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Open Access **REVIEW PAPER**

A REVIEW OF PRODUCTION RISK IN AGRICULTURE OF BANGLADESH: PERSPECTIVE HEAVY RAINFALL

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Abstract

Heavy rainfall is one of the major influencing factors of flood and water logging which are the causes of significant production risk in agriculture sector of Bangladesh. Therefore, this study aims at identifying the seasonal variation of rainfall data and assessing its impacts on agricultural crop production. Secondary data and information, collected from various sources such as journals, articles, books, and reports, have been used to obtain the objectives. The study revealed substantial seasonal variations of rainfall in Bangladesh with Sirajganj district receiving highest rainfall during the monsoon season. It also found that heavy rainfall has negative impact on agriculture in Bangladesh, leading to loss of various crops, including local Aus, HYV Aus, B Aman, LT Aman, and HYV Aman. During the months of March and April, 2015, Sunamganj district experienced significant damage to Boro rice production, while during July and August, 2016, Sirajganj district experienced the highest loss. Broadcast Aman production losses in Sirajganj region amounted to around 3328 metric tons in 2017. Similarly, the second round floods of 2019 caused huge crop damage in the north-eastern districts like Rajshahi, Rajbari, Chapai Nawabganj, Pabna, and Natore. In 2020-21, heavy rainfall caused rice production loss about 15% and resulted in significant price hikes. Therefore, this study highlights the need for effective management and mitigation strategies to reduce negative impacts of heavy rainfall on agriculture in Bangladesh.

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1. Introduction

The term 'extreme heavy rain' refers to the precipitation that exceeds 100 mm in a 24-hour period. Heavy rainfall results in flooding, which poses risk to human life, damages of infrastructure, and also results in destruction of crops and livestock (Yang, 2021). Due to its geographical position of Bangladesh, with its flat and low-lying lands frequently experiences natural disasters (Khan, 2013, Tol, 2013). Bangladesh has a subtropical monsoon climate, which is distinguished by significant seasonal fluctuations in temperature, rainfall, and humidity. Approximately 75% of the annual rainfall occurred in the monsoon or humid summer season in the country, which is brought on by moisture-rich southwest trade winds that are drawn to the Indian subcontinent by the region's extreme heat and resulting low pressure system over south Asia. The country receives very little rainfall throughout the winter, with only 3% of the year's total rain falling during this time (Figure 1).

Rainfall is crucial to agricultural productivity and the economy, because Bangladesh is mostly an agriculture dependent economy (Hossain *et al.* 2014). However, rainfall affects the country's agricultural output on a number of occasions, and there are numerous examples of these kinds of climatic catastrophic events (Zakaria *et al.* 2014, Basak, 2011). According to Rimi *et al.* (2022), there are significant regional differences in the patterns of changes in the relative risks of intense rainfall in Bangladesh. The rainfall during the pre-monsoon season results in severe economic losses, and impacts the agricultural sector significantly. For instance, the 2017 pre-monsoon season's heavy rainfall in the north-east Bangladesh led to the first flash flood since 2000. Prices significantly increased as a result of the damage done to the rice crop that could be harvested. According to the research finding by Rimi *et al.* (2019b), anthropogenic climate change has increased the likelihood of this specific extreme rainfall event by twofold. In contrast, when large, populated areas are frequently flooded during the monsoon season, property damage is more likely to happen. In 2017, the Meghalaya hills of India received a lot of rain, which led to pre-monsoon floods in March in the north-eastern regions of the country. As a result, a considerable portion of the harvestable Boro paddy crop, a locally high-yielding variety of paddy, was damaged and large portions of haors, a local term for lowland wetlands and low-lying areas were submerged (Nirapad, 2017). At least 156 people were killed by devastating floods, and a number of landslides occurred in Bangladesh's south-eastern regions due to high rains (Paul and Hussain, 2017). The highest rainfall accumulation of more than 510 mm in only 3 days was estimated to have occurred between June 12 and 14, 2017 by the National Aeronautics and Space Administration (NASA)'s near-real time Integrated Multi-satellite Retrievals for Global Precipitation Measurement, GPM (IMERG) data (Gutro, 2017). Additionally, 350 mm in 3 days during the height of the monsoon season caused a landslide in south-east Bangladesh (Ali *et al.*, 2014), and exceptional 10 days of rainfall in August, 2017 caused widespread flooding in the Brahmaputra River basin (Philip *et al.*, 2018). These events occurred in the north-east, and south-east regions of Bangladesh.

