

A STUDY OF THE IMPACT OF CLIMATIC HAZARD ON AGRICULTURAL PRACTICES IN ASSAM WITH SPECIAL REFERENCE TO BHURAKALA GAON, JORHAT

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Abstract

Climate change can drive significant and long-term changes in the statistical distribution of weather patterns over periods of time ranging from a few decades to millennia, regardless of the cause. Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming affects agriculture in a number of ways, including through changes in average temperatures, rainfall and climate extremes; changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. The main objective of this study is to identify the root causes and consequences of climatic hazard on agriculture and to access climate change influencing farmers' livelihood and productivity. The researchers tried to identify the legal parameters in maintaining climatic hazard for better protection and for that researchers have adopted both primary and secondary sources of data, the former one is collected through survey and field visit in the study area and the later one is collected through books, journals, magazines etc.

Keywords: *Climate change, Agriculture, Climatic Hazards, Global warming*

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INTRODUCTION

Climate change is the global phenomenon of climate transformation characterized by the changes in the usual climate of the planet (regarding temperature, precipitation, and wind) that are especially caused by human activities. As a result of unbalancing the weather of Earth, the sustainability of the planet's ecosystems is under threat, as well as the future of humankind and the stability of the global economy.¹

NASA's definition of climate change says it is *"a broad range of global phenomena created predominantly by burning fossil fuels, which add heat-trapping gases to Earth's atmosphere. These phenomena include the increased temperature trends described by global warming, but also encompass changes such as sea-level rise; ice mass loss in Greenland, Antarctica, the Arctic and mountain glaciers worldwide; shifts in flower/plant blooming; and extreme weather events."*²

While the word *agriculture* is a late Middle English adaptation of Latin *agricultūra*, from *ager*, "field", and *cultūra*, "cultivation" or "growing". Agriculture is the science and art of cultivating plants and livestock and thus agriculture usually refers to human activities. Agriculture is defined with varying scopes, in its broadest sense using natural resources to "produce commodities which maintain life, including food, fiber, forest products, horticultural crops, and their related services".³ Agriculture has an important role to play in the economic growth of an agrarian economy like that of India. Therefore, this study would mainly focus on the State of Assam considering the Jorhat District where the local habitants totally depends their earning sources on agriculture.

In Assam among all the productive sectors, agriculture makes the highest contribution to its domestic sectors, accounting for more than a third of Assam's income and employs 69% of workforce. Assam's biggest contribution to the world is Assam tea. It has its own variety, *Camellia sinensis* var. *assamica*. The state produces rice, rapeseed, mustard seed, jute, potato, sweet potato, banana, papaya, areca nut, sugarcane and turmeric. Assam's agriculture is yet to experience modernization in a real sense.

¹ Climate Change: Meaning, Definition, Causes, Examples And Consequences; Available at: <https://youmatter.world/en/definition/climate-change-meaning-definition-causes-and-consequences/>

² Ibid.

³ Available at: <https://www.coursehero.com/file/61075691/AGRICULTUREpdf/>, Accessed on 29th May, 2020.

Study Area

Here, the study area comprise of Jorhat district of Assam. Jorhat is an administrative district of the Indian state of Assam situated in the central part of the Brahmaputra Valley. The district is bounded by Majuli on north, Nagaland state on the south, Sivasagar on the east and Golaghat on the west. On the north of the district, the river Brahmaputra forms the largest riverside island of the world. The administrative seat is at Jorhat town.

With the tropical monsoon climate, Assam is temperate (summer max. at 95–100 °F or 35–38 °C and winter min. at 43–46 °F or 6–8 °C) and experiences heavy rainfall and high humidity. The climate is characterized by heavy monsoon downpours reducing summer temperatures and affecting foggy nights and mornings in winters, frequent during the afternoons. Spring (March–April) and autumn (September–October) are usually pleasant with moderate rainfall and temperature.



Source: Internet (Google map)

The researcher has adopted both primary and secondary sources of data, the former one is collected through observation visiting in the study area and the later one is collected through books, journals, internet etc.

CLIMATIC CHANGES AND ITS EFFECT ON AGRICULTURE

The potential major effect of climate change on agriculture are the shifts in the sowing time and length of growing seasons geographically, which would alter planting and harvesting dates of crops and varieties currently being used in an area. Seasonal precipitation distribution patterns and amounts could change due to climate change. With warmer

temperatures, evaporate transpiration rates would raise, which would call for much greater efficiency of water use.

