Agrarian and Environmental Factors of Crop Production in the North-East Lowland Agro-Ecological Zones of Bangladesh under the Influenced of Climate Change

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Abstract

The purpose of this study is to evaluate the progress and regional variations of crop production in Bangladesh. The secondary data were used and collected for the years 1980-81 to 2002-03 from the 'Statistical Yearbooks of Bangladesh', 'Yearbook of Agricultural Statistics' and population census of different years. The study was conducted during the period from September 2006 to February 2008. An analysis was done for twelve mutually exclusive agroecological zones by assigning various indicators of crop sector development. The remarkable progress of rural literacy rate, ratio of agricultural workers to population, number of farmer's co-operative societies and per capita regional domestic agricultural products in two decades was observed in different regions. 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 socioeconomic 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 has developed remarkably in the last twenty years.

Keywords: *Crop production, Development indicator, Growth performance, Regional variation.*

INTRODUCTION

Agriculture sector plays an important role in overall economic development of Bangladesh. The agricultural sectors (crops, animal farming, forests and fishing) contributes 14.74 percent to the country's GDP, provides employment about 41 percent of the labour force according to Quarterly Labour Force Survey 2015-16. Moreover, agriculture is the source of wide range of consumer demanded agricultural commodity markets, especially in rural areas. Achieving the target of self-sufficiency in food is one of the goals of the present Government. To attain this goal the Government has placed highest importance on the overall development of agriculture sector.

With a view of developing the agriculture sector, the Government has taken a number of steps. These include expansion of small irrigation facilities, reduction of water logging, production of improved quality and high yielding varieties of seeds and their preservation and distribution. Agricultural research has been given special priority for the development and expansion of the draught and saline tolerant varieties, short-duration crops and varieties of crops adaptable to the weather and environment of a particular region and producing crops suitable for a particular kind of soil as well as proper use of fertilizer and Integrated Pest Management (IPM) for pest control. Saline tolerant and short duration crop variety and technology have been invented using nuclear technology and bio-technology. Saline tolerant crop varieties have extended the coverage of rice cultivation in the vast coastal areas of southern region. Steps have been taken to scale up subsidy on agricultural inputs, ensure fair price and supply of agricultural inputs. Moreover, expansion of irrigation facilities and increased availability of irrigation instrument, agriculture extension as per target, quality control of agricultural products and ensuring sufficient storage facility of food grains have been scaled up. Implementation of various programmes are underway to increase food production by expanding the coverage of agricultural land and by creating the opportunities of multiple cropping line of expansion of irrigation by using ground water in various regions of the country, reduction of water logging and planned drainage of water in haor areas.

Table 1: Most vulnerable countries to floods and cyclones, UNDP (2004)

CYCLONES			FLOODS		
Sl	**Country**	**Death/100,00 people exposed**	**Sl**	**Country**	**Death/100,00 people exposed**
1	Venezuela	4.9	1	Bangladesh	32.1
2	Afghanistan	4.3	2	India	20.2
3	Pakistan	2.2	3	Philippines	8.3
4	China	1.4	4	Honduras	7.3
5	India	1.2	5	Vietnam	5.5
6	Bangladesh	1.1	6	China	2.8

Source: Extracted from Bangladesh Climate Change Strategy and Action Plan, Ministry of Environment and Forests, Government of Bangladesh, 2009.

As table 1 suggests, Bangladesh is highly vulnerable to cyclones and floods because of its geographic location, flat and low-lying topography, and other socioeconomic difficulties. Many of the anticipated adverse effects of climate change, such as sea-level rise, higher temperatures, enhanced monsoon precipitation, and an increase in cyclone intensity, will aggravate the existing stresses that already impede development in Bangladesh, particularly by reducing water and food security and damaging essential infrastructure. Such impacts will harm the economy, natural ecosystems, national development, and the people of Bangladesh. The government of Bangladesh acknowledges that the projected climate change impacts that the country is facing will result in:

- Increased flooding, both in terms of extent and frequency, associated with sea-level rise, greater monsoon precipitation and increased glacial melt;
- Increased vulnerability to cyclone and storm surges;
- Increased moisture stresses during dry periods leading to increased drought;
- Increased salinity intrusion
- Greater temperature extremes.

Government Report, 2008

Source: Relief Web http://reliefweb.int/map/bangladesh/bangladesh-major-river-basin

OBJECTIVES OF THE STUDY

In the context, the present research program was undertaken with the following major objectives:

1. To identify the factors of climate sensitive and vulnerable production factors.
2. To assess the North-East agro-climatic parameters influencing Agrarian livelihood.
3. To know the Haor beel based AEZ crops.

METHODOLOGY

Methodology shows the approach by which the study is accomplished. It includes some sequential steps that are required for performing the study effectively. This study is mainly based on primary and secondary data through which the study is completed.

Data Collection
For conducting this research, both primary and secondary data were collected and analyzed.

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.

Methods of Data Collection
Researcher conducted the face to face interview with the respondents of the study areas.