According to Hossain *et al.* (2017), heavy rainfall can result in flooding and water logging problems throughout the country, whilst light rainfall can lead to drought. Both of these occurrences are detrimental for the country. Temperature, rainfall, and climate change- all have impacts on agriculture and fisheries. The IPCC study predicts that rainfall in Bangladesh would increase by 5% to 6% by the year 2030(IPCC 2007). Therefore, the output rate will vary greatly in Bangladesh due to the wide range in rainfall amounts. The drawback is that heavy rain and flash flood events would happen more frequently, destroying fisheries and farms. Food shortages and economic losses will result from crop loss. The unpredictable rainfall and related extreme events must have significant impacts on Bangladesh's ecological systems, agricultural productivity, food security, health, water availability and quality, and the way of life of common people of Bangladesh (Shahid, 2011). Therefore, the objectives of this study are to identify the patterns of seasonal rainfall variation in Bangladesh and to assess the impact of heavy rainfall on agriculture of the country.

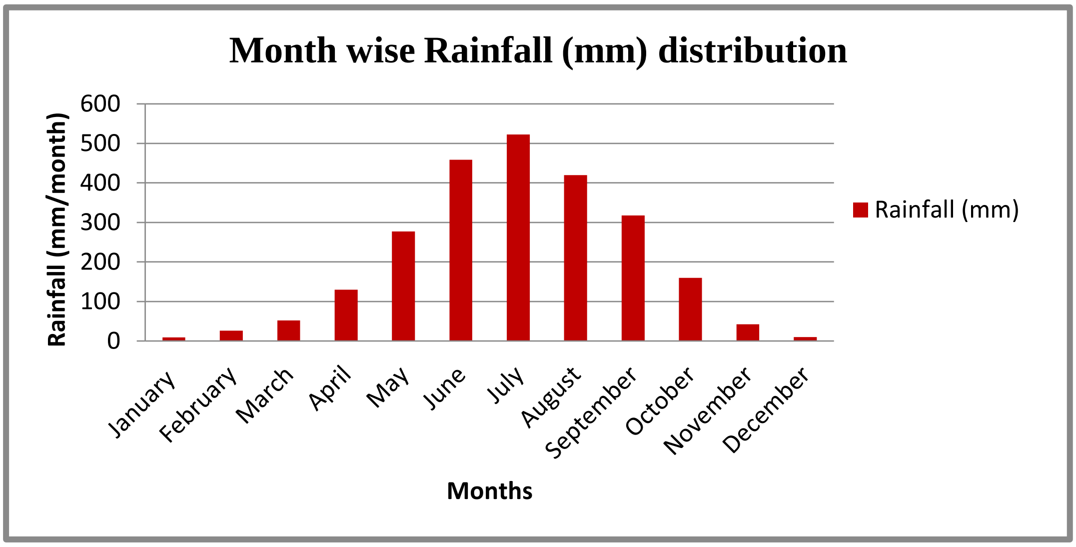

Figure 1: Long term Average rainfall in Bangladesh, **Source**: Author created from the data of BMD, 2013

2. Methodology

The present study relied on secondary data and information that have been collected from various journals, articles, books and the reports of BMD, BWDB and BBS. Accumulated data have been analyzed using qualitative synthesis. The benefits of this study stem from its capacity to enhance knowledge obtained through the data, and from its utility for historical study, despite a number of limitations, including the inability to change data collection, questions, measurements, or procedures. The analyzed data and findings are presented by using of tables and figures. The analytical framework of this study is shown in Figure 2.