In order to understand the farmers' response to changing climatic condition, a very primary survey was conducted in Jorhat District. Jorhat regularly faces severe flood, and farmers need to adjust with changing climate for survival.

One of the important characteristics of the survey areas are that the chosen farm families are mostly small (more than 1 ha but less than 4 ha) and marginal (below 1 ha) farmers. Also, there is none uniform distribution of cultivated area among farming households in all the survey areas. About 65% of the respondent farmers in Jorhat district, respectively, small holders. However, more than 25% of farmers have landholdings between 30.0 and 75.0 bighas in Jorhat district. It also indicates the presence of common land-leasing practice in all those survey areas. The landholdings are not only small in size but also fragmented into many parcels due to subdivisions on account of breakdown of the joint family system and law of inheritance. The lease out and lease in phenomena are found to be more prominent among the marginal and small farmers. However, lease on short-term contracts and substantial fraction of croplands would lead to fewer incentives for investments in soil conservation by the operators. However, owner farmers have more capacity to adopt new technologies frequently than owner-cum-tenant and tenant farmers (Habiba et al. 2012). Moreover, it is widely believed that land ownership encourages adaptation of technologies like irrigation, application of fertilizer, etc. Farmers adapt their choice of farm type and irrigation to their local climate that treats the choice of crops, livestock and irrigation as endogenous factors (Mendelsohn and Seo 2007).

Various types of crops are cultivated by the respondent farmers in different seasons. Generally, the major crops grown are paddy, wheat, mustard, sesamum, blackgram, greengram, lentil, pigeon peas, chillies, turmeric, ginger, sugarcane and others are grown to a minor extent.

Paddy is mostly grown as both Ahu (autumn) and Sali (winter) in kharif season. Ahu is grown by broadcasting in the month of March- April and harvested in June-July. Sali is cultivated by both broadcasting and transplanting in June-August and harvested in December-January. Bao (low land/deep water) paddy is also grown to some areas in kharif season. Boro paddy (summer) is grown in Rabi season to a less extent. A majority of farmer pointed

out the irrigation system is not suitable for Boro cultivation; therefore they are not able to adapt to changes. The general crop rotations followed in the district are paddy-wheat, paddy-pulses or oilseeds, paddy-fallow-paddy, pulses-vegetables and major areas are under only one crop, mainly paddy.

Rice occupies the predominant place in the total cropped area, and mustard is the second most important crop. Share of non-food gains is still very less (merely 18% of GCA). This is an indication of very poor level of diversification and that toward inferior crops, which happens only when there is a lack of basic inputs like irrigation, access to capital, and other technology. However, there is significant inter-village variation in allocation of land toward non-food crops including jute, areca nut, sesamum, mustard, bamboo, and tea. Most of the farmers in Jorhat district utilize a part of their cultivable land for mustard, bamboo, and areca nut. This may be due to the occurrence of floods in rainy seasons that force the poor farmers to cultivate early some winter crops but less capital intensive and cultivate bamboo that can sustain in flood and protect homelands from the flood. However, for non-food-grain crops, it is irrigation that is important, as many of these crops are highly water intensive. Potato and chilly are grown mostly for home consumption like other vegetable crops by the farmers in the study area. All these above reflect the non-arrival of the Green Revolution technology at desired level, and the rural farmers have not yet fully adapted to the modern methods of cultivation.

Another important feature of surveyed area is that most of the farmers follow single cropping system. The low incidence of double cropping is due to the prevalence of traditional and subsistence farming depending primarily on rainfall with very limited irrigation facility, use of chemical fertilizer and flood and pesticide control arrangements. Moreover, there is great variation in the pattern of diversification across the survey areas in the district. This variation is in line with the disparity in share of income generated from the crop-raising activities. However, some varieties of rice are found to be grown by the sample farms. Overall, about two-third of the total sample farmers are agriculturally low crop diversified. It may be due to the impact of extreme climate hazards (especially regular flood) in the area. The low diversified farm families have an average farm size of 24.95 bigha. Per capita income of those high diversified families is much more than that of the low diversified families is much more than that of the low diversified families. Total area under cultivation and degree of

diversification have significant positive impact on earnings from agriculture, while with rising number of agricultural labourer adversely affect the agricultural earning of the families.

