Agronomic Dynamics of Maximizing Crop Production in South West Agro-Ecological Zones of Bangladesh as Influenced by Climate Change

Md. Abul Hashem
Agriculture Extension Specialist
Southwest Area Integrated Water Resources Planning and Management Project-AF
Bangladesh Water Development Board

Abstract

Now-a-days crop production is hindered by climate such as heavy rainfall, flood, hail strom, cyclones etc. So, it is crying need to adopt dynamic crop production tehnologies to increase crop production as well as tocope up with adverse effect of climate changes.However, the present study is conducted to identify the changed climate vulnerable field crop yield factors, to assess the AEZ soil and agro-climatic parameters reducing crop production and to know the South west AEZ based agronomic crops. Data were collected from the capital and the field level conducting interview, discussion and observation using primary source i.e. interview with the respondents from the selected study areas. Primary data were collected through interview. Data were also collected from secondary source through literature review i.e. reference books, newspapers, periodicals, articles from national and international level. Internet sources have been used for research. An attempt was made to include the latest information whenever available. The nature of the study requires combining analytical and empirical approaches in the methodology. Accordingly, both qualitative and quantitative information and data were required. In order to generate database of the study, all necessary information were collected from different primary and secondary sources. Data were also analyzed and presented through the use of necessary figures, tables and charts. From the result it was found that AEZ 13 Khulna Koira showed highest vulnerability 64 % as maximum and AEZ 12 Faridpur Sodor 30% as lowest. Summer season Kharif 1 was found to highest vulnerable as 59%. Rainy season was less vulnerable crop production as 36%.Wide disparities in the level of crop sector development had been observed across the regions. The overall results reveal that some of the regions are in better positions in respect of socio-economic progress, land use pattern, input use, growth performance of HYV rice and food-grains production. The developed regions were 'Old Himalayan Piedmont Plain and Tista Floodplain', 'Karatoya Floodplain and Atrai Basin', 'Brahmaputra-Jamuna Floodplain' and 'Middle Meghna River Floodplain' on the basis of land utilization pattern, input use and food-grains production. Analysis of regional disparities reveals that 'Sylhet Basin and Surma-Kusiyara Floodplain', Greater Dhaka', 'Middle Meghna River Floodplain' and 'Lower Meghna River and Estuarine Floodplain' regions have developed remarkably in the last twenty years.

Key Words: *Crop Production, AEZ, Climate Change, Coping mechanism*

INTRODUCTION

The potential impacts of climate change on agriculture are highly uncertain. The large number of studies conducted over the past few years for many different sites across the world show few, if any, robust conclusions of either the magnitude or direction of impact for individual countries or regions. Where apparent consensus exists it frequently appears to occur because only one or two studies have been conducted using a single climate scenario. Many such studies have focused on doubled (2xCO2,) General Circulation Model (GCM) equilibrium scenarios.

Potential future climate changes are also made more uncertain because of the recently recognized role of sulphate aerosols which may partly offset the warming expected from increased concentrations of CO2, methane, nitrous oxide and other radiatively active trace gases. The significant spatial variation in sulphate aerosol concentrations means that the regional pattern of climate change may be quite different from that simulated on the basis of CO2increase alone. The short lifetime of aerosols in the atmosphere (a few days) means that if the use of high sulphur coal in India or China increases or efforts to control sulphur emission in the United States or Europe are intensified, the spatial pattern of climate change could change significantly within a relatively short period of time due to changes in the aerosol cooling effect.

Different impact methodologies also yield widely varying results of the direct impacts of climate change on crop yields and agricultural production even when examining the same region and the same climate scenarios. The socio-economic environment, agricultural technology and natural resource base will also necessarily undergo profound changes over the next 100 years whether agriculture meets the many challenges of feeding the world's growing population or fails to do so.

The robust conclusion that does emerge from impact studies is that climate change has the potential to change significantly the productivity of agriculture at most locations. Some currently highly productive areas may become much less productive. Some currently marginal areas may benefit substantially while others may become unproductive. Crop yield studies show regional variations of +20, 30 or more per cent in some areas and equal size losses in other areas. Most areas can expect change and will need to adapt, but the direction of change, particularly of precipitation, and required adaptations cannot now be predicted. Nor may it ever be possible to predict them with confidence. Current evidence suggests that pole ward regions where agriculture is limited by short growing seasons are more likely to gain while subtropical and tropical regions may be more likely to suffer drought and losses in productivity. However, these broad conclusions hardly provide the basis for mapping out a long-term strategy for agricultural adaptation. Thus, policy must retain flexibility to respond as conditions change.

