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'Impact of Climate Change like Vulnerability on the Intensifying Floods and Intervening Droughts in Assam

Dr. Chandra Kala Magar

,
Asst Professor, Dept. of Geography, B.Borooah College, Guwahati, Assam

ABSTRACT

Climate change is the long-term alteration of temperature and typical weather patterns in a place where it usually causes weather patterns to be less predictable. These unexpected weather patterns can make it difficult to maintain and grow crops in regions such as the developing countries like India where around 60 per cent of the population rely on monsoon for their agriculture because expected temperature and rainfall levels can no longer be relied on. As such it is a shift in global or regional climate patterns that has also been connected with other damaging weather events such as more frequent and more intense hurricanes, floods, downpours, drought, aridity and winter storms.The cause of climate change especially after the mid-20th century is largely due to human activity such as burning fossil fuels, industrial activities, cutting down forests and farming livestock. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming. The warming of the planet causes drastic impacts on global, local and regional climates. Although the climate change is naturally a slow process which can take over hundreds and thousands of years to warm the planet yet the human activities have accelerated the process so tremendously making it vulnerable to various natural and man-made disasters.The IPCC Third Assessment Report (TAR) defined climate change vulnerability as "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes"(IPCC, 2001). As such an attempt is made in this paper (a) to understand impact and increasing intensity of flood due to climate change and vulnerability; (b) to analyse the impact of climate change and vulnerability on drought and associated issues: and (c) to identify the strategies that can be adopted by the communities to counter the impacts of climate change like flood and drought associated issues. The research is based on secondary data which has been processed, analysed and interpreted in the form of necessary maps and diagrams.

Key words: climate change, vulnerability impact, IPCC

Introduction:

Climate change is the long-term alteration of temperature and typical weather patterns in a place where it usually causes weather patterns to be less predictable. These unexpected weather patterns can make it difficult to maintain and grow crops in regions such as the developing countries like India where around 60 per cent of the population rely on agriculture because expected temperature and

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rainfall levels can no longer be relied on. As such it is a shift in global or regional climate patterns that has also been connected with other damaging weather events such as more frequent and more intense hurricanes, floods, downpours, drought, aridity and winter storms.

The cause of climate change especially after the mid-20th century is largely due to human activity such as burning fossil fuels, industrial activities, cutting down forests and farming livestock. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming. Burning these materials releases greenhouse gases into Earth's atmosphere which causes the rise in the planet's temperature commonly called as global warming. The warming of the planet causes drastic impacts on global, local and regional climates. Although the climate change is naturally a slow process which can take over hundreds and thousands of years to warm the planet yet the humanactivities have accelerated the process sotremendously making it vulnerable to various natural and man-made disasters.

The IPCC Third Assessment Report (TAR) defined climate change vulnerability as "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes". Vulnerability can mainly be broken down into two major categories, economic vulnerability, based on socioeconomic factors and geographic vulnerability (IPCC, 2001).

a) Economic vulnerability- Economic vulnerable communities are those which do not have the needed financial resources for building infrastructures, engineering sustainable energy sources, and preparedness systems which can make them resilient towards climate change.

b) Geographic vulnerability- The second type of vulnerability includes the geographically vulnerable areas on earth which are susceptible to natural and man-made hazards and disasters like cyclones, floods, earthquakes, rising sea levels, flood, drought and dramatic changes in ecosystem services including access to food such as communities depending on sustenance activities.

It means that the people mostly belonging to the developing countries will be worst affected by climate change and thus are most vulnerable economically and geographically. Hence it is becoming more imperative for local government and agencies to create strategies to react to change and adapt infrastructure to meet the needs of those impacted. Vulnerability assessments are done for local communities to evaluate where and how communities or systems will be vulnerable to climate change. However, such assessments are not much successful in developing countries and more so in less developed states like Assam where flood and drought are recurring problems with no clear strategies for adaptation, mitigation, and resilience plans.

Statement of the Problem: Developing countries, with their low adaptive capacities and high dependence on climatic variables, are highly susceptible to climate-induced tragedies. The impact of

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climate change is more likely to have an adverse effect in the developing countries due to high dependency on climate sensitive livelihood like rain-fed agriculture, water, and forestry (Moorhead 2009). According to IPCC (2007) the impacts of climate change and their associated costs will fall disproportionately on developing countries threatening to undermine achievement of the Sustainable Development Goals, reduce poverty, and safeguard food security. It will also reduce access to drinking water, affects the health of the poor, will pose a threat to food security.

Climate change will lead to increased geopolitical tension as countries scramble to control resources and dominate new technologies required for clean energy.Poor people in developing countries tend to be more vulnerable due to limited opportunities and choices, small land holdings and lack of access to market. Within countries the marginalized groups have limited resources and capacity to adapt and are the most vulnerable (IPCC 2001). IPCC in its first assessment report has mentioned that by 2050, estimated 150 million people could be displaced due to climate-induced factors like floods, drought on storms (IPCC 1990).