Variables
The research program formulated here is a type of technical field investigation comparing with previous performances. The main variables of the studies are:

A. Site-

i. AEZ 20 District Sylhet, Habiganj, Moulvibazar

ii. AEZ 21 District Sunamganj, Netrokona

iii. AEZ 19 district Kishoreganj BBaria

B. Production

i. Rice ii. Fish iii. Upland crops

C. AEZ Parameters

i. Agro-climatic factors ii. Hydrology iii. KPET factors

Sample Population: 150-200 from each Greater district

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

Data Analysis: All the processed information was analyzed to fulfill the objective of the study. Different statistical tools and figures were used here to amalgamate the information collected from the secondary sources.

Questionnaire Guideline

1. Cereal (Rice) yield become vulnerable – Name three sites and Season

	District	Upazila	Season	
AEZ 19	Kishoreganj	Itna	Rabi/Kh1/Kh2	
	BBaria	Nasirnogor	Rabi/Kh1/Kh2	
AEZ 20	Sylhet	Bishanath	Rabi/Kh1/Kh2	
	Sylhet	Beanibazar	Rabi/Kh1/Kh2	
	Habiganj	Bahubal	Rabi/Kh1/Kh2	
	Moulvibazar	Srimangal	Rabi/Kh1/Kh2	
	Moulvibazar	Borolekha	Rabi/Kh1/Kh2	
AEZ 21	Sunamganj	Tahirpur	Rabi/Kh1/Kh2	
	Sunamganj	Dherai	Rabi/Kh1/Kh2	
	Netrokona	Kolmakanda	Rabi/Kh1/Kh2	
	Netrokona	Mohanganj	Rabi/Kh1/Kh2	

2. Upland crop yield become vulnerable – Name three sites and Season

	District	Upazila	Season
AEZ 19	Kishoreganj	Itna	Rabi/Kh1/Kh2
	BBaria	Nasirnogor	Rabi/Kh1/Kh2
AEZ 20	Sylhet	Bishanath	Rabi/Kh1/Kh2
	Sylhet	Beanibazar	Rabi/Kh1/Kh2
	Habiganj	Bahubal	Rabi/Kh1/Kh2
	Moulvibazar	Srimangal	Rabi/Kh1/Kh2
	Moulvibazar	Borolekha	Rabi/Kh1/Kh2

AEZ 21	Sunamganj	Tahirpur	Rabi/Kh1/Kh2
	Sunamganj	Dherai	Rabi/Kh1/Kh2
	Netrokona	Kolmakanda	Rabi/Kh1/Kh2
	Netrokona	Mohanganj	Rabi/Kh1/Kh2

3. Fish yield become vulnerable – Name three sites and Season

	District	Upazila	Season
AEZ 19	Kishoreganj	Itna	Rabi/Kh1/Kh2
	BBaria	Nasirnogor	Rabi/Kh1/Kh2
AEZ 20	Sylhet	Bishanath	Rabi/Kh1/Kh2
	Sylhet	Beanibazar	Rabi/Kh1/Kh2
	Habiganj	Bahubal	Rabi/Kh1/Kh2
	Moulvibazar	Srimangal	Rabi/Kh1/Kh2
	Moulvibazar	Borolekha	Rabi/Kh1/Kh2
AEZ 21	Sunamganj	Tahirpur	Rabi/Kh1/Kh2
	Sunamganj	Dherai	Rabi/Kh1/Kh2
	Netrokona	Kolmakanda	Rabi/Kh1/Kh2
	Netrokona	Mohanganj	Rabi/Kh1/Kh2

4. Livelihood standard decreasing – Name three sites and Season

	District	Upazila	Season
AEZ 19	Kishoreganj	Itna	Rabi/Kh1/Kh2
	BBaria	Nasirnogor	Rabi/Kh1/Kh2
AEZ 20	Sylhet	Bishanath	Rabi/Kh1/Kh2
	Sylhet	Beanibazar	Rabi/Kh1/Kh2
	Habiganj	Bahubal	Rabi/Kh1/Kh2
	Moulvibazar	Srimangal	Rabi/Kh1/Kh2
	Moulvibazar	Borolekha	Rabi/Kh1/Kh2
AEZ 21	Sunamganj	Tahirpur	Rabi/Kh1/Kh2
	Sunamganj	Dherai	Rabi/Kh1/Kh2
	Netrokona	Kolmakanda	Rabi/Kh1/Kh2
	Netrokona	Mohanganj	Rabi/Kh1/Kh2

5. Flash flood increasing – Name three sites and Season

	District	Upazila	Season
AEZ 19	Kishoreganj	Itna	Rabi/Kh1/Kh2
	BBaria	Nasirnogor	Rabi/Kh1/Kh2
AEZ 20	Sylhet	Bishanath	Rabi/Kh1/Kh2
	Sylhet	Beanibazar	Rabi/Kh1/Kh2
	Habiganj	Bahubal	Rabi/Kh1/Kh2
	Moulvibazar	Srimangal	Rabi/Kh1/Kh2
	Moulvibazar	Borolekha	Rabi/Kh1/Kh2
AEZ 21	Sunamganj	Tahirpur	Rabi/Kh1/Kh2
	Sunamganj	Dherai	Rabi/Kh1/Kh2
	Netrokona	Kolmakanda	Rabi/Kh1/Kh2
	Netrokona	Mohanganj	Rabi/Kh1/Kh2