A further issue is how do climate change impacts on agricultural production fit within the other pressing challenges facing agriculture in different regions of the world. Is climate changing a minor threat, likely to be undetected among the many changes that will reshape the agricultural sectors of the world's economies? Or is it another critical challenge to an agricultural sector straining to cope with a growing population, resource degradation, tighter constraints on available resources, and exhaustion of technological capabilities to expand production using existing land and water resources?

It is useful to place some of the 2xCO2 agricultural projections in the context of other future projections. If we accept long-term demographic trends, the largest absolute addition to the world's population will occur during the decade of the 1990s, the growth rate having already slowed from that of the 1950s and 1960s. By the time 2xCO2 climate scenarios are expected to be realized (sometime around 2100 or later), the world population will have stabilized and agricultural research will no longer face the challenge of increasing productivity to keep up with a growing population.

Therefore, there is a need for more specific analysis about how climate will change over the next 10, 20 or 30 years rather than over the next 100. It also provides a caution not to consider our response to climate change apart from our response to the immediate needs of agriculture: feeding a growing population where presently an estimated 740 million people still suffer from hunger and malnutrition while maintaining the productivity of basic agricultural resources and meeting the demands placed on agriculture to minimize damage to the environment.

This paper will: (1) briefly discuss the major methodologies used to estimate impacts of climate change as different models lead to substantially different estimates of climate change impacts; (2) review the broad literature reporting results of crop yield studies of climate change conducted for many different areas (how much (or little) do we know?); (3) review the set of estimates that has been made for global agricultural production and what it means for regional agricultural impacts; (4) discuss the issue of vulnerability, adding a precise definition, while reviewing some of the vulnerability concepts that have been used in the literature; and (5) review specific issues of adaption - how can the world's agricultural system, or more to the point, those populations highly dependent on agriculture, make themselves less likely to suffer loss from climate change.

Climate change is a problem that is affecting people and the environment. Historically, Bangladesh is most susceptible countries of the world in the negative impact of climate change. The coastal population is one of the worst affected areas to attune such variations. Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind, sea level rise, extreme events) lasting for an extended period (decades or longer) pose risks for ecosystems, food security, water resources, human health, settlement and society. Greater energy efficiency and new technologies hold promise for reducing greenhouse gases (such as Carbon dioxide- CO_2, Methane- CH_4, Nitrous oxide- N_2O, water vapor, while others are synthetic. Those that are man-made include the chlorofluorocarbons-CFCs, Hydro-fluorocarbons-HFCs, Per-fluorocarbons-PFCs, Sulphur hexafluoride- SF_6) and solving this global challenge. Greenhouse gases and certain synthetic chemicals, trap some of the Earth’s outgoing energy, thus retaining heat in the atmosphere. Reducing, reusing and recycling solid waste can decrease the amount of heat-trapping greenhouse gases released.

There are a wide variety of meteorological phenomena, which pose a threat to the coastal zones. They could be roughly listed the following: Floods/flash floods, cloud burst, heavy precipitation; Tropical cyclones and their associated storm surges; Severe convective storms - thunderstorms, hailstorms, tornadoes, lightening, dust storms, sand storms; Heat wave and cold wave; Snow avalanches; Sea erosion etc. The spatial and temporal scales of these hazards vary widely from short-lived, violent phenomena of limited extent (e.g. severe thunderstorms), through large systems (e.g. tropical cyclones). These events can subject large regions to disastrous weather phenomena like strong winds, heavy flood-producing rains, storm surges and coastal flooding, heavy snowfall, blizzard conditions, freezing rain and extreme hot or cold temperature conditions for periods of several days. With this wide variety of the scales of weather phenomena, the requirements of meteorological and hydrological forecasting for effective early warning of these hazards also vary spanning over a very broad spectrum.

These can range from very short range forecasts of less than one hour in the case of severe thunderstorms and flash floods; through short and medium range forecasts of from a few hours to days for tropical cyclones, heavy rains, extreme temperatures and high winds.

According to the 3rd assessment report of IPCC, South Asia is the most vulnerable region of the world to climate change impact (Mc Cathie, et.al-2001). Bangladesh ranks high in respect of vulnerability due to its topography and other factors such as hydro geological and socio-economic factors mentioned below:

1. Its Geographical location in South Aisa
2. The Ganga-Bramaputra-Meghna Catchments area includes a great diversity of Physical environment
3. Its flat deltaic topography with very low elevation
4. Its extreme climate variability that is governed by monsoon and which results in acute water distribution are space and time.

