Indian states J Agrometeors, 19, 160-163 (2017)
- Stochastic Envion Res Rek Assess, 32, 3067-3081(2018) Chakraborty,
  D. VK Sehgal, R Dhakar M. Ray and DK. Das Spatio- temporal trendin heatwaves over Indiaand simpact assessment ansheal crop Theor Appl Climatol, 138, 1925-1937 (2019) Choudhury BU, AnupDas, SV Ngacha A Song Bordols and P Chowdhury Trend analysis of after varabens in mid

 $\circ$   $\circ$   $\circ$