6. Crop hazards increasing – Name three sites and Season

AEZs	District	Upazila	Season
AEZ 19	Kishoreganj	Itna	Rabi/Kh1/Kh2
	BBaria	Nasirnogor	Rabi/Kh1/Kh2
AEZ 20	Sylhet	Bishanath	Rabi/Kh1/Kh2
	Sylhet	Beanibazar	Rabi/Kh1/Kh2
	Habiganj	Bahubal	Rabi/Kh1/Kh2
	Moulvibazar	Srimangal	Rabi/Kh1/Kh2

	Moulvibazar	Borolekha	Rabi/Kh1/Kh2
AEZ 21	Sunamganj	Tahirpur	Rabi/Kh1/Kh2
	Sunamganj	Dherai	Rabi/Kh1/Kh2
	Netrokona	Kolmakanda	Rabi/Kh1/Kh2
	Netrokona	Mohanganj	Rabi/Kh1/Kh2

RESULTS AND DISCUSSION

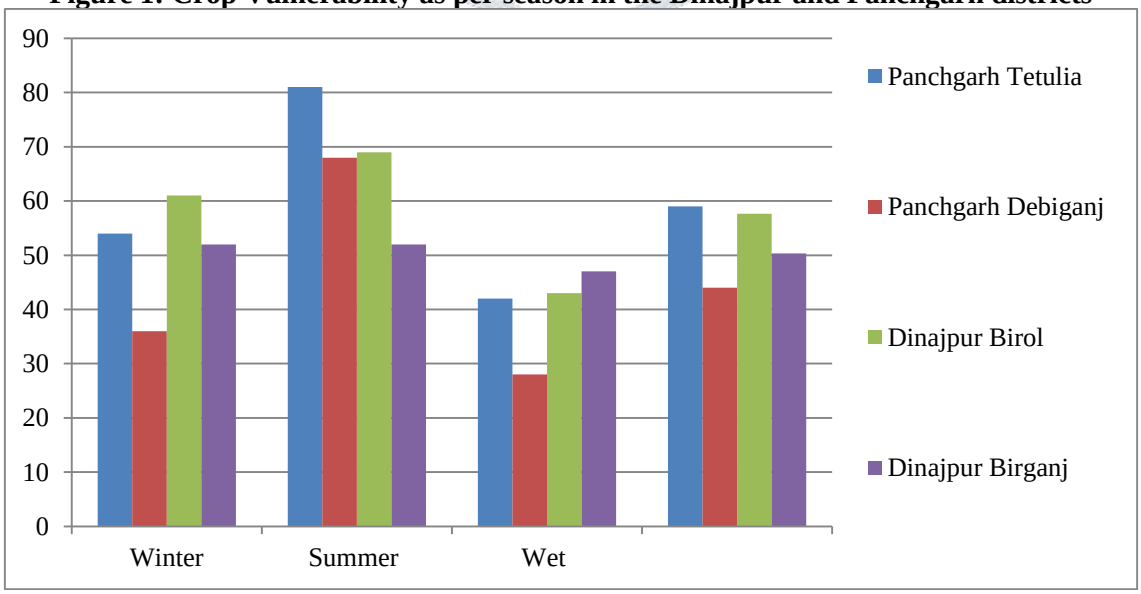
The results obtained from the present research entitled Agrarian and Environmental Factors of Crop Production in the North-East Lowland Agro- Ecological Zones of Bangladesh under the Influenced by Climate Change presented here in the forms of tables and graphs after compilation and analysis. The results are presented here sequentially as per highlighted points of objectives and expected outputs and outcomes. It may be remembered here that the main objectives of the study were to i. To identify the factors of climate sensitive and vulnerable production factors; ii. To assess the North East agro-climatic parameters influencing Agrarian livelihood; and iii. To know the Haor beel based AEZ crops.

Table 1: Crop yield vulnerability% North West Belt

AEZ	District	Upazila	Seasons			Mean
			Winter	Summer	Wet	
AEZ 1	Panchgarh	Tetulia	54	**81**	42	59
	Panchgarh	Debiganj	36	68	28	44
	Dinajpur	Birol	61	69	43	58
	Dinajpur	Birganj	52	52	47	50
AEZ 3	Rangpur	Mithapukur	42	72	56	57
	Rangpur	Gangachara	57	77	**69**	**68**
	Nilphamari	Domar	68	68	68	68
	Nilphamari	Dimla	58	58	58	58
	Lalmonirhat	Patgram	63	79	35	59
	Lalmonirhat	Kaliganj	64	67	55	62
AEZ 11	CNowabganj	Shibganj	68	63	55	62
	CNowabganj	Bholahat	**72**	66	52	63
	Rajshhi	Mohanpur	53	80	42	58
	Rajshhi	Chargat	32	71	29	44
	Chuadanga	Jibonn ogor	57	72	56	62
	Chuadanga	Alamdanga	59	50	36	48
Mean			56	68	48	58

The highest mean vulnerability was 68%, Rangpur the lower being Deviganj (Panchgarh) and charged (Rajshahi).