It may be mentioned here that there are four main seasons recognized according to monsoon. Those are:
a. Pre monsoon (March-May)
b. Monsoon (June-September)
c. Post Monsoon (October- November)
d. Dry Season (winter)

5. Life style of costal people
6. High population density and poverty incident.
7. Major population depending upon Agriculture and livelihood depends on climate variability and change.

At present Bangladesh has experienced that due to climate change the frequency and intensity of these disasters have increased. These disasters, as happened in the past, continue to impact seriously on the society in terms of human casualties, economic and social losses, disruption of livelihoods, and degradation to environment also affecting health and sanitation and availability drinking water.

OBJECTIVES OF THE STUDY

The major objectives of the studyare mentioned as below:

1. To identify the changed climate vulnerable field crop yield factors.
2. To assess the AEZ soil and agro-climatic parameters reducing crop production.
3. To know the South west AEZ based agronomic crops.

METHODOLOGY

Research methodology is a collective term for the structured process of conducting research. It usually encompasses the procedures followed to analyze and interpret the data gathered. This research study is descriptive-cum-empirical as well as suggestive in nature. The study is survey type. The present study has been included secondary resources consisting of books, newspapers, periodicals, articles from national and international level. Internet sources have been used for the research. Attempts have been made to include the latest information whenever available. At the same time primary data have been collected through interview with some officials and experts on the topic.

Source of Data

Data were collected from the capital and the field level conducting interview, discussion and observation using primary source i.e. interview with the respondents from the selected study areas. Primary data were collected through interview. Data were also collected from secondary source through literature review i.e. reference books, newspapers, periodicals, articles from national and international level. Internet sources have been used for research. An attempt was made to include the latest information whenever available. The nature of the study requires combining analytical and empirical approaches in the methodology. Accordingly, both qualitative and quantitative information and data were required. In order to generate database of the study, all necessary information were collected from different primary and secondary sources. Data were also analyzed and presented through the use of necessary figures, tables and charts.

Tools of Data Collection

In the empirical study field work plays an integral role. The study relied on four main data collection tools namely: in-depth interview guideline/checklist; observation of respondent, cross checking of data collected from field using mobile/telephone and review of related documents. All these tools are closely related. Although different approaches were applied in this study, the main purpose was to ensure that they complemented each other. The findings were presented in table and narrative way because this thesis is both quantitative and qualitative in nature.

Methods of Data Collection

Researcher conducted the face to face interview with the respondents of the study areas. As per the plan for data collection the researcher communicated the concerned officials by emails, telephone/ mobile phone for appointment with the respective respondents. The researcher took help of his colleagues and friends during conducting data collection.

Variables

A. Site-
   1. AEZ 12 District Faridpur
   2. AEZ 13 District Khulna
   3. AEZ 14 district Gopalganj

B. Crops
   1. Cereal
   2. Vegetables
   3. Fruits

C. AEZ Parameters
   1. Agro-climatic factors
   2. Soil factors
   3. Land factors

Sample Population: At least 100 from each Professional group balancing other variable criteria with sufficient diversity found.

Data Analysis

Collected data were tabulated and analyzed by using computer program SPSS & Microsoft Excel.

RESULTS AND DISCUSSION

The results obtained from the present studies are presented and described here.The major respondent groups were Agri Officers, College teachers and Public representatives and related stake holders.The results found from the research are presented in the Tables 1 to 3 and also in Figures.

Cereal production vulnerability

The results found as to the percentage of cereal production vulnerability are given here. The results show that AEZ 13 Khulna Koira showed highest vulnerability 64 % as maximum and AEZ 12 Faridpur Sodor 30% as lowest summer season Kharif 1 was found to highest vulnerable as 59%. Rainy season was less vulnerable crop production as 36%.