Picture 1: Sugarcane cultivation



Source: Internet

Picture 2: Banana Cultivation



Source: Internet

Picture 3: Crop cultivation



Source: Internet

MEASURES ADOPTED TO MITIGATE CLIMATE RISK

The study tried to focus on farmer's perceptions and adaptation strategy followed in Assam. It provides information on the farmer's response to climate change and possible factors that influence their adaptation of strategies to moderate extreme climate impacts. Diversification of crops is one of the important adaptation measures where with the changing climatic conditions farmers can choose suitable cropping pattern over the years to adjust with the changing climate and simultaneously maximize returns from agriculture in their respective region. However, geographical locations and socioeconomic conditions have important influence on the farmer's adaptability with the changing technology and climatic conditions in diversifying their crops. Sources of acquiring new knowledge or information about agricultural technologies and their cost effectiveness are important factors that also affect technology adoption. However, most of the farmers in Assam particularly the survey areas are unaware of many programs sponsored by the government to promote adaptation of new technologies. It may be due to lack of information or knowledge regarding agricultural techniques. These farmers being more tradition ridden and conservative are found to be less responsive toward the adoption of new agricultural technology. However, some farmers are ready to adopt new agricultural technology but are not in a position to adopt the improved technology at the full scale due to certain socioeconomic constraints faced by them in their daily life. Farmers produce both the modern and traditional varieties of crops simultaneously depending upon the availability of seeds and capital.

Experience of last 5 years by the respondents reveals that the entire Jorhat District has never been affected by floods but rarely do they face flood. Farmers of survey areas are reported damage of their crops due to floods and damage of some crops of a few farmers due to pests and insects are reported for the last 5 years. Farmers of survey areas are reported several adaptation measures to save their crops particularly from floods that occur frequently every year and at different times. Most of the respondents adopt early cultivation method and cultivate short period crops to save from floods and harvest early. They argued that early land preparation and plantation is associated with increased chances of survival of the crops (mainly winter paddy) from floods. Over three-fourth of the respondents preserve seedlings for sowing again if the crop is damaged due to flood during the peak monsoon time. It is clear that, despite a number of constraints faced by the farmers in the study area, there is enormous scope to diversity their crops and adaptability varies across the space with the changing

technology and environment. Adaptation and disaster mitigation requires adequate knowledge, access to suitable technology, capital and appropriate policy measures. A failure in adaptation with the changing climatic uncertainty may lead to socioeconomic disaster and jeopardize the livelihood security of the people particularly those who are dependent more on natural weather for agricultural activities.

ADAPTABILITY OF FARMERS IN RESPONSE TO CLIMATE CHANGE

Agricultural adaptation to climate risk is a relatively new field of inquiry in North-East India. Knowledge of the respondent farmers and farm size and area of holdings and share of family income from agricultural activities are found to be important factors for the diversification by the farmers. Training to the farmers and irrigation intensity however do not significantly influence crop diversity here. This may be due to the fact that training on cultivation of particular crops makes the farmers proficient on some specific crops and not on diversification needs. Also slowly growing irrigation facilities helped the small and marginal farmers to go for some staple food crops for food security, and agriculture is still at subsistence stage. In respect of adaptation, looking at the features of the farmers, it is observed that the level of education of the heads of households improves level of adaptation. Education generally increases knowledge and helps farmer to gain adaptive capacity to the changing climatic conditions and use of appropriate agro-technologies. The size of operational holding of the farmer (total cropped area) and years of cultivation experience also have significantly positive impacts on adaptation. The implication is that adaptive capacity of farmers increases with the increasing size of the landholdings and cultivation experience. However training of the farmers is found to have no impact on adaptation as the training conducted by the concerned departments are basically held to train farmers on raising crop productivity through the use of modern technology rather than on adaptation and awareness strategy toward climate change in Assam. The above discussion reveals that, in spite of many problems and limitations, the rural farmers of Assam manage to raise varieties of crops under rain-fed weather condition depending upon their availability of resources. One of the major factors hindering the proper utilization of new farm technology is the dominance of scattered tiny plots (marginal and small in size) in the state. It is needless to mention that training of farmers on available modern technology can go a long way in accelerating the agricultural production and productivity.

Most of the farmers are found to be risk averter and are sceptical in trying new varieties. It is also observed that farmers are not aware of the concept of crop planning, and the effort of the agriculture department to train the farmers is inadequate. As expected in the traditional cropping system, thus crop diversification is limited as the farmers do not have suitable facilities and supporting agro-infrastructure. Lack of climatic changes perception of the farmers in the survey area of Jorhat district is due to limited climate change effects in the area. Nature of adaptation with the changing technology and climatic conditions by some sample farmers proves that farmers are eager to adopt newer technology in their cropping activities to save their crops and moderate climate change impacts.