Figure 1: Crop Vulnerability as per season in the Dinajpur and Panchgarh districts



The results show that crops were most vulnerable during summer in the Tetulia areas.

Table 2: Crop yield vulnerability % South Eastern AEZs

AEZ	District	Upazila	Seasons			Mean
			Winter	Summer	Wet	
AEZ 19	Kishoreganj	Itna	74	51	42	56
	Kishoreganj	Tarail	66	36	58	53
	BBaria	Nasirnagor	61	39	**73**	58
	BBaria	Ashuganj	72	52	47	57
	Habiganj	Kokilchera	72	49	56	59
	Habiganj	Ajmiriganj	57	33	69	53
AEZ 20	Sylhet	Bishanath	68	48	68	61
	Sylhet	Beanibazar	58	38	58	51
	Habiganj	Bahubal	63	59	65	**62**
	Habiganj	Nabiganj	64	52	55	57
	Moulvibazar	Srimangal	68	43	55	55
	Moulvibazar	Borolekha	72	45	52	56
AEZ 21	Sunamganj	Tahirpur	73	37	62	57
	Sunamganj	Dherai	72	50	49	57
	Netrokona	Kalmakanda	**87**	38	56	60
	Netrokona	Mohanganj	59	**50**	36	48
	Kishoreganj	Itna	54	41	42	46
	Kishoreganj	Mithamoin	66	48	56	57
Mean			67	45	56	56

The crop yield vulnerability was found to be highest in case of Bahubal Habiganj and Kalmakanda Netrakona.

Figure 2: Crop yield vulnerability % North Eastern AEZs

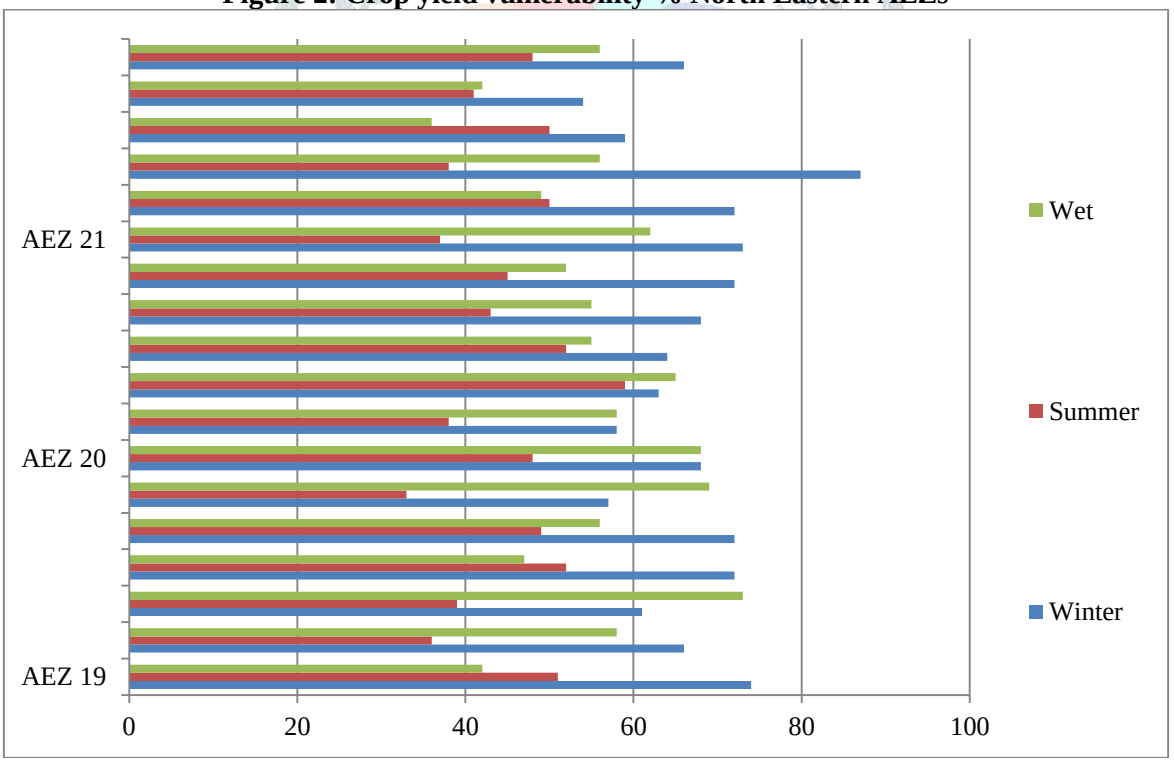


Table 3: Cereal crop yield vulnerability %

AEZ	District	Upazila	Seasons			Mean
			Winter	Summer	Wet	
AEZ 1	Panch	Tetulia	64	**81**	32	59
	Panch	Debi	43	78	28	50
	Dinaj	Birol	67	69	43	60
	Dinaj	Birganj	42	39	21	34
AEZ 3	Rang	Mithap	46	65	36	49
	Rang	Ganga	57	78	49	61
	Nilpha	Domar	78	81	48	**69**
	Nilpha	Dimla	48	42	17	36
	Lalmo	Patgram	69	82	38	63
	Lalmo	Kali	60	71	46	59
AEZ 11	CNowab	Shib	**82**	83	**56**	74
	CNowab	Bhol	68	76	43	62
	Rajsh	Mohan	59	74	33	55
	Rajsh	Charg	72	77	39	63
	Chua	Jibon	52	61	17	43
	Chua	Alam	69	61	48	59
Mean			61	70	37	56

The results in the Table 3 and Fig 3 show that the Cereal crop production was most vulnerable in case shibganj CNganj being 74% followed by Domar (69%).