Assam is one of the extremely vulnerable state in India to climate change due to very unique topography and physiographic location of valleys surrounded by Himalayas in the north, Naga, Manipur and Mizo Hills on the east and Garo and Jaintia Hills on the south, the state's dense network of rivers and also due to the state's location in an area where the Southwest Monsoon dominant affecting our agricultural economy to a big extent.This vulnerability is reflected in the exposure, sensitivity and adaptive capacity of the local population to climate induced extreme events such as floods. The state is characterised by high rainfall and a subtropical climate. It gets annual floods and frequent droughts, both of whose severity has risen due to adverse climatic conditions.

The poor are more vulnerable to extreme climate events and the drastic climate change projections are particularly worrisome for Assam as almost 32% of its population lives below the poverty line. Further, a majority of this population is dependent for its income on agriculture, which in turn is highly dependent on climatic factors such as precipitation and weather, and is frequently disrupted due to damage from floods and droughts. The state's low adaptive capacity further exacerbates the situation and makes the populace dependent on agriculture highly. Frequent droughts have affected the produce of the bountiful state and have often led to economic consequences. Drought conditions lower the production of agricultural commodities such as tea, jute etc, which in turn push their prices up. One can easily imagine the result of low incomes and high prices in the face of events such as droughts and floods.

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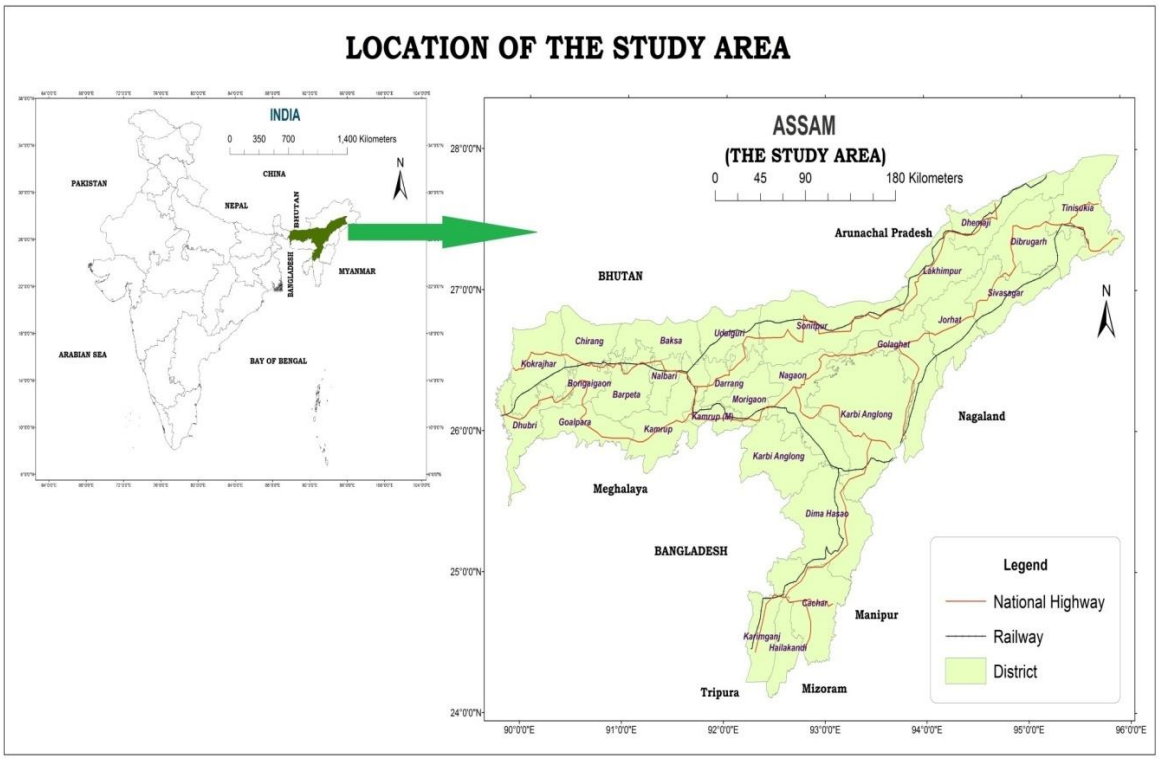

Fig. 1

Climate change issues have received short shrift in the state, and efforts are more focused on recovery than creation of adaptive capacity. According to the State Action Plan for Climate Change, the annual mean temperature in the state has increased by 0.59 degrees Celsius over the last 60 years (1951 to 2010), and is likely to increase by 1.7-2.2 degree Celsius by 2050. Climate projections in the state action plan also predict that extreme rainfall events will increase by 38% (Saikia, 2018). The state action plan for climate change, endorsed by the environment and forest ministry, states that the annual rainfall has decreased by 2.96 mm every year. The report has also warned of more frequent and severe floods, higher losses and damage in the forestry sector, and increasing freshwater scarcity. It also points out that the effects of such drastic climate change will be felt most strongly by the poor.