Table 1: Cereal production vulnerability %

AEZ Site	Winter Nov-April	Sum Kharif 1 Mar-Aug	Rainy Kharif 2 Jul-Dec	Mean
AEZ 12 Faridpur Sodor	33	47	11	30
AEZ 12 Faridpur Bhanga	37	56	24	39
AEZ 13 Khulna Botiaghata	54	71	36	54
AEZ 13 Khulna Koira	63	83	45	64
AEZ 14 GopalganjSodor	47	43	36	42
AEZ 14 GopalganjTungipara	54	56	38	49
Mean	48	59	32	46

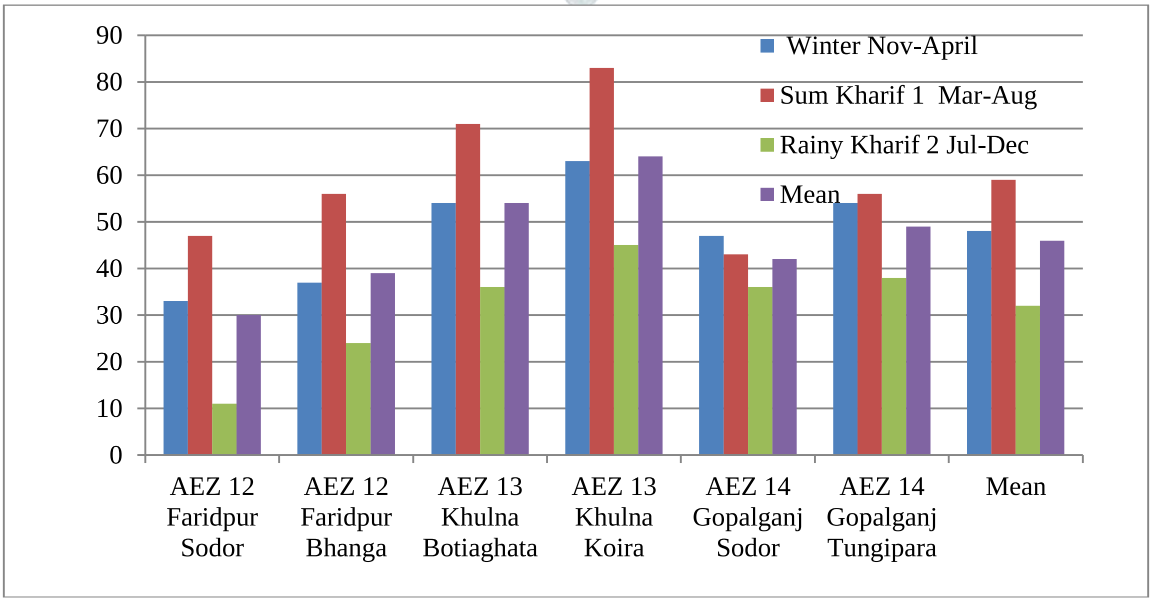

Fig. 1: Cereal production vulnerability % as per season

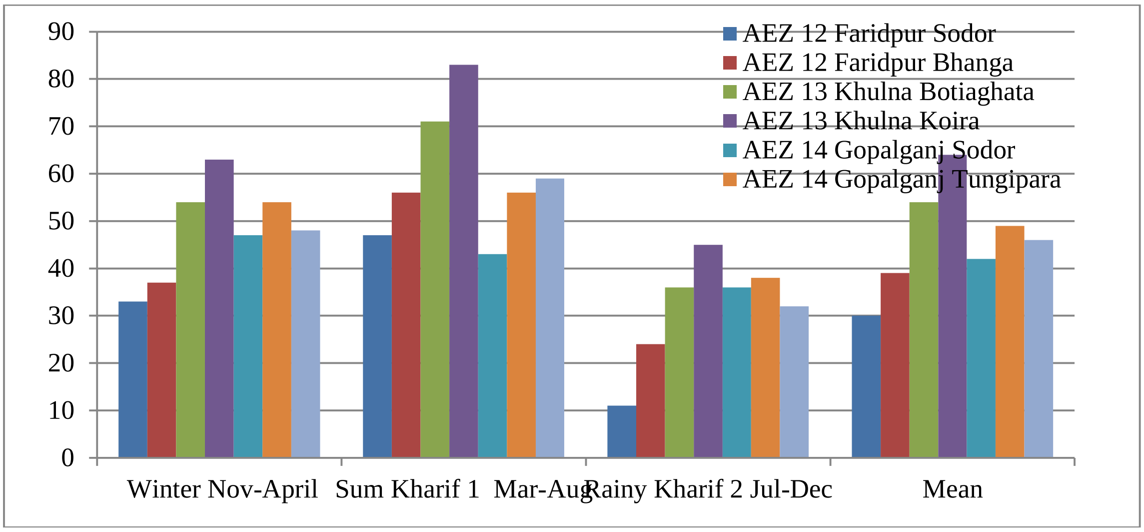

Fig. 2: Cereal production vulnerability % as per AEZ

Vegetable production vulnerability

Table 2: Vegetable production vulnerability %

	Winter Nov-April	Sum Kharif 1 Mar-Aug	Sum Kharif 2 Jul-Dec	Mean
AEZ 12 FaridpurSodor	53	47	41	47
AEZ 12 FaridpurBhanga	57	56	24	46
AEZ 13 Khulna Botiaghata	74	61	66	67
AEZ 13 Khulna Koira	83	83	45	70
AEZ 14 GopalganjSodor	57	43	46	49
AEZ 14 GopalganjTungipara	54	56	48	53
Mean	63	58	45	55

The results found (Table 2) and Figs as to the percentage of vegetable production vulnerability are given here. The results show that AEZ 13 Khulna Koira showed highest vulnerability 70 % as maximum and AEZ 12 FaridpurSodor 46% as lowest winter season was found to highest vulnerable as 63%. Rainy season was less vulnerable crop production as 45%.