Fig. 3: Cereal crop yield vulnerability % in the Northern AEZs

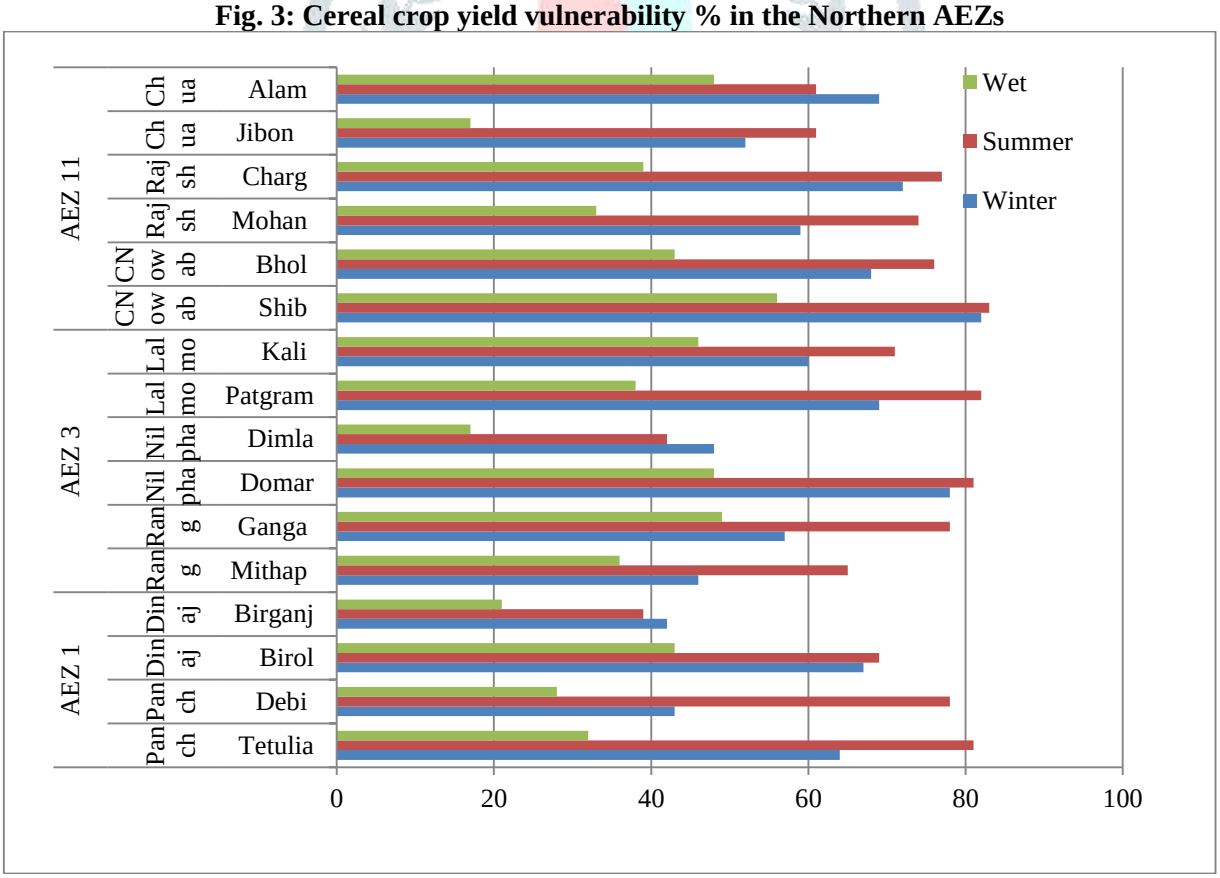


Table 4: Rice yield vulnerability

AEZ	District	Upazila	Seasons			Mean
			Winter	Summer	Wet	
AEZ 19	Kishoreganj	Itna	47	33	12	31
	BBaria	Nasirnogor	**83**	49	28	53
AEZ 20	Sylhet	Bishanath	46	75	30	50
	Sylhet	Beanibazar	57	71	29	52
	Habiganj	Bahubal	83	**78**	**63**	**75**
	Moulvibazar	Srimangal	68	72	27	56
	Moulvibazar	Borolekha	59	76	41	59
AEZ 21	Sunamganj	Tahirpur	73	67	46	62
	Sunamganj	Dherai	68	71	43	61
	Netrokona	Kolmakanda	44	48	38	43
	Netrokona	Mohanganj	70	39	39	49
	Chua	Jibonogor	59	64	27	50
	Chua	Alamdanga	72	63	49	61
Mean			64	62	36	54

Rice yield become vulnerable being highest Bahubal Habiganj being 75% followed by Tahirpur Sunamganj being 62%.