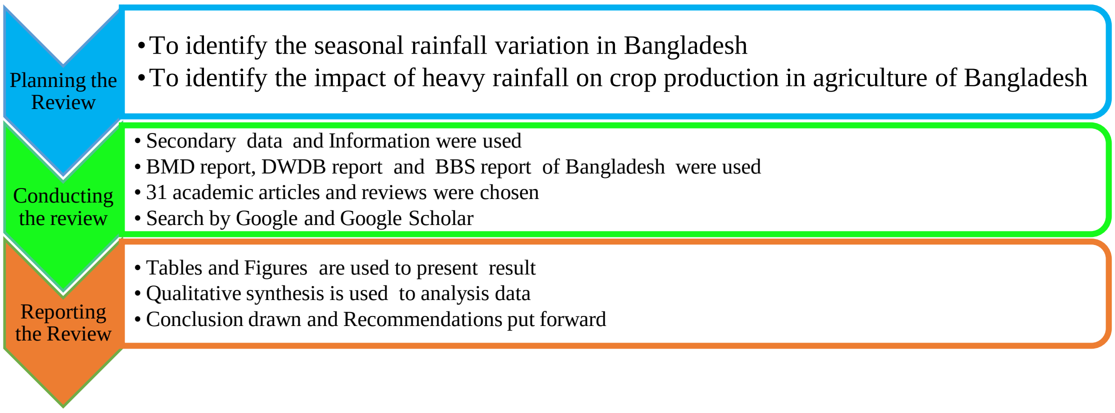

Figure 2: Analytical Framework of the present study

3. Findings and Discussion

3.1 Seasonal Rainfall Variation in Bangladesh

The variation in yearly or seasonal rainfall above or below a long-term average is known as rainfall variability. Every year, over a certain time period, a location's rainfall can vary, either above or below its normal level, which is called variability (IPCC, 2007). Although the rainfall varies for that period, the mean does not change throughout the year. According to the Bangladesh Meteorological Department, there are four different seasons in Bangladesh: (1) pre-monsoon (March to May), (2) monsoon (June to September), (3) post-monsoon (December-February), and (4) winter (October-November) in Bangladesh (Rahman and Abdullah, 2023). But in order to determine the seasonal variance for the years 2017, 2018, 2019 and 2020, here we used the BWDB hydrological calendar, which is as follows: summer (March, April, and May), monsoon (June, July, August, and September), post-monsoon (October and November) and winter (December, January, and February).

The seasonal rainfall variation in 2017 of the country shows that, Naogaon district received 339 mm of rainfall in summer, 950mm in monsoon, 198mm in post-monsoon, and 9 mm in winter. In summer, Sirajganj district received 720 mm, in monsoon 1748 mm, in post-monsoon 323 mm, and in winter 12 mm rainfall. In summer, Rajshahi district received 276 mm, in monsoon 1018 mm, in post-monsoon 201mm, and in winter 20 mm rainfall. However, rainfall pattern in Chapai Nawabganj district were 206 mm in summer, 952 mm in monsoon, 158 mm in post-monsoon, and 13 mm in winter. 457 mm is received in summer, 1158 mm in monsoon, 260 mm in post-monsoon, and 8 mm in winter in Bogura district. On the other hand, in the year 2018 Naogaon district obtained a total rainfall of 357 mm in summer, 714 mm in monsoon, 35 mm in post- monsoon, and 27 mm in winter season, while Sirajganj district received total rainfall of 386 mm in summer, 549 mm in monsoon, 86 mm in post-monsoon, and 42 mm in winter season. Rajshahi district received 337 mm in summer, 751 mm in monsoon, 95 mm in post-monsoon, and 30 mm in winter season. Chapai Nawabganj district received 290 mm in summer, 770 mm in monsoon, 69 mm in post-monsoon, and 29 mm in winter season, while Bogura district received 464 mm in summer, 858mm in monsoon, 61 mm in post-monsoon, and 27 mm in winter season (BWDB, 2019). So, the study found that seasonal variation of rainfall in Bangladesh for the years of 2017 and 2018 occurred in significantly (Figure 3 and Figure 4).

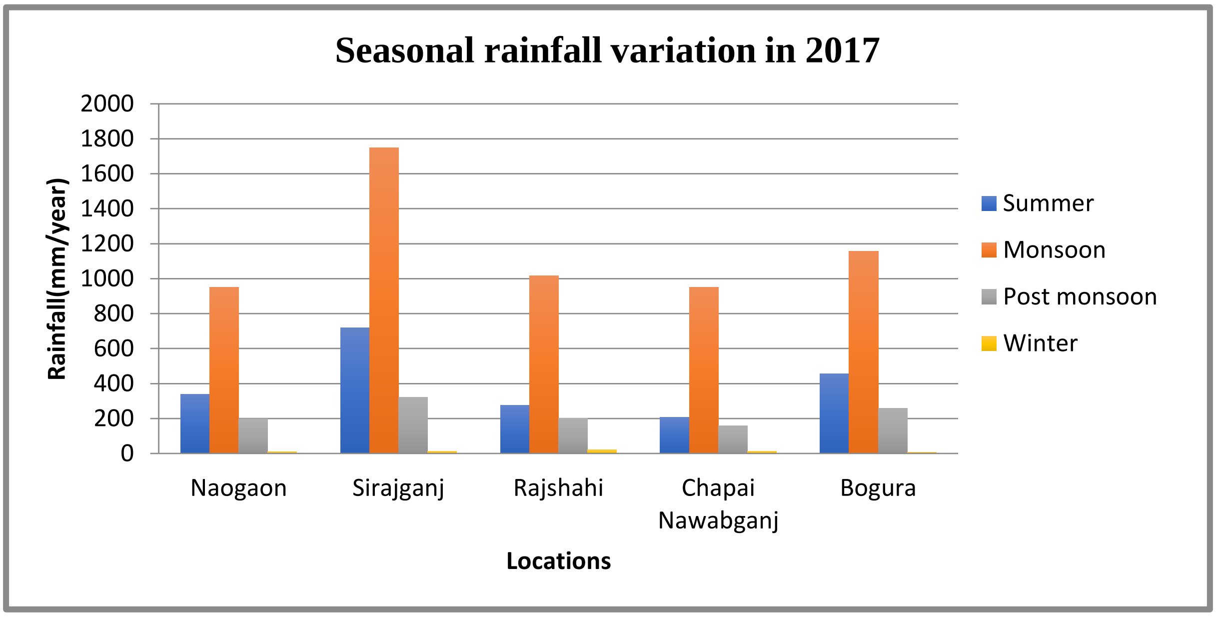

Figure 3: Seasonal Variation of Rainfall in 2017 of Bangladesh. **Source**: BWDB, 2019

