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MEASURING RAINFALL IN DIFFERENT RICE CROPPING SEASON AT RANGPUR DISTRICT IN BANGLADESH

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ABSTRACT

This study examined the rainfall variability among *Aus*, *Aman* and *Boro* season from 1990 to 2020 in Rangpur district of Bangladesh. In this study, rainfall data (1990-2020) was used which gathered from Bangladesh Meteorological Department (BMD). To investigate the seasonal rainfall variation, linear trend analysis was employed. The result of the study exposed that diurnal, monthly and seasonal variation of rainfall were found much anomalies, where annual rainfall increased in *Aus* and *Boro* season but decreased in the *Aman* season. The findings of this research ensure that rainfall has had significant changes in *Aus*, *Aman* and *Boro* season. These changes could have an unfavorable impact on rain-based agriculture in Bangladesh. For sustainable agriculture, various environmental techniques, thresholding, and nationwide rainfall analysis can be useful to support adaptation planning for the rain-driven agricultural economy in Bangladesh.

Key words: Rainfall, season, variability

Introduction

Rainfall is the dominant component of Bangladesh's climate. Owing to the country is located a tropical monsoon zone, rainfall is relatively high (Hossain *et al*., 2014). However, annual rainfall cycles have distinct seasonal patterns that are much pronounced than annual temperature cycles (Rahman *et al*., 2017). Winter is very dry, accounting for only 2% to 4% of total annual rainfall. In this season rainfall varies from less than 2 cm in the west and south to just over 4 cm in the northeast (Roy and Ghosh, 2013). The northern portion was "drought prone" because to greater rainfall variability combined with low rainfall, whereas the south-western coastal zone is a more "humid area" with low fluctuation and high rainfall (Hossain *et al*., 2014). Changes in rainfall patterns are being sparked by climate change, and these changes may have a big impact on when crops are sown and harvested (Mirza *et al*., 2004; Abrol *et al*., 2003). Pre-monsoon, post-monsoon, and dry seasons which together account for more than 95% of the annual rainfall, when the principal rice types including *Aus*, *Aman*, and *Boro* are sown and harvested. The farming system depends largely on the timely arrival of monsoon rain and its distribution, even if the harvesting and sowing periods of the crops vary geographically depending upon the agro-climatic parameters of the area (Mirza *et al*., 2004; Ahasan *et al*., 2010). Recently, in 2010, high rainfall in the post-monsoon and insufficient rainfall (30% below typical levels) during the monsoon caused significant harm to the agricultural sector. Rangpur district is one of the key districts for agricultural output in northern Bangladesh. Rice production, for example, is entirely dependent on important meteorological factors like rainfall. Rafiuddin *et al*. (2010), Ahsan *et al*. (2010), and Rafiuddin *et al*. (2007) are just a few of the numerous studies that have been done to look at the peculiarities of rainfall patterns in Bangladesh. These studies have mostly concentrated on the features and patterns of monsoon or pre-monsoon rainfall. Other researchers have also examined the temporal and spatial rainfall patterns (Mirza *et al*., 2008; Shahid and Khairulmaini, 2009; Hossain and Roy, 2009; Islam and Uyeda, 2007; Kripalani *et al*., 1996). Few of them, like Shahid and Khairulmaini (2009), focused on the country's rainfall variability from 1969 to 2003. Most of their research focused on particular localities. Numerous researches only examined the effects of shifting the *Boro* rice planting date on yield in Bangladesh (Basak *et al*., 2010). Sarker *et al*. (2017) found that rainfall has come to be risk-increasing for *Aman* rice in Bangladesh. There have been no studies conducted to assess the fluctuation of rainfall among *Aus*, *Aman* and *Boro* seasons in Rangpur district as the region of Bangladesh that is most sensitive to climate change. Here, present study was designed to analyze the trends of rainfall variability among different rice crop seasons in the environmental circumstance of this region. The objectives are (i) to assess the diurnal and monthly rainfall variation of the study area, and (ii) to investigate the variability of rainfall patterns of *Aus, Aman* and *Boro* rice seasons.

Materials and Methods

Study area: Rangpur district covers an area of 2400.56 km², situated in between 25°18' N and 25°57' N latitude, and in between 88°56' E and 89°32' E longitude. It is bordered by the districts of Nilphamari and Lalmonirhat on the north, Gaibandha on the south, Kurigram on the east, and Dinajpur on the west (Fig. 1) (BBS, 2011; Islam *et al*., 2022).