Fig. 4: Rice yield vulnerability

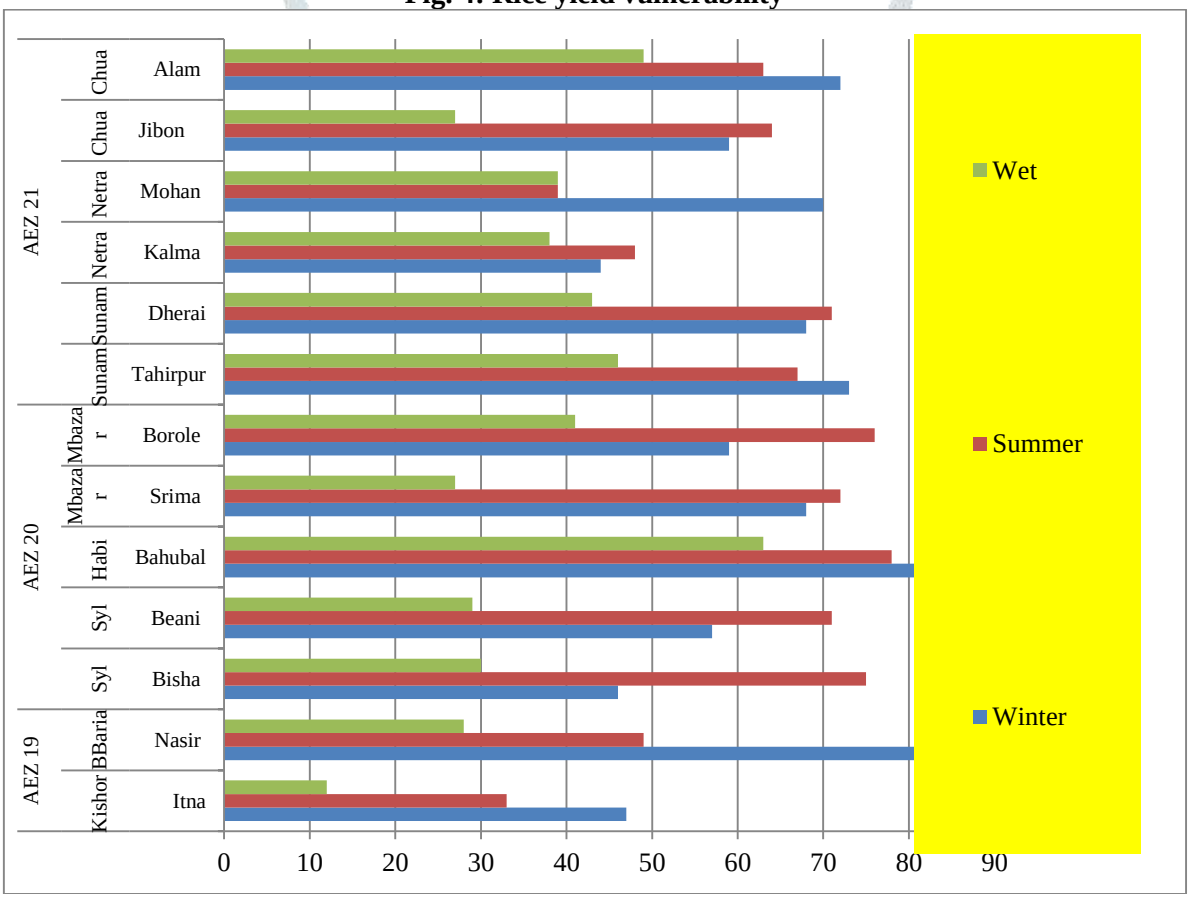


Table 5: Upland crop yield vulnerability

AEZ	District	Upazila	Seasons			Mean
			Winter	Summer	Wet	
AEZ 19	Kishoreganj	Itna	67	**83**	**82**	**77**
	BBaria	Nasirnogor	63	59	58	60
AEZ 20	Sylhet	Bishanath	66	75	80	74
	Sylhet	Beanibazar	55	71	59	62
	Habiganj	Bahubal	68	68	63	66
	Moulvibazar	Srimangal	68	62	57	62
	Moulvibazar	Borolekha	59	66	50	58
AEZ 21	Sunamganj	Tahirpur	67	61	56	61
	Sunamganj	Dherai	58	58	73	63
	Netrokona	Kolmakanda	54	68	61	61
	Netrokona	Mohanganj	64	56	67	62
	Chua	Jibonogor	59	74	48	60
	Chua	Alamdanga	**70**	68	56	65
Mean			63	67	62	64

The results obtained on Upland crop vulnerability showed that it was highest for Itna Kishoreganj (77%) and Biswanath Sylhet (74%).