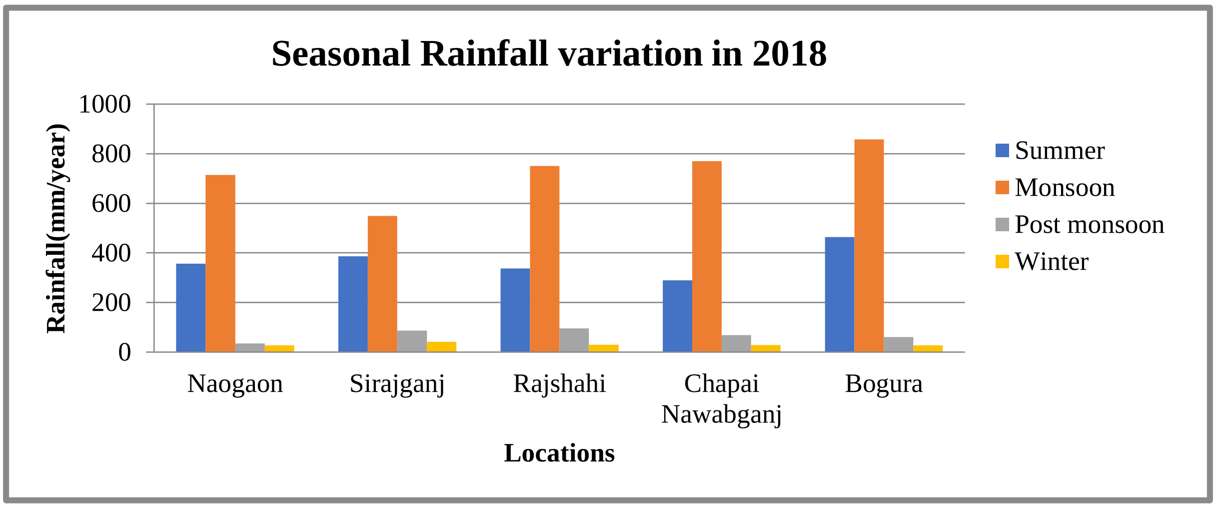

Figure 4: Seasonal Variation of Rainfall in 2018 of Bangladesh. **Source**: BWDB, 2019

In 2019, Naogaon district had 272.07 mm of rainfall in summer, 1084.58 mm in monsoon, 174.68 mm in post-monsoon, and 41.08 mm in winter. Whereas, Sirajganj district acquired rainfall 259.19 mm in summer, 858.93 mm in monsoon, 163.48 mm in Post-monsoon, and 58.56 mm in winter. Rajshahi district received rainfall 286.82 mm in summer, 879.52 mm in monsoon, 201.02 mm in post-monsoon, and 52.76 mm in winter. The rainfall pattern for Chapai Nawabganj district were 217.64 mm in summer, 899.86 mm in monsoon, 175.76 mm in post-monsoon, and 36.56 mm in winter. Additionally, Bogura district received rainfall 358.03 mm in summer, 778.49 mm in monsoon, 183.27 mm in post-monsoon, and 30.66 mm in winter. On the other hand, in the year 2020, rainfall pattern for Naogaon district were 394.50 mm in the summer, 1236.38 mm in the monsoon, 104.61 mm in the post-monsoon, and 18.45mm in the winter rainfall. In the summer, Sirajganj district received 422.28mm, in the monsoon, 980.18 mm, in the post-monsoon, 249.08 mm, and in the winter, 27.42 mm rainfall. Additionally, Rajshahi district received 280.56 mm in the summer, 1131.66 mm in the monsoon, 124.50 mm in the post-monsoon, and 18.72mm in the winter rainfall, while Bogura district received 422.28 mm in the summer, 980.18 mm in the monsoon, 249.08 mm in the post-monsoon, and 27.42 mm in the winter rainfall. Moreover, Chapai Nawabganj district received 250.96 mm in the summer, 1102.06 mm in the monsoon, 87.90 mm in the post-monsoon, and 35.10 mm in the winter rainfall (BWDB, 2021). So, the study also found that the seasonal variation of rainfall in Bangladesh for the years of 2019 and 2020 occurred in significantly (Figure 5 and Figure 6).