While the country's gross domestic product (GDP) could shrink by 3% annually with every one-degree centigrade rise in temperature, the state-level impact could vary, it said citing a study by Advancing Earth and Space Science, an international nonprofit scientific association. It is ultimately their individual fiscal capacities that will help states tackle the crisis. Those with lower spending on the environment are highly vulnerable (Sharma, 2021).

Droughts in the rainy state of Assam are not unheard of anymore as many places in Assam experience unexpected and longer dry spells even during the monsoon season. Warmer temperatures have affected the state's ever lush tea gardens for decades. However, the lengthy dry spells are affecting the agricultural population in the state as it is during this season that the paddy fields are planted. Several crops are being damaged bringing disappointment and grief to the farmers and the

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state has even declared many districts as drought affected offering compensation. However, this is not the final and only solution to the ever-accelerating problem due to global warming. Therefore, some measures need to be adopted to help train the local communities in hazard affected areas to develop local methods to deal with such environmental issues rather than wait for the government's intervention to provide solutions to the recurring issues of climate change.

Objectives:

The focus and objective of this paper is to understand:

i. To understand impact and increasing intensity of flood due to climate change and vulnerability.

ii. To analyse the impact of climate change and vulnerability on drought and associated issues.

iii. To identify the strategies that can be adopted by the communities to counter the impacts of climate change like flood and drought associated issues?

Data Base and Methodology

a) Selection of the Study Area- Assam being one of the states in India being affected by flood every year and since few decades' drought accompanying it is being selected as the study area.

b) Sources of Data- Due to time constraint the study is basically concentrated on secondary data. Secondary data necessary for the study have been collected from sources, such as statistical handbooks, government of Assam, economic survey, government of Assam, e-newspapers, internet, etc.

c) Data Analysis and Representation- Data obtained from various secondary sources have been processed, tabled and analysed. Necessary maps have been prepared for giving a clear exposition of the problem.

Impact of climate change on intensifying Floods in Assam:

The Brahmaputra is considered a mighty river, meandering through the Tibetan plateau, entering Arunachal Pradesh in India, passing through the Eastern Himalayas, braiding through the plains of Assam and Bangladesh, before falling into the Bay of Bengal. It is joined by tributaries from Nagaland, Meghalaya, Arunachal Pradesh and Bhutan, some of which are larger than many of the rivers flowing through northern and southern India. The floods that occur annually in the alluvial plains of the Brahmaputra river basin are often termed as catastrophic because of the life and property they destroy, and the ravages they do to the ever dwindling economy of Assam (Table 1).

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Table 1: Districtwise major flood events in Assam, 2004 to 2021

Sl. No	Year	Areas Affected	Loss of life and Property
1	2021	16 districts affected (Barpeta, Biswanath, Bongaigaon, Chirang, Dhemaji, Dibrugarh, Golaghat, Jorhat, Kamrup, Lakhimpur, Majuli, Morigaon, Nagaon, Sivasagar, Sonitpur and Tinsukia)	2.58 lakhs people affected, forests submerged in Kaziranga and many animals lost their lives.
2	2020	26 districts hit	Affecting 36 lakhs people and destroying crops
3	2017	Flood affected across nine districts (Lakhimpur, Biswanath, Barpeta, Morigaon, Nagaon, Golaghat, Jorhat, Sivasagar, Karimganj)	60, 000 people affected and 76 people lost their lives.
4	2014	The 23 affected districts are Barpeta, Bongaigaon, Chirang, Darrang, Dhemaji, Dhubri, Dibrugarh, Goalpara, Golaghat, Jorhat, Kamrup Metro, Kamrup Rural, Karbi Anglong, Karimganj, Kokrajhar, Lakhimpur, Morigaon, Nagaon, Nalbari, Sivasagar, Sonitpur, Tinsukia and Udalguri.	67 people have lost their lives and over 42 lakh people across Assam were affected in three waves of floods[1] 884 roads, 86 RCC bridges, 113 SPT bridges and 125 culvertdamaged
5	2009	10 districts affected Lakhimpur, Dhemaji, Dibrugarh districts, Jorhat in upper Assam, Morigaon in central Assam and Barpeta, Kamrup(Guwahati), Bongaigaon, Dhubri and Baksa in lower Assam were submerged[2].	One killed, 400,000 displaced[2]
6	2006	16 out of 27 districts have been affected by floods. The affected districts are Nagaon, Morigaon, Karimganj, Hailakandi, Dhemaji, Cachar, Jorhat (Majuli), Kamrup, NC Hills, Darrang, Barpetta, Lakhimpur, Tinsukia, Sonitpur, Dibrugarh and Nalbari.	Death toll 12 and displacing nearly 160,000 people,
7	2004	23 out of 28 districtsaffected such as Tinsukia, Dibrugarh, Shivsagar, Jorhat, Golaghat, Nagoan, Morigaon, Kamrup, Kamrup Metro, Darrang, Sonitpur, Dhemaji, Lakhimpur, Nalbari, Berpetta, Bongaigaon, Kokrajhar, Goalpara, Dhubri, Chirang, Karbi Anglong, Karimganj and Hailakhandi but Kamrup and Nalbari, Darrang, Sonitpur, Dhemaji and Lakhimpur.[3]	At least 200 people died and more than 12 million were displaced widespread damage to human life and property, standing crops, flood control embankments and other basic infrastructure[3]