Figure 5: Upland crop vulnerability

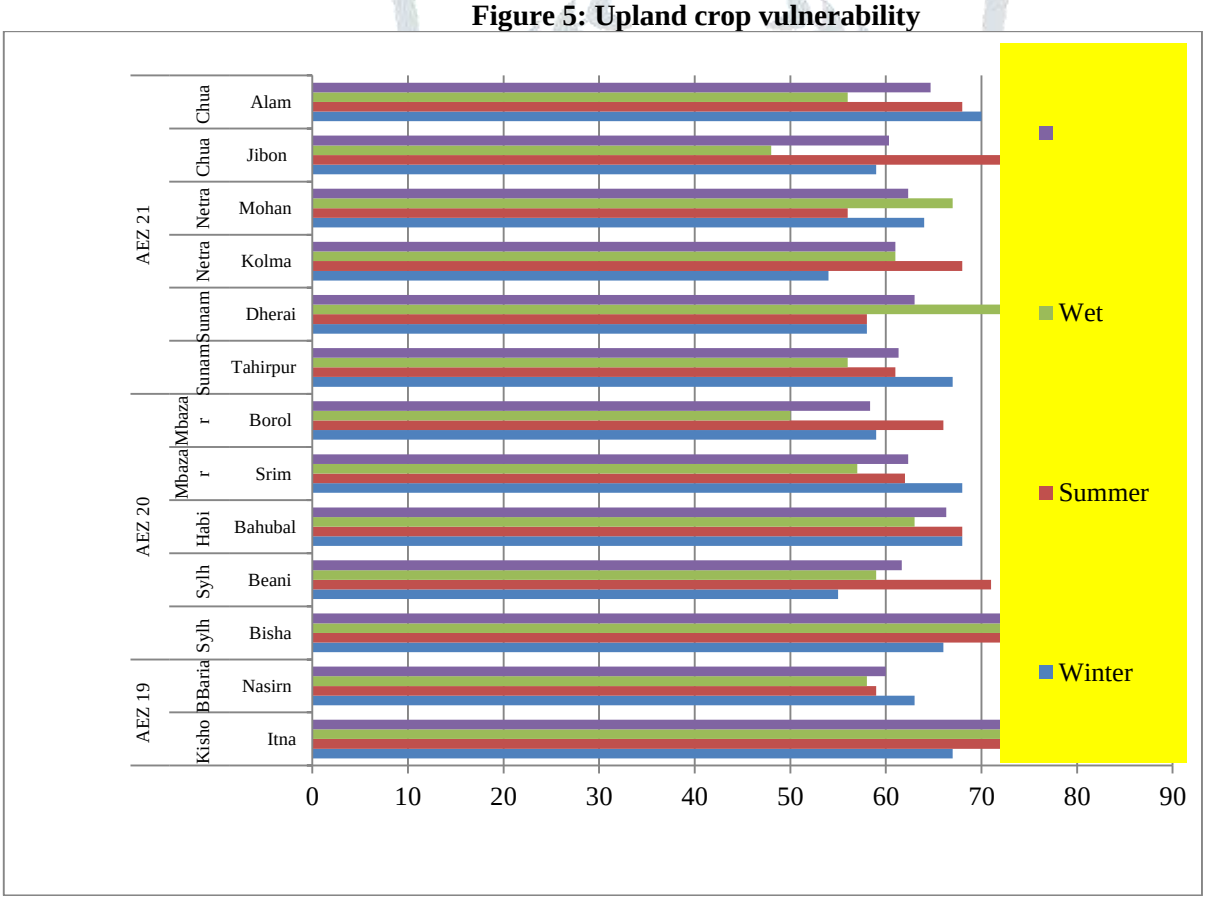
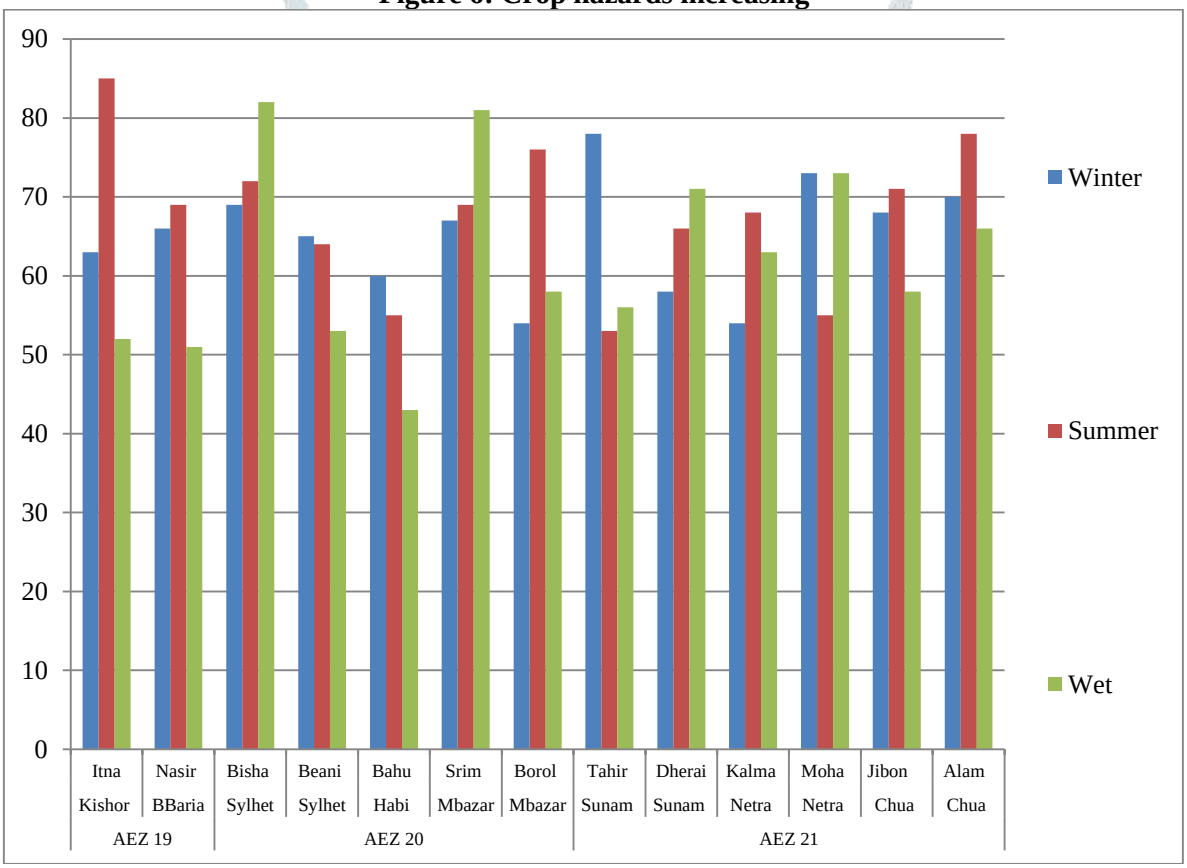