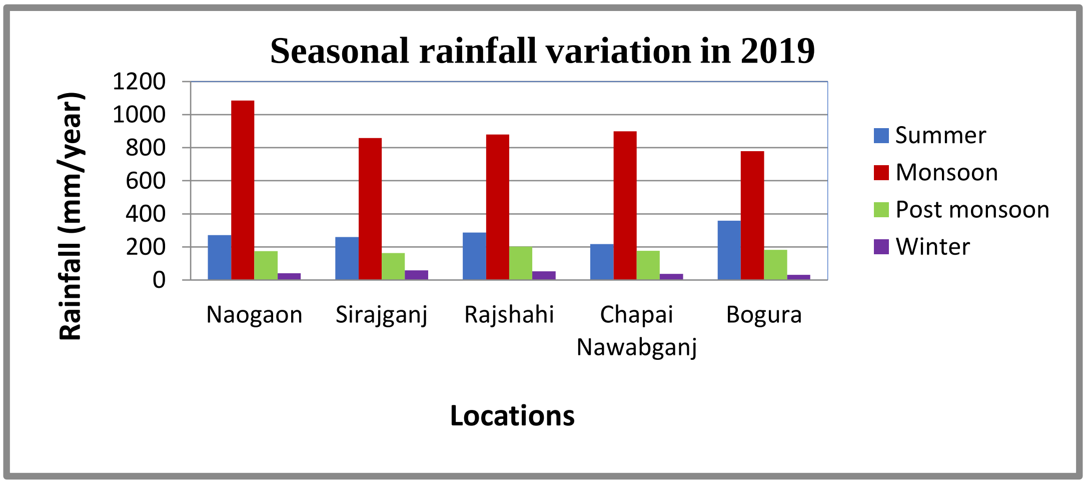

Figure 5: Seasonal Variation of Rainfall in 2020 of Bangladesh. **Source**: BWDB, 2021

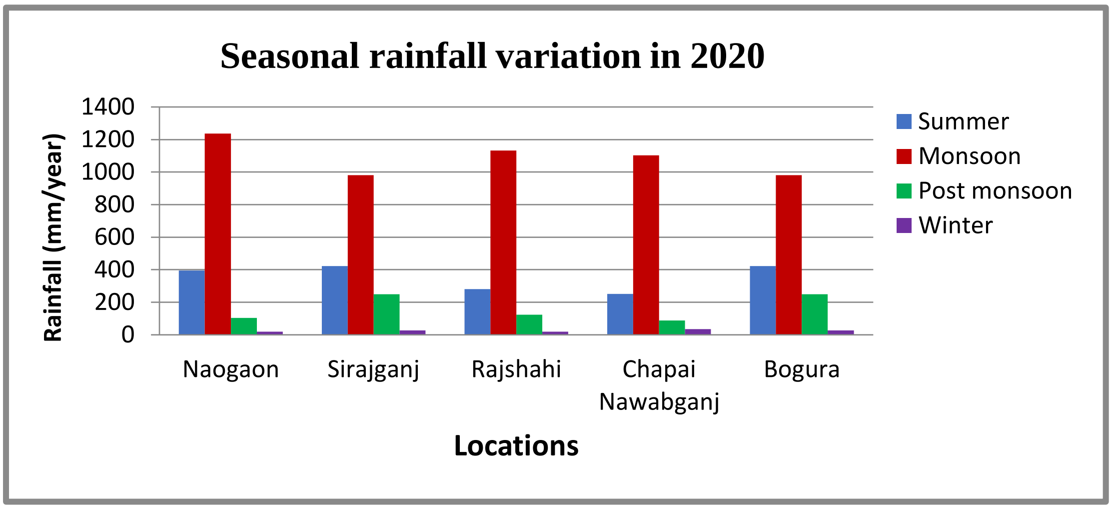

Figure 6: Seasonal Variation of Rainfall in 2020 of Bangladesh. Source: BWDB, 2021

It was also evident that due to the fluctuation of rainfall, numerous natural disasters such as floods, droughts, cyclones, thunderstorms, and hailstorms occur frequently in the study districts of Bangladesh. It directly affects agriculture and other sectors of Bangladesh economy. Earlier studies observed that there are some factors that are significantly linked to rainfall variability in Bangladesh. These factors are climate change, monsoonal wind, and man-made causes (Chakraborty *et al*., 2021; Haque,2009; IPCC, 2007; Ahmed and Kim, 2003). These factors along with their direct effects are shown in Table 1.

Table1 Factors behind rainfall variation

Name of Factors	Effects
Climate change	Rainfall varies in intensity, volume, and distribution as a result of climate change. One of the main climatic variables is rainfall, which has a significant impact on agricultural productivity.
Monsoonal wind	The monsoonal wind is from south to north, it may be the source of changes in rainfall.
Man-made causes	People are destroying hills and deforesting areas in Bangladesh because of the country's excessive population, which has a detrimental impact on temperature and rainfall patterns

Source: Haque, 2009; IPCC, 2007; Ahmed and Kim, 2003; Chakraborty *et al*., 2021

3.2 Impact of Heavy Rainfall

Floods are occurring more frequently in Bangladesh and Nepal as a result of recent observations of accelerated glacier retreat and increased monsoon precipitation (Agrawala *et al*., 2003). Floods in South Asia are primarily caused by monsoonal factors. As per the findings of Ghatak *et al.* (2012), the southwest monsoon is generally responsible for 70 to 80% of the rainfall that occurred in Bangladesh and Nepal between June and September. Two-thirds of the total rainfall fell over a period of 4-month, resulting in uneven conditions that overflow river banks and cause floods. One mm increase in rainfall during the vegetative, reproductive, and ripening stages was found to decrease Aman rice production by 0.036, 0.230 and 0.292 tons, respectively (Hoffmann, 2011).