Source: Outlook[1], Times of India[2], reliefweb[3]

Floods in the Brahmaputra basin of India are characterized by their extremely large magnitude, high frequency, and extensive devastation. During the last forty years of flood record, the highest flood occurred in 1962. But, more recently, the 1988 floodappears to be the most devastating one, causing inundation of 62 per cent of Assam's Brahmaputra valley. The mean annual flood discharge of the river at Pandu is 47,608 m3s' with a recurrence interval of 2.56 years (Bhattacharyya and Bora 2009).During the period from 1987 to 1998, the highest flood occurred on 20 June 1993 in the Puthimari River, atributary of Brahmaputra when the deviation between DL and flood levelwas 4.65 m (Dhar and Nandargi, 2000).

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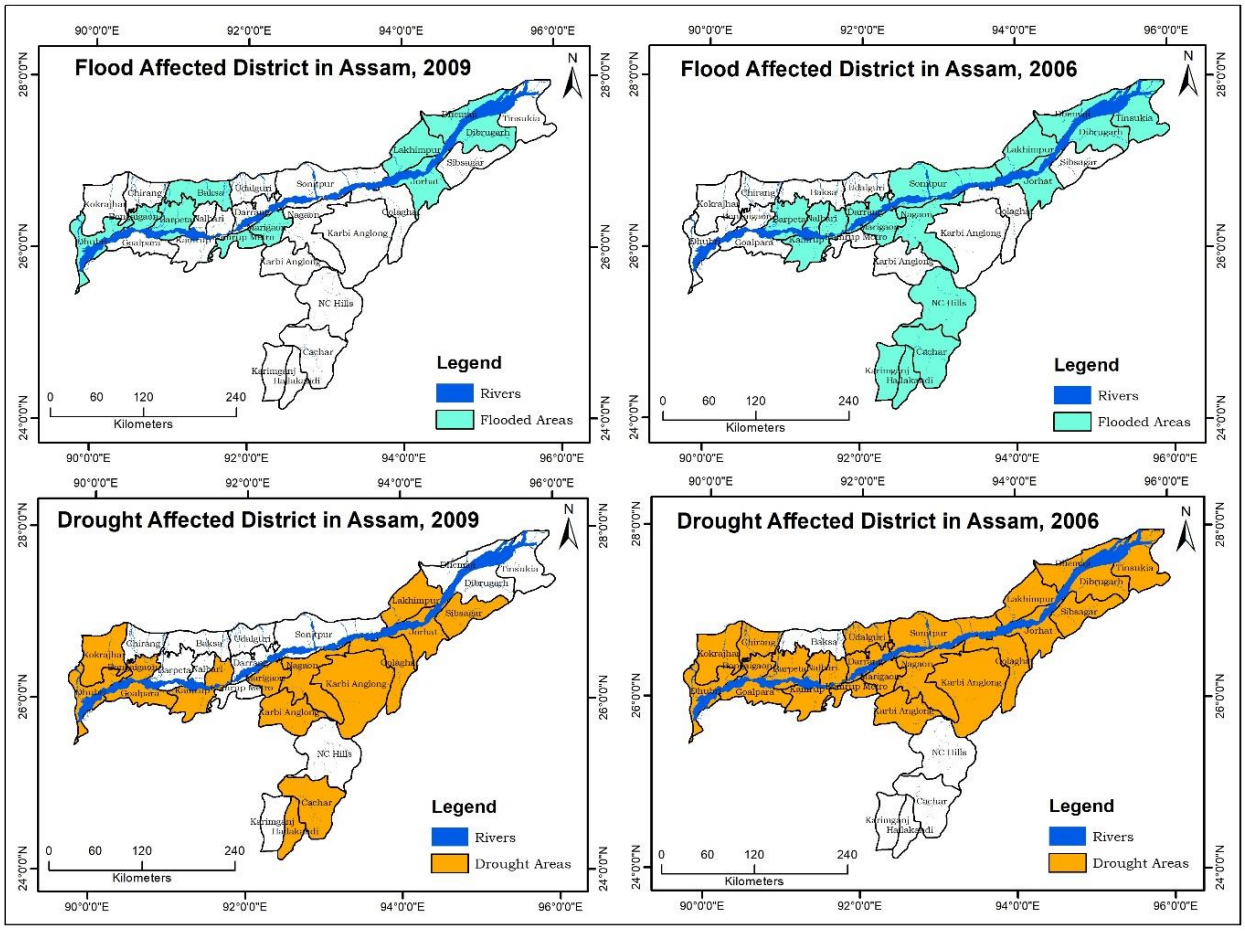