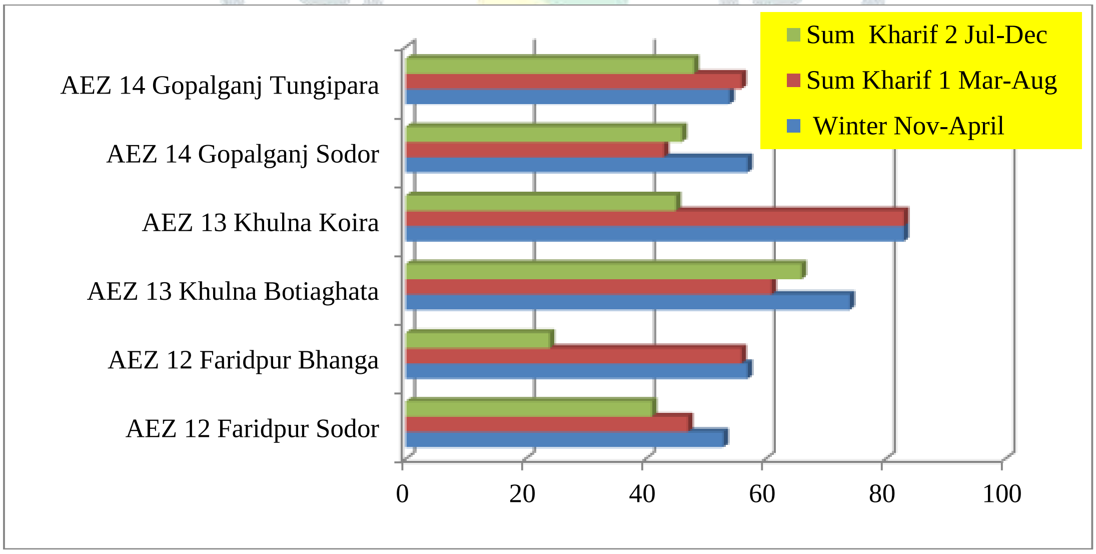

Fig. 3: Vegetable production vulnerability as per season

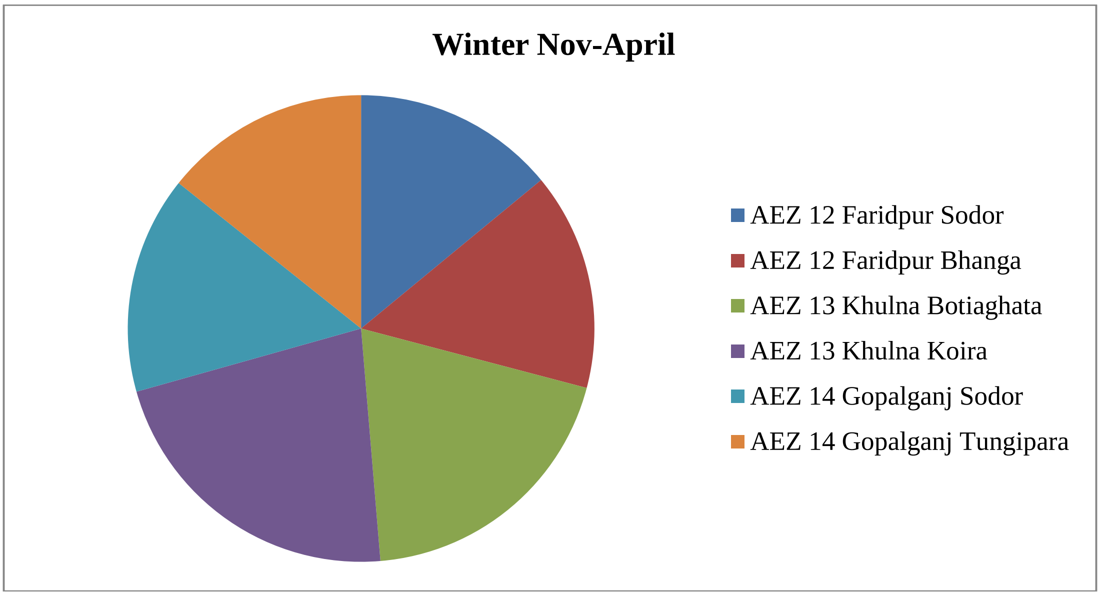

Fig. 4: Vegetable production vulnerability as per winter season

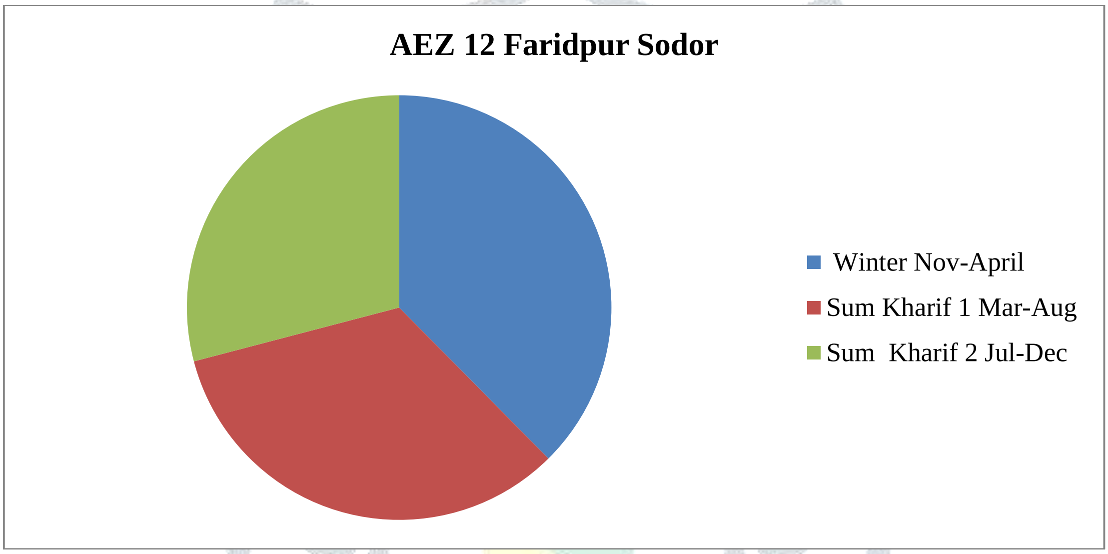

Fig. 5: Vegetable production vulnerability as for Faridpur AEZ 12

Fruit production vulnerability

Table 3: Fruit production vulnerability %

	Rabi winter Nov-April	Kharif 1 Mar-Aug	Kharif 2 Jul-Dec	Mean
AEZ 12 Faridpur Sodor	73	67	41	60
AEZ 12 Faridpur Bhanga	67	56	54	59
AEZ 13 Khulna Botiaghata	50	41	26	39
AEZ 13 Khulna Koira	42	65	41	49
AEZ 14 Gopalganj Sodor	57	52	46	52
AEZ 14 Gopalganj Tungipara	54	66	38	53
Mean	57	58	41	52

The results found (Table 3) and Figs as to the percentage of fruits production vulnerability are given here. The results show that AEZ 12 Faridpur Sodor showed highest vulnerability 60 % as maximum and AEZ 13 Khulna Koira 49% as lowest summer season was found to highest vulnerable as 58%. Rainy season was less vulnerable crop crop production as 41%.