Excessive rain, flash flooding, and a rush of water affected the various crops in Bangladesh during the fiscal year 2014–2015. Local Aus production loss was 1414 metric tons, whereas loss of HYV Aus was 7077 metric tons. Production loss for B Aman was 4121 metric tons, LT Aman was 12149 metric tons, and HYV Aman was 108980 metric tons (Table 2). Again in 2015-2016 fiscal year, Bangladesh experienced floods, rain, and flash floods causing crop destruction. Local Aus experienced 5553 metric tons of output loss, while LT Aman and HYV Aman experienced 24808 and 77446 metric tons, respectively (Table 2). During the 2016-2017 fiscal year, Bangladesh experienced significant crop losses caused by similar reasons. Production loss of HYV Aus was estimated to be 4559 metric tons, while broadcast Aman and LT Aman suffered losses were 21527 and 32914 metric tons, respectively which are shown in Table 2. Similar losses were observed in the 2017–2018 fiscal year. The local Aus and HYV Aus production losses in this year were 1116 metric tons and 63366 metric tons, respectively. Broadcast Aman and HYV Aman both saw output losses by 3328 metric tons and 731577 metric tons, respectively(Table2).

Table 2 Total Rice Production Loss due to Heavy Rainfall in Bangladesh in different years

Name of the crops	**Production loss(M.tons)**			
	Year 2014-2015	**Year 2015-2016**	**Year 2016-2017**	**Year 2017-2018**
Local Aus (LT)	1414	5553	-	1116
HYV Aus	7077	11842	4559	63366
Total Aus	8491	17395	4559	64482
B Aman	4121	-	21527	3328
(LT) Aman	12149	24808	32914	-
HYV Aman	108980	77446	-	731577
Total Aman	125250	102254	54441	734905
Boro Local	-	2153	13541	-
HYV Boro	-	94178	711830	-
Hybrid	-	1261	140325	-
Boro Total-	-	97592	865696	-

Source: BBS, 2016 and BBS, 2022

Similarly, the production of Jute, Aman saplings, Patal, Chalkumra, Summer Brinjal, Cucumber, Kharif Chilies, Karala, Puisak, Other Summer Vegetables, Lalsak (Red spinach), Data sak, Kakrol, Green papaya, Turmeric, Ginger, and Betel leaves, etc. were also harmed in Fiscal Year 2017–2018 by severe rainfall which is shown in Table 3.

Table 3 Total Loss in Crop Production of Bangladesh in Year 2017-2018

Name of the crops	**Total production loss (M.tons/bales)**
Jute	33895
Aman Seed bed	460
Patal	5995
Chalkumra	1246
Summer Brinjal	6035
Cucumber	463
Kharif Chilies’	740
karala	520
Puisak	1513
Other Summer Vegetables	20759
Lalsak	256
Data Sak	535
Kakrol	323
Katcha (Green) Papya	352
Chichinga	162
Barbati	195
Turmeric	95
Ginger	1248
Betel leaves	4129
Ladies Finger	117
Dhundal	29
Arum	1305
Jhinga	398
Kochurlati	81

Source: BBS, 2022

3.3 Region Wise Estimates of Crop Damages

During the months of July and August 2015-2016, different crops were damaged due to flood and excessive rain in Bangladesh (Table 4). During this fiscal year, the Local Aus production loss (5356 metric ton) was the highest in Noakhali district in Bangladesh. The production loss of HYV Aus was 10185 metric tons and total Aus production loss was 15541 metric tons in Noakhali district. Table 4 also shows that during the months of August and September-2015-2016, different crops were damaged due to flood and excessive rain in Bangladesh. In this time, the Local Aman production loss (19000 metric ton) was the highest in Gaibandha district. The production loss of HYV Aman was 77341 metric tons and total Aman production loss was 96341 metric tons in Gaibandha district.

Table 4 shows that during the months of March and May-2015-2016, different crops were damaged due to flood and excessive rain in Bangladesh. Additionally, the production loss of Local Boro was 2153 metric tons in Sylhet region. The production loss of HYV Boro was the highest in Sunamganj district. The Hybrid Boro production loss in Hobigonj district was 944 metric tons. Total Boro rice production in Sunamganj district was highly damaged than other districts of Bangladesh.