Fig.2

Floods on the Brahmaputra have been a recurring feature from early times. They may be attributed to the involvement of a host of related causes of a natural, hydrometeorological, and anthropogenic nature. But, in recent years floods of the river have become more severe, due to a variety of newly-emerged manmade causes, in addition to those generally recognized (Bhattacharyya and Bora 2009). The flood control measures adopted in the basin since the early fifties are all of a short-term and ad-hoc nature and in fact, no proper floodplain management program is being implemented. Consequently, there have been regular flood onslaughts, adversely affecting the agrarian economy of the Brahmaputra valley.In addition to these, due to climate change and global warming the melting of the glaciers in the Himalayas may result in increased flood risk in the Brahmaputra Basin though the overall impact on annual discharge is likely to be low (Nepal and Shrestha, 2015).

Floods in Brahmaputra valley has been a recurring feature since time immemorial, but in recent years, the river and its intensity is becoming severe with the passage of time.Though flood visits the Assam plains every year with two or more flood waves, it was observed that in the 1980s and 1990s, the high severity and magnitude of flood used to occur once or twice in a decade or two.However, in recent years the nature and intensity of the magnitudes of floods have changed. As can be observed from the table 1, more and more areas of the valleys are inundated and submerged every year. While the

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magnitude and intensity is also increasing with longer flood spells and more flood waves causing heavy loss to lives, properties and environment.

Catastrophic water-related events on the Brahmaputra have become far more frequent with climate change and accompanying shifts in the rainfall pattern. There are several layers of environmental disaster such as river-bank erosion, degradation and ruptures in wetland connectivity, deforestation, unsustainable mining of river-bed boulders which provides a natural cushion from the impact of floods, especially dam-induced flash floods in downstream areas, such as those witnessed in recent years because of the sudden discharge of water from Ranganadi, Kopili and Doyang hydropower projects etc.

Impacts of climate change on drought in Assam: Drought is an extended period of unusually dry weather when there is not enough rain. The lack of precipitation can cause a variety of problems for local communities, including damage to crops and a shortage of drinking water. These effects can lead to devastating economic and social disasters, such as famine, forced migration away from drought-stricken areas, and conflict over remaining resources.

Because the full effects of a drought can develop slowly over time, impacts can be underestimated. A drought is defined depending on the average amount of precipitation that an area is accustomed to receiving. Unlike many natural hazards that bring about sudden and dramatic results, the onset of a drought can be gradual and subtle. Though it is one of the costliest weather-related disasters, it usually take years for the full effects of long-term inadequate rainfall to become apparent.Due to climate change and global warming of the earth, the excess heat trapped in the climate system draws out more moisture from soils, thereby worsening drought conditions.The presence of anthropogenic forcing has increased the drought frequency, maximum drought duration, and maximum drought intensity experienced in large parts of the Americas, Africa, and Asia (Chiang, Mazdiyasni, &AghaKouchak, 2021).

While drought is a naturally occurring part of the weather cycle and cannot be prevented, human activity can influence the effects that drought has on a region. Many modern agricultural practices may make land more vulnerable to drought. While new irrigation techniques have increased the amount of land that can be used for farming, they have also increased farmers' dependence on water.

Rain deficiency is not totally a new phenomenon in Assam. In 1971, rains fell short by about 25 per cent, according to the state's meteorological office. Assam also has had 12 years of below-normal rainfall since 1982. During 2005 there was a rainfall deficit of around 8 per cent, though the state still experienced floods, but a 40 per cent unprecedented deficiency occurred during 2006(Down to Earth). As can be observed from table 2, the intensity of intervening droughts after the onslaught of flood is increasing. During the years 2006, 2009, 2014 and 2021 Assam experienced flood (June to August) and was followed by a drought like situation in many parts of the state (Fig 2 and 3). This is a clear

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indication that climate change and variability is playing an integral role in causing catastrophic events along with anthropogenic induced forces.