Table 1: Agricultural facility provided by the Government for farmers found during survey.

Facility provided by Government	Total percentage (%)	Yes (%)	No (%)	
Soil health care	100%	0%	100%	
Krishi vigyan kendra	100%	10%	90%	
Krishan call centre	100%	10%	90%	
NICRA	100%	20%	80%	
Insurance	100%	10%	90%	

Bhogdoi River collects its water from the monsoonal rain, thus it is non perennial, for this non perennial nature, the problem of flood effective in region. In this radius the bed appears to stand above the agricultural field and village.

1. At Bhurakala gaon area primary source of livelihood is agriculture and climate change has gradually started affecting this source of livelihood. During the discussion, the participants also mentioned that till about a decade back they used to raise two to four crops and used to earn enough for themselves but this has started falling down.
2. According to the union budget 2016, there are few scheme which has been launched in the favour of farmers like, *Pradhan Mantri Krishi Sinchai Yojana*, *Parampragat Krishi Vikas Yojana*, *Soil Health Card* etc.

3. According to the information obtained from agriculture information centre (ATIC) of Assam Agriculture University(AAU), Krishi vigyan Kendra have been set up in all the districts and Kisan call centres in every state to help the farmers by disseminating useful information.
4. The National initiative on climate resilient agriculture is a project which was launched in 2011, with the aim to mitigate the problem of the villages facing extreme weather condition, NICRA provide location specific climate resilience interventions to minimize production loss.
5. A majority of the farmer pointed out the irrigation system is not suitable for Boro cultivation, therefore they are not able to adapt to the changes.
6. Most farmers have not enjoyed the soil health card as yet. Moreover farmers have least idea about kisan call centre (1800-180-1551), they hardly interact with the Krishi Vigyan Kendra officials. The farmers have not adopted any agriculture insurance policy for agriculture field and other instruments.

The farmers point out that as result of climate change there has been a rise in temperature and also the frequency and intensity of flood has increase which is affecting their source of livelihood.

Most of the farmers also said that their agricultural production has gone down over the years, and this is affecting their source of income for families. Farmer also mentioned that the rate of river bank erosion also affect in agriculture field.

IMPLEMENTATION OF LEGAL ASPECTS IN CLIMATIC HAZARD

India became a signatory to the Montreal Protocol in 1992. India is an Article 5 country and is entitled to assistance from the Multilateral Fund in its efforts to phase out ODSs and switch over to non-ODS technologies. India mainly manufactured and utilized 7 of the 20 substances controlled under the Protocol. These are CFC-11, CFC113, CFC-12, Halon-1301, Halon-1211, Carbon tetrachloride, Methyl Bromide and Methyl Chloroform.⁴ In India, the implementation of the Montreal Protocol comes within the ambit of the Ministry of

⁴ Montreal Protocol [UPSC Environment & Ecology]; Available at: https://byjus.com/free-ias-prep/montreal-protocol/?utm_source=Google&utm_medium=CPC&utm_campaign=MI_IAS_BMM_Mumbai_Eligibility_Dec&utm_term=&gclid=Cj0KCOjw9b_4BRCMARIsADMUIyph7cwZQr1dn6SvHd2_WGPWBcqTfvXAJvRAIS53VfeNikwnfKenLscaAnRIEALw_wcB Accessed on: 16.07.2020.

Environment, Forests and Climate Change. The Ministry has established an Ozone Cell for the purpose of implementing the Protocol.

The Kyoto Protocol is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to reduce greenhouse gas emissions, based on the scientific consensus that (part one) global warming is occurring and (part two) it is extremely likely that human-made CO₂ emissions have predominantly caused it.⁵

The Vienna Convention for the Protection of the Ozone Layer is a multilateral environmental agreement signed in 1985 that provided frameworks for international reductions in the production of chlorofluorocarbons due to their contribution to the destruction of the ozone layer, resulting in an increased threat of skin cancer.⁶

The Paris Agreement's long-term temperature goal is to keep the increase in global average temperature to well below 2°C above pre-industrial levels; and to pursue efforts to limit the increase to 1.5 °C, recognizing that this would substantially reduce the risks and impacts of climate change. The Paris deal is the world's first comprehensive climate agreement.⁷