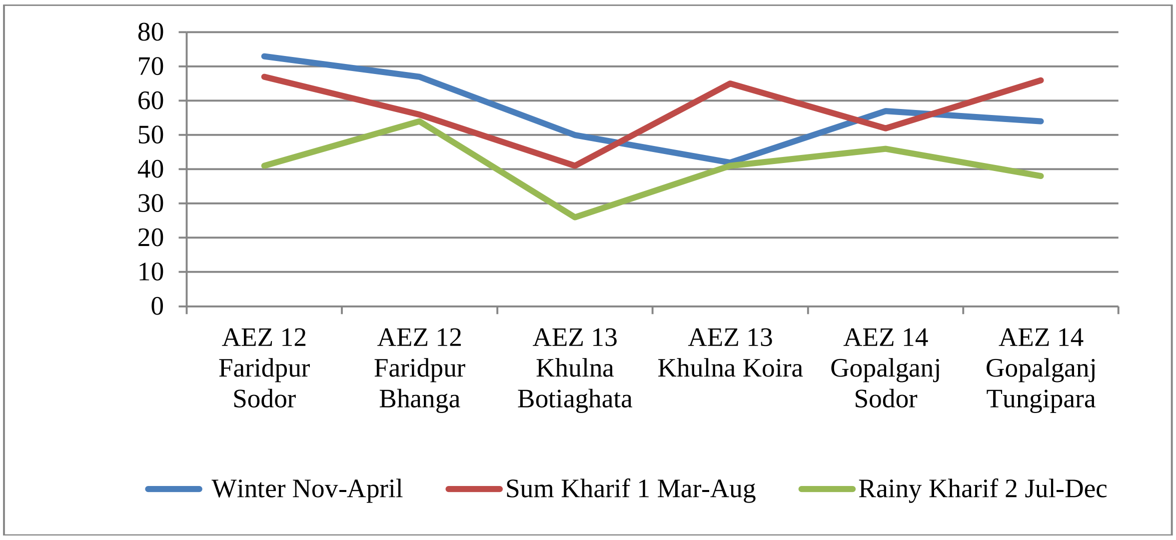

Fig 6. Fruit production vulnerability as per season

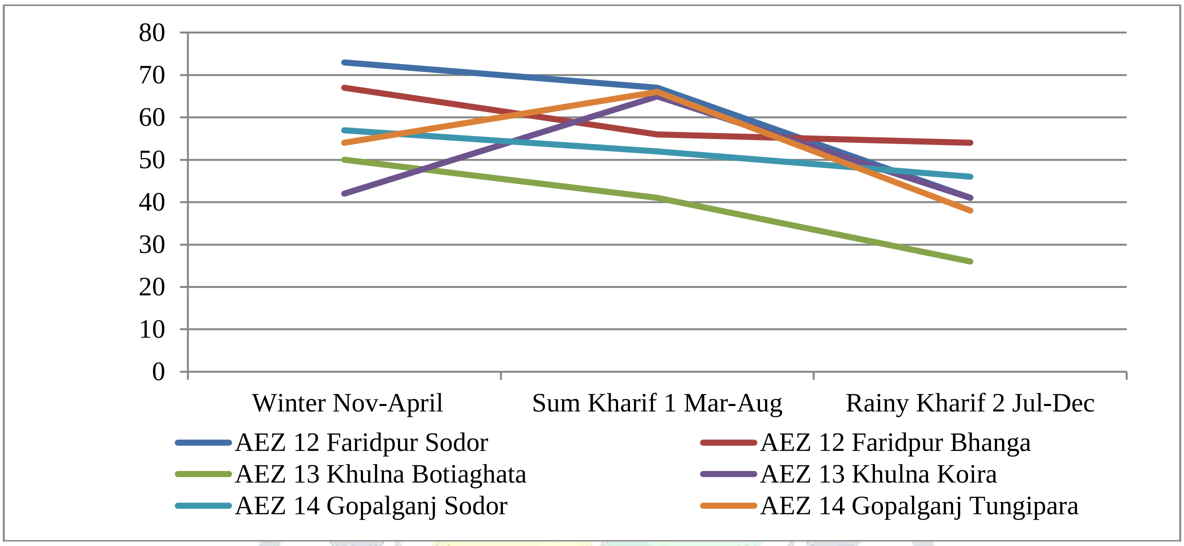

Fig. 7: Vegetable production vulnerability as per AEZ

The factors affecting crop vulnerability was found to be mostly related to soil moisture extreme temperature range and soil and water salinity which was significantly affected by climatic changes.

SUMMARY AND RECOMMENDATIONS

The results obtained from the present studies are presented and described here based on the variables:

A. Site: AEZ 12 District Faridpur, AEZ 13 District Khulna
AEZ 14 district Gopalganj
B. Crops: Cereal. Vegetables Fruits
C. AEZ Parameters: Agro-climatic factors, Soil factors, Land factors.