Table 2: Districtwise major drought events in Assam, 2006 to 2021

Sl. No	Year	Rains Received	Areas Affected
1	2021	16 per cent below normal level 40 per cent less rainfall during the pre-monsoon season from March to May Tea industry likely to suffer 10-15% crop loss	5 districts received scanty rainfall such as Golaghat, Hojai, Kamrup Rural, Karbi Anglong and West Karbi Anglong most hit[3,4]
2	2018	Monsoon deficit by 26-30 per cent of normal rainfall	Heatstroke and drought like conditions in Morigaon, Sonitpur, Kamrup, districts of Assam.
3	2015		Continuous drought in Northeast India
4	2014		14 districts in Assam facing drought like situations (Baksa district most hit)
5	2013	30 per cent less rain than normal	14 of the 28 districts such as Bongaigaon, Cachar, Dhubri, Goalpara, Golaghat, Hailakandi, Jorhat, Kamrup, Karbi Anglong, Kokrajhar, Lakhimpur, Morigaon, Nagaon and Sibsagar in the state as drought-hit[1]
6	2009	a deficit of nearly 30 per cent rainfall from the beginning of of June to July	14 of the 27 districts Bongaigaon, Cachar, Dhubri, Goalpara, Golaghat, Hailakandi, orhat, Kamrup, Karbi Anglong, Kokrajhar, Lakhimpur, Morigaon, Nagaon and Sivasagar
7	2006	40 per cent unprecedented[5] deficiency In some districts the rainfall was deficit by about 70 percent	22 out of 27 districts were drought hit[2]such as Kokrajhar, Dhubri,Goalpara,Barpeta,Morigaon, Nagaon,Sonitpur, Lakhimpur,Dhemaji, Tinsukia, Dibrugarh,Sivasagar, Jorhat,Golaghat,Bongaigaon,Chirang,Kamrup,Kamrup Metro Nalbari,Darrang, Karbi Anglongand Udalguri

Source: Business Standard[1], Hindustan Times[2], East Mojo[3], The Print[4], Down to Earth[5],

The intensity of intervening droughts after the onslaught of flood is increasing. During the years 2006, 2009, 2014 and 2021 Assam experienced flood (June to August) and was followed by a drought like situation in many parts of the state (Fig 2 and 3). This is a clear indication that climate change and variability is playing an integral role in causing catastrophic events along with anthropogenic induced forces.

In recent years it has been observed that the amount of rain that falls in Assam is mostly concentrated from the month of June to August while the rest of the year remains more or less dry with little precipitation.The agricultural sector alongwith the tea industry of Assam has been suffering a great loss due to drought like situation since a decade. Tea production is threatened by a range of climate driven stresses including rising temperatures, droughts, frosts, shifting and unpredictable weather patterns as well as changing incidences of pests and diseases.

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Drought can also create significant economic and social problems. The lack of rain can result in crop loss, a decrease in land prices, and unemployment due to declines in production. As water levels in rivers and lakes fall, water-supply problems can develop. These can bring about other social problems. Many of these problems are health-related, such as lack of water, poor nutrition, and famine. Other problems include conflicts over water usage and food, and forced migration away from drought-stricken areas. The tea industry and the agricultural economy has been heavily affected due to the recurring intensity of drought in Assam.