Table 4 Crop Production Losses due to Flood and Excessive Rainfall in Different Months of Fiscal Year 2015-2016 in Bangladesh

Crops production loss in the months of July & August-2015-2016		
Name of region	**Crops type**	**Production Loss (Metric Ton)**
Cumilla	Local Aus	192
Noakhali		5356
Feni		5
Bandarban	HYV Aus	259
Cumilla		1398
Noakhali		10185
Bandarban	Total Aus (Local + HYV)	259
Cumilla		1590
Noakhali		15541
Feni		5
Crops production loss in the months of August & September 2015-2016		
Name of region	**Crops type**	**Production Loss (Metric Ton)**
Sunamgonj	Local Aman	5808
Gaibandha		19000
Feni	HYV Aman	105
Gaibandha		77341
Feni	Total Aman (Local + HYV)	105
Sunamgonj		5808
Gaibandha		96341
Crop production loss in the months of March & May 2015-2016		
Name of Region	**Crops type**	**Production loss (Metric Ton)**
Sylhet	Local Boro	2153
Maulvibazar	HYV Boro	2473
Sunamgonj		81625
Sylhet		10080
Hobigonj	Hybrid Boro	944
Sylhet		317
Sylhet	Total Boro (Local + HYV + Hybrid)	12550
Maulvibazar		2473
Sunamgonj		81625
Hobigonj		944

Source: BBS, 2022

During the months of March and April-2016-2017, different crops were damaged due to flood and excessive rain in Bangladesh (Table 5). During this period the Local Boro production loss (6671 metric ton) was the highest in Sunamganj district. The production loss of HYV Boro was 366080 metric tons and Boro Hybrid was 84624 metric tons in Sunamganj district. These are very large amounts production loss than other districts in Bangladesh.

Table 5 Crop Production Losses (M.ton.) due to Excessive Rainfall induced flood in the months of March and April in 2016-2017

Name of Region	Crops type	Loss of crops production (Metric Ton)
Maulvibazar	Boro Local	218
Sunamgonj		6671
Sylhet		6438
Netrokona		214
Hobigonj	Boro HYV	34599
Maulvibazar		29867
Sunamgonj		366080
Sylhet		48534
Netrokona		62313
Kishoregonj		170437
Hobigonj	Boro Hybrid	48000
Maulvibazar		749
Sunamgonj		84624
Sylhet		2867
Netrokona		4084
Hobigonj	Total Boro (Local + HYV + Hybrid)	82600
Maulvibazar		30834
Sunamgonj		457376
Sylhet		57840
Netrokona		66611
Kishoregonj		170437

Source: BBS, 2022

Crop damage caused by flood in Bangladesh during July and August, 2016-2017 is shown in Table 6. This table shows that flood affected crops like Aus HYV rice, Aman Broadcast, LT Aman, jute, Patal, Brinjal, and Chalkumra. Sirajganj experienced the highest damage, with 2909 metric tons of Aus HYV rice production. Floods and excessive rain in Bangladesh during July and August in 2017-2018 caused significant crop damages which are shown in Table 7. Local Aus rice production in Sirajganj district suffered 65 metric tons, while HYV Aus production in Rajshahi district was 446 metric tons.

Broadcast Aman production loss in Sirajganj region was 3328 metric tons. Loss of production of various summer vegetables occurred in July and August, 2017-2018 in Bangladesh due to floods and excessive rainfall (BBS, 2022). The loss of production of Jute and Aman saplings in Sirajganj region was 11145 metric tons, while other summer vegetables production loss in Naogaon region were 1304 metric tons. Patal, Brinjal, Cucumber, Chilies, Kakrol, Puisak, Chalkumra, Lalsak, Dantasak, Karala, Green Papaya, Chichinga, Barbati, Turmeric, Ginger, Betel leaves, Lady's finger, Dhundal, Arum, Jhinga, and Kachurlati were all affected. Heavy rainfall damaged the production of pumpkin, Red spinach, Green Papaya, Barbati, Ginger, Betel leaves, Ladies finger, Dhundal, Arum, Jhinga, Kachurlati during the months of July and August, 2017-2018 (BBS, 2022).

Table 6 Crop Production Losses due to Flood in the Months of July and August 2016-2017

Name of Region	Name of crops	Losses of crop production (Metric Ton)
Manikgonj	Aus HYV	315
Madaripur		639
Sirajganj		2909
Gaibandha		301
Kurigram		395
Manikgonj	Aman Broadcast	17496
Sirajgonj		4031
Manikgonj	L T Aman	7709
Madaripur		1057
Sirajgonj		22256
Gaibandha		1892
Manikgonj	Total Aman (B+HYV+ LT Aman)	25205
Madaripur		1057
Sirajgonj		26287
Gaibandha		1892
Sirajgonj	Jute	18541
Gaibandha		5170
Kurigram		548
Manikgonj	Patal(Perbal)	30
Madaripur		1192
Manikgonj	ChalKumra (Pumpkin)	31
Manikgonj	Summer Brinjal	43