The major respondent groups were Agri Officers, College teachers and Public representatives and related stake holders.The results found from the research are summarized here.

Cereal production vulnerability

The percentage of cereal production vulnerability is given here. The results show that AEZ 13 Khulna Koira showed highest vulnerability 64% as maximum and AEZ 12 Faridpur Sodor 30% as lowest summer season Kharif 1 was found to highest vulnerable as 59%. Rainy season was less vulnerable crop production as 36%.

Vegetable production vulnerability

The percentages of vegetable production vulnerability are given here. The results show that AEZ 13 Khulna Koira showed highest vulnerability 70 % as maximum and AEZ 12 Faridpur Sodor 46% as lowest winter season was found to highest vulnerable as 63%. Rainy season was less vulnerable crop production as 45%.

Fruit production vulnerability

The percentage of fruits production vulnerability show that AEZ 12 Faridpur Sodor showed highest vulnerability 60% as maximum and AEZ 13 Khulna Koira 49% as lowest Summer season was found to highest vulnerable as 58%.

Rainy season was less vulnerable crop production as 41%.The factors affecting crop vulnerability was found to be mostly related to soil moisture extreme temperature range and soil and water salinity which was significantly affected by climatic changes.

The following conclusion and recommendations may be made from present research program.The cereal cultivation including Wheat, maize, minor cereals may be limited to north Khulna AEZ 13 (a) to (d). However rice cultivation may extend to south but soil reclamation should be done.

Vegetables and fruit production may be done if irrigation by sweet water is ensured.Any attempt which influences climate change should be avoided making appropriate policies in the disaster management strategies of the country.

REFERENCES

1. Adger, W.N. 2006. Vulnerability. Global environmental change. Vol 16. pp 268-281
2. Agarwal, B. 1997. Gender, Environment and Poverty Interlinks: Regional Variations and Temporal shifts in Rural India, 1971-91", World Dev 25-1: 23-52.
3. Al-Amin and Siwar, C 2006. Globalization, Economic Growth, Poverty and Environmental Degradation in Third World Countries: A Review.' Paper presented at the 3rd International GSN Conference, UKM, Malaysia, 21-23
4. Al-Amin, Siwar, C Hamid, A & Huda, N 2007c. Trade liberalization & pollution: an environmental input-output analysis of air emissions in Malaysia.'paper for ecological modeling for sustainable development conference, Penang, Malaysia, 2007.
5. Al-Amin, Siwar, S Hamid, A & Huda, N 2007b. Pollution implications of electricity generation in Malaysian economy: An input-output approach.' Paper for Singapore AERC Conference, 2007, Singapore.
6. Amin, M. S. 1989. The Disaster Flood- 1987-88: The Causes and Rehabilitation Agro-technologies. Edited. Bangladesh Agricultural Research Council Ministry of Agriculture. GOB.
7. Amin, M. S. 1992. Natural hazards and appropriate crop production technology in Bangladesh. Proceeding of the First Biennial Conference of the Crop Science Society of Bangladesh. Advances in Crop Science. 158-167. Bangladesh Agricultural University Mymensingh.
8. Amin, M.S.; Anwar, I 1990. Hailstorms in Bangladesh and its Rehabilitation. Bangladesh Agricultural Research Council. Ministry of Agriculture. GOB.
9. Amin, M.S.; Anwar, I and Huq, S. M. I. 1990. Flood in Bangladesh and its Rehabilitation. Bangladesh Agricultural Research Council Ministry of Agriculture. GOB.
10. Amin, M.S.; Anwar, I and Rahman S. F. 1990. Tornados in Bangladesh and its Rehabilitation. Bangladesh Agricultural Research Council Ministry of Agriculture. GOB.
11. Gallopin, G. C. 2006. Linkages between vulnerability, resilience and adaptive capacity. Global Environmental Change. Vol 16.293-303
12. Lele, S.M 1991. Sustainable Development: A Critical Review", World Development, Vol.19, No.6, pp.607-621.
13. Nicholls, R.J. and Mimura, 1998. Regional issues raised by sea-level rise and their policy implications, Climate Research, 11(1), 5-18.
14. Smit, B. and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change. Vol 16, pp 282-292.
15. World Bank 1992. China's Environmental Strategy Paper, Washington DC.
16. World Common Environ and Dev 1987. Our Common Future, Oxford University Press, Oxford.