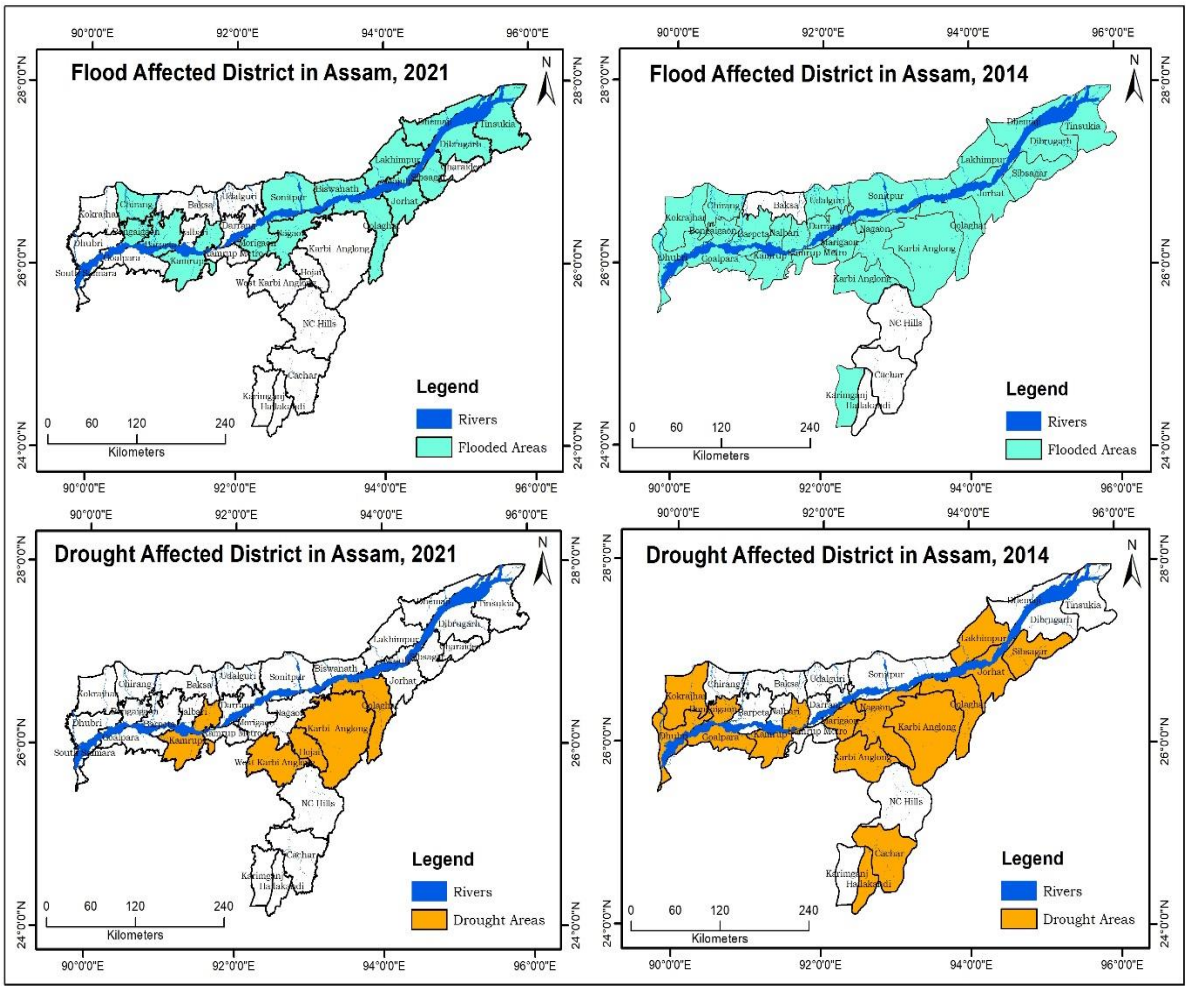

Fig.3

Community-based Flood Adaptation Measures:

The concept of community-based flood risk management (CBFRM) has evolved as a holistic approachto enhance community responsibility and engagement in the development process. Self-help,mutual-help, and public-help scenarios are essential elements in responding to flood disasters.Whereasself-help and mutual-help among local residents are most useful in providing prompt emergencyresponse, especially when affected sites are rendered inaccessible (due to disruption of transport andcommunications, for example), the public-help element (provided mainly by government) is essential insustaining benefits for affected communities in the long term. Trees and

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other plants have adapted to withstand the effects of drought through various survival methods. Some plants (such as grasses)slow their growth or turn brown to conserve water. Plants and trees that can adapt to such drought prone areas can be planted in large scale.

Table 3: Role of community-based drought adaptation for building up food-security and flood resilience during flood and non-flood period

Policy Domain	**Non-flood period**	**Flood period**
Early warning systems	• Risk and vulnerability assessment •Strengthening climateinformation and early warning system •Identify and map main hazard zones andplaces for safe refuge. • Knowledge dissemination	• Ongoing impact assessment •Plan a suitable monitoring network,evaluation of mitigation and emergency measures
Landscape Management	•Organize a five-level hierarchy of responsibility andaccountability—at county, town, village,production group, and household levels. • Small-scale structural measures to protect communities. •Perform trial exercises and field drills	•Coordination and collaboration among hydrometeorological departments and local communities. •information dissemination, organizing people, warning and evacuation.
Agriculture	• Grow new varieties of flood resilient crops. Plants, including staple crops such as rice, wheat and barley that can survive temporary periods of flooding • Seed (emergency) stocks	• Protecting key animals or recovery • Seed distribution (recovery)
Finance	• Crop and livestock (weather) insurance • Savings • Cash transfer facilities •Building local social capital	• Ease of disbursements • Use of emergency cash transfers
Upscaling Community	• Empowering communities to plan and implement adaptation in a proactive manner • Community based climate risk management in proactive manner	• Scaling up to flood-affected populations, cash or in kind
Food markets	• Fostering and integration of food crop markets •Establishing food price monitoring systems	• Facilitating the inflows of food • Regional food aid

Source: Prepared by researcher

The farming community can be encouraged to grow new varieties of crops that suit the changing climate. The overarching goal of the community development programme can also be to contribute in

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enhancing climate resilience and adaptive capacities of vulnerable families in the Brahmaputra River basins by leveraging outcomes from such pilot initiatives, thereby improving their livelihoods.