In India the Ministry of Environment and Forests (MoEF) is the nodal agency in the administrative structure of the Central Government for planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes.⁸ The National Action Plan on Climate Change (NAPCC) encompasses eight core missions on specific areas of Solar Energy, Enhanced Energy Efficiency, Sustainable Habitat, and Water, Sustaining the Himalayan Ecosystem, Strategic knowledge for Climate Change, Green India and Sustainable Agriculture.⁹ State Action Plans on Climate Change (SAPCC) have been prepared in line with the NAPCC to achieve coherence between the strategies and actions at national and sub-national level. Climate Change Action program (CCAP) is a central sector scheme with an objective of building and strengthening scientific & analytical capacity for climate change assessment, establishing appropriate institutional

⁵ Kyoto Protocol to the United Nations Framework Convention on Climate Change. UN Treaty Database.

⁶ Nolan, C.V.; Amanatidis, G.T. (1995), *European commission research on the fluxes and effects of environmental UVB radiation*, Journal of Photochemistry and Photobiology B: Biology

⁷ Paris Agreement, FCCC/CP/2015/L.9/Rev.1 (PDF). UNFCCC Secretariat

⁸ About MoEFCC - PARIVESH, Available at: <http://parivesh.nic.in/About.aspx>, Accessed on: 06.08.2020

⁹ Annual Report 2019-2020 Ministry Of Environment, Forest and Climate change Government of India, Available at: <http://moef.gov.in/annual-report-2019-2020/> Accessed on: 08.08.2020

framework and implementing climate related actions in the context of sustainable development at Central and State levels.¹⁰

In response to the decisions of the Conference to the Parties, India submitted its Nationally Determined Contribution for the post-2020 period to UNFCCC on 2nd October, 2015, outlining the climate actions intended to be taken under the Paris Agreement. The period of implementation for India's NDC is 2021-2030. For preparing the road map for implementation of India's NDC, the Ministry is holding inter-Ministerial consultations through an NDC Implementation Committee Chaired by Secretary, EF&CC, and six thematic Sub-committees, involving key Ministries and Departments of the Government of India.

OTHER SUCH INITIATIVES UNDERTAKEN BY GOVERNMENT OF INDIA

- Upskilling air-conditioner service technicians under Pradhan Mantri Kaushal Vikas Yojana,
- Department of Agriculture & Horticulture in Assam to provide food and nutritional security to the people of Assam and make Agriculture profitable and attractive enterprise with sustainability,
- Mukhya Mantri Krishi Sa Sajuli Yozana,
- National e-Governance Plan Agriculture (NeGP-A),
- Paramparagat Krishi Vikas Yojana(PKVY),
- National Mission on Agricultural Extension & Technology (NMAET),
- Rashtriya Krishi Vikash Yojana (RKVY),
- Assam Government has launched a Mega Mission named as Chief Minister Samagra Gramya Unnayan Yojana(CMSGUY)to double the farm income in five years.

VARIOUS LEGISLATIVE ENACTMENTS

According to Article 38 of the Constitution of India, State must secure social order for promotion of the welfare of the people and to minimize inequalities and income and endeavour to eliminate inequalities in status, facilities and opportunities. Article 39 assures right to an adequate means of livelihood. Article 39(A) speaks of free legal aid. Article 48 the Constitution of India deals with organization of Agriculture and Animal husbandry.

- The Insecticides Act, 1968

¹⁰ Ibid

- Agricultural Produce (Grading and Marking) Act, 1937
- The Seeds Act, 1966
- Protection of Plant Varieties and Farmers' Rights Act, 2001
- The Assam Agricultural Pests And Diseases Act, 1950
- Assam Farmers (Group Irrigation) Act, 1978

CONCLUSION

In the context of foregoing discussion, it is felt that there is urgent need of improving the present agricultural situation in Assam by raising the crop intensity through multiple or relay cropping and substantially raising the productivity of crops per unit of area.

It is very unfortunate that the various land reform measures undertaken in Assam have not been implemented properly to assist the farmers in their endeavours to raise agricultural production. Therefore, the following steps should be taken to implement these measures properly and if necessary by changing the existing policies.