Table 6: Crop hazards increasing

AEZ	District	Upazila	Seasons			Mean
			Winter	Summer	Wet	
AEZ 19	Kishoreganj	Itna	63	**85**	52	67
	BBaria	Nasirnogor	66	69	51	62
AEZ 20	Sylhet	Bishanath	69	72	**82**	**74**
	Sylhet	Beanibazar	65	64	53	61
	Habiganj	Bahubal	60	55	43	53
	Moulvibazar	Srimangal	67	69	81	72
	Moulvibazar	Borolekha	54	76	58	63
AEZ 21	Sunamganj	Tahirpur	**78**	53	56	62
	Sunamganj	Dherai	58	66	71	65
	Netrakona	Kalmakanda	54	68	63	62
	Netrakona	Mohanganj	73	55	73	67
	Chua	Jibonogor	68	71	58	66
	Chua	Alamdanga	70	78	66	71
Mean			65	68	62	65

The results show that the crop hazards were highest for biswanath (74%) followed by Srimangal 72% vulnerability.

Figure 6: Crop hazards increasing



SUMMARY AND RECOMMENDATIONS

The research results collected from Crop-climate change vulnerability show that in the Northern region crop vulnerability was highest in the Districts of Rangpur and Nilphamari. General crop production vulnerability was studies for AEZ 1. AEZ 3 and AEZ 11.

In the northern regions summer crops were more sensitive (68%) to wet season crops. The results show that crops were most vulnerable during summer in the Tetulia areas. The crop yield vulnerability was found to be highest in case of Bahubal Habiganj and Kalmakanda Netrakona.

The results in the Table 3 and Fig 3 show that the Cereal crop production was most vulnerable in case shibganj CNganj being 74% followed by Domar (69%). Rice yield become vulnerable being highest Bahubal Habiganj being 75% followed by Tahirpur Sunamganj being 62%.

Upland crop yield vulnerability
The results obtained on Upland crop vulnerability showed that it was highest for Itna Kishoreganj (77%) and Biswanath Sylhet (74%).

Upland crop vulnerability
The results show that the crop hazards were highest for Biswanath (74%) followed by Srimangal 72% vulnerability.

Bangladesh is one of the most climate-vulnerable countries in the world due to the combination of frequent natural disasters, high population density, and low resilience to economic shocks. Bangladesh has a primarily agrarian economy. Agriculture is the single largest producing sector of the economy since it makes up nearly 30% of the country's GDP and employs around 60% of the total labor power. The operation of this sector has a significant impact on major macroeconomic objectives like job creation, poverty mitigation, human resources development, and food security (Chowdhury and Chowdhury 2011). However, the agriculture sector is largely impacted by the adverse impact of climate change-related extreme events including cyclone, flooding, drought, salinity intrusion, etc.

As a result, the food security of the people, especially the people living in the climate change hotspots, is in a precarious condition. Despite all these climatic stressors, people are trying to cope with the adverse situation, both through their traditional knowledge of agrarian adaptation and through newly emerged technologies in the agricultural sector. These adaptation options vary with geographic location, extent and type of climatic impacts, etc. The people of Bangladesh are using those practices since they are well-known adaptation options for those climate-induced disasters and extreme events. They are trying their level best to build their resilience in combating climate change impacts in the agricultural domain. These efforts need to be more organized and developed, based on improved technologies existing in the world. The government should consider recognizing the local and indigenous agrarian adaptation practices in its relevant policies and should move forward with new strategies for better implementation of those adaptation techniques.

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