Preparedness is one of the main objectives of flood prevention measures, where the community is prepared beforehand with specific plans, provisions and preparedness to combat loss of life and property.The community can be divided into groups and given responsibilities such as disseminating information, vigilance, resource mobilization etc. To combat flood, the communities can also be trained to use locally available resources such as bamboo poles, banana plant, sand bags etc to make temporary boats and other safety aids.Adopting suitable crop varieties that can resist temporary water logging for the duration of flood inundation (eg.*boro rice* which is cultivated by the indigenous communities during rainy season)can be of much help to the communities (table 3).

Further to build a climate resilient economy, a climate responsive budget can be prepared by the state government where the funds granted by the centre can be spend under budgetary heads such as “soil and water conservation” and “forestry and wildlife”and other environment conservations.

Community-based Drought Adaptation Measures:

As the climate is getting vulnerable day after day, it is imperative that the local farmers in the drought affecting areas can be encouraged to practice community farming. It will not only insure food security but also help them to adopt latest technologies in farming. The interventions by agriculture experts can infuse a fresh lease of life in the farming practices by way of introducing new crops in the ecologically sensitive areas of Assam valleys.

As the climate is getting vulnerable day after day, it is imperative that the local farmers in the drought affecting areas be encouraged to practice community farming. It will not only insure food security but also help them to adopt latest technologies in farming. The interventions by agriculture experts can be of much help in the farming practices by way of introducing new crops in the ecologically sensitive areas of Assam valleys. A pilot initiative can be launched to help the farming community grow new varieties of crops that can suit the changing climate.

To develop a drought resilient community, diversification of livelihood practices can be the main adaptation strategy. For example‘*mushrooms* farming’ may lead the household to invest all its labour and other assets in it, disregarding both conventional farming activities and wage labour.Communities can also built small scale sand dams or small ponds or reservoirs that can harvest the rain water for emergencies.Drought resilient varieties of crops can also be used for farming to withstand the impact of unpredictable weather conditions.

A pilot initiative can be launched to help the farming community grow new varieties of crops thatcan suit the changing climate. Community based farming practices can be of immense help in the coming years as the agricultural lands are going to experience tremendous pressure due to the expanding

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population pressure. Therefore, the above-mentioned practices can aid in the long run to achieve drought resilience and food security amidst ongoing catastrophes.

Table 4: Role of community-based drought adaptation for building up food-security and drought resilience during drought and non-drought times

Policy Domain	Non-drought period	Drought period
Early warning systems	• Risk and vulnerability assessment • Strengthening climate information and early warning system •Drought planning • Knowledge dissemination	• Ongoing impact assessment • Monitoring and evaluation of mitigation and emergency measures
Landscape Management	•Watershed management, water harvesting project locally and constructing small scale sand dams or reservoirs • Water storage and (Water-saving) irrigation • integrated water resource managemnet	• Contingency execution (drinking and livestock first)
Agriculture	• Grow new varieties of drought resilient crops • Drought resilience breeding • Seed (emergency) stocks	• Irrigation or stop according to drought severity and outlook • Protecting key animals, recovery • Seed distribution (recovery)
Finance	• Crop and livestock (weather) insurance • Savings • Cash transfer facilities	• Ease of disbursements • Use of emergency cash transfers
Upscaling Community	• Empowering communities to plan and implement adaptation in a proactive manner • Community based climate risk management	• Scaling up to drought-affected populations, cash or in kind
Food markets	• Fostering and integration of food crop markets •Establishing food price monitoring systems	• Facilitating the inflows of food • Regional food aid
General economic development	• Diversification of livelihood • Contingency planning •Climate responsive budget	• Infrastructure-building as part of emergency aid (cash/food for work)

Source: Prepared by researcher

Conclusion:

The study clearly indicates that the impact of climate change and vulnerability in the region is real and there is the need of the hour to combat the issue when it is playing at micro-level. Proper management of the community resources using local knowledge can be of great help to adapt ourselves to the recurring and intensifying floods and drought related issues. For droughts, diversification of livelihood activities is the main adaptation strategy, while relief-seeking can be applied to both droughts and floods. Recommendation can also be made for greater preparedness, capacity building, and the changing of livelihoods as means of enhancing adaptation.The local knowledge system of the

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communities can be adopted to bring about the resilience of the community to manage natural disasters triggered by global weather change. This paper tries to make some effort by bringing to the forefront the communities' adaptation to flood and drought. This is important to understand the human dimension and plight of the local communities and how they evolve resilient strategies to live with floods and droughts. The findings will be of interest to policy makers and experts to design new strategies on how community knowledge can be integrated to policymaking on climate change and its associated issues.

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