- a) For this purpose, a drastic land distribution policy should be taken, which will break the monopoly of big farmers and help equal distribution of rural income.
- b) The agricultural land distribution policy of the Government should be such that each farmer gets sufficient land for remunerative production.
- c) In order to reduce the pressure of population on agricultural land, Government should undertake programmes for the development of rural based industry and other projects such as transport, irrigation projects, rural electrification etc. Such programmes will absorb a large labour force and thus will release the excess surplus labour force from agriculture.

SUGGESTIONS

Following the suggestions provided by the researchers in the context of the climatic hazards.

a. Development Of Agricultural Research, Education, Training And Extension Services

For the development of agriculture, the research and extension services of Assam will have to be strengthened to provide solutions of problems faced by the farmers. For this purpose,

agricultural research institution should be revitalized. The various research conducted by the Agricultural University should be based on local level problems and production oriented so that it can suit the specific needs of the state. The agro-climatic and other situations of Assam are different from other parts of the country. Assam has fertile soil for different crop cultivation, but the soil of certain area need special treatment to raise the yield of crops. Therefore, agricultural research work in the state should be directed to evolve such seeds and technology that will be most suitable for the different types of soils and climatic conditions of the state and farming technology appropriate for small and marginal farmers. Further, there must be wide publicity about the seeds and technology developed by such research work among the farmers through establishment of experimental farm and by holding field demonstrations.

b. Pest Management

As the HYV seeds are easily susceptible to pest and diseases, necessary steps should be taken to protect the crop from the ravages of pest by adopting appropriate pest management practices.

c. Irrigation And Water Management

Agricultural development depends a great deal on the availability of adequate and assured irrigation facilities. Assured irrigation especially during winter months is an imperative need for the optimum utilization of chemical fertilizers and HYV seeds. Irrigation also enables diversification of cropping pattern from the traditional mono-cropping to multiple cropping vis-a-vis increase in productivity. So, required steps should be taken in time to develop the irrigation facilities and water management system in the state. For this purpose the following measures have been suggested:

- a) Detail soil surveys should be carried out in the areas where irrigation facilities are available to find out the optimum requirements and over application of water. Incentive should be given to those farmers who save water and the motto for the farmers should be '*more crop per drop of water*'
- b) Govt. should identify areas suitable for setting up Lift Irrigation schemes and provide adequate funds for completion of schemes.

- c) To minimize wastage of water and water logging and salinity proper drainage facilities should be developed.
- d) Financial assistance should be provided to farmers for purchasing and repairing of machines, pump sets etc in time.
- e) The micro irrigation system such as drip irrigation not only saves each drop of water most efficiently, but also save the soil from getting water logged or saline. Steps should be taken to adopt and develop such schemes in the district and in the state.
- f) Water management requires substantial skill which depends upon technical knowledge of the persons involved in irrigation. So, proper training should be given to farmers and irrigation workers.
- g) High priority should be given on rural electrification.
- h) In Assam there is a wide gap between irrigation potential created and utilized. Govt. should take steps to reduce the gap.

d. Natural Hazards

Flood in Assam is main natural and regular hazard which causes much damage to crops every year in all the localities of the state; as a result, control of flood is the urgent necessary for increasing production. Actually, the flood problem of Assam is caused by the mighty river Brahmaputra and its tributaries. The problem is so severe and costly that it is not possible to tackle it by the state Govt. alone. Some part of the state is sometimes suffered from drought situation due to irregular rainfall. The following suggestions have been made to minimize the damage due to flood and drought in the district and the state:

- a) To minimize the damage early variety of paddy and short duration crops should be cultivated before the probable flood period.
- b) There are some flood resistant paddy and other crops, which should be cultivated during the flood period. Proper selection of crop rotation also help the flood affected farmers to a great extent.
- c) Flood can be controlled scientific way by constructing dams and reservoir in flood prone area.

- d) Proper irrigation facilities can minimize the effect of drought in drought prone areas.
- e) The flood problem in Assam should be recognizing as a National Problem and Government both a State and Union should think for permanent solution.
- f) For all these, research is essential and Govt. should install such research centre under the guidance of reputed scholars in the line.

Agriculture is strongly influenced by weather and climate. While farmers are often flexible in dealing with weather and year-to-year variability, there is nevertheless a high degree of adaptation to the local climate in the form of established infrastructure, local farming practice and individual experience. Climate change has significant economic effects on agriculture including changes in farm productivity cropping pattern, profitability price, supply and trade. The variability of climate poses major challenge for the large peasantry and small farmers. Climate change can therefore be expected to impact on agriculture, potentially threatening established aspects of farming systems but also providing opportunities for improvements.