Source: BBS, 2022

Over one-fourth of the country's territories experienced landslides and serious flooding as a result of Bangladesh's excessive rains between July and September 2019. Crop land covering over 532,000 hectares were destroyed and embankments were harmed. During the first week of October 2019, Bangladesh saw a second round of flooding that devastated the north-eastern districts named Rajshahi, Rajbari, Chapai Nawabganj, Pabna, and Natore, which affected some new areas (IFRC, 2021). According to the Foreign Agricultural Service (FAS) of the US Department of

Agriculture (USDA), heavy rainfall has hampered Bangladesh's rice production for the 2020-21 fiscal year. While about 15% crop losses due to heavy rainfall induced flooding in June and July of 2020. As a result, rice prices increased in the second half of the year (WG, 2021).

Table 7 Crop Production Losses (Rice) due to flood and Excessive rainfall in the months of July and August 2017-2018

Name of Region	Name of crops	Loss of crops production (Metric Ton)
Rangamati	Local Aus	704
Sylhet		347
Sirajganj		65
Noakhali	HYV Aus	1311
Rangamati		241
Maulvibazar		2350
Sylhet		4294
Sirajganj		446
Rajshahi		28686
Naogaon		21176
Chapai Nawabganj		4862
Noakhali	Total Aus (Local + HYV)	1311
Rangamati		945
Maulvibazar		2350
Sylhet		4641
Sirajganj		511
Rajshahi		28686
Naogaon		21176
Chapai Nawabganj		4862
Sirajganj	Broadcast (Aman)	3328
Jamalpur	HYV Aman	93123
Sherpur		8685
Netrakona		25490
Mymensingh		26126
Joypurhat		23855
Rajshahi		6882
Naogaon		135446
Chapai Nawabganj		1792
Rangpur		431828
Gaibandha		59227
Sirajganj	Total Aman (Broadcast + HYV)	3328
Jamalpur		93123
Sherpur		8685
Netrakona		25490
Mymensingh		26126
Joypurhat		23855
Rajshahi		6882
Naogaon		135446
Chapai Nawabganj		1792
Rangpur		431828
Gaibandha		59227

Source: BBS, 2022

4. Conclusion and Recommendations

The present study found the seasonal variation of rainfall in Bangladesh. However, Sirajganj received more rainfall (1748 mm) during monsoon season than summer, post-monsoon, and winter season in 2017. Naogaon, Rajshahi, Bogura, Chapai Nawabganj also received more rainfall during monsoon season, which was less than Sirajganj district. This study found that Bogura district received more rainfall (858 mm) during monsoon season than Naogaon, Sirajganj, Rajshahi, and Chapai Nawabganj in 2018. In 2019, the rainfall was more in Naogaon district (1084.58 mm) during monsoon season than other three seasons. Sirajganj, Rajshahi, Bogura, Chapai Nawabganj also received more rainfall during monsoon season in 2019. The rainfall of Naogaon district (1236.38 mm) during 2020 was more in monsoon season than other district namely Sirajganj, Rajshahi, Bogura, and Chapai Nawabganj. The study identified climate change, monsoonal wind, and man-made causes as the main factors influencing rainfall variability in Bangladesh. This study identified the negative impact of heavy rainfall in Agriculture of Bangladesh and found the crops production loss (M. tons/bales) of Bangladesh by excessive rainfall in different years. Heavy rain in Bangladesh damaged production of Local Aus, HYV Aus, B Aman, LT Aman, and HYV Aman in 2014-2015 and in 2015-2016 fiscal years. High production losses were observed in Noakhali and Gaibandha. During the months of March and May-2015-2016, floods and excessive rain damaged crops in Bangladesh, with Sunamganj experiencing the highest damage for Boro rice production. Sunamganj experienced significant production loss in March and April 2016-2017, with Sirajganj suffering the most damage, resulting in 2909 metric ton of Aus HYV rice production in July and August 2016-2017. Sirajganj district experienced losses 65 metric tons of Aus Rice production, 446 metric tons of HYV Aus production, and 3328 metric tons of broadcast Aman production in 2017-2018. Bangladesh experienced landslides and flooding in July-September 2019, destroying crops and embankments, with the second round causing further damage to several north-eastern districts. Heavy rains impacted rice production in 2020-2021, leading to 15% crop loss and increased prices in the second half of the year. However, Heavy rain can cause soil damage, root drowning, and crop illnesses due to water logging and soil erosion. To tackle this issue, various effective strategies can be employed. This study suggested some tactics. These include using organic mulch, attempting contour farming, enhancing drainage, implementing crop rotation, strategizing cultivation, constructing sufficient support, covering the crops, donning windbreakers, and scheduling routine field condition inspections (PMFBY, 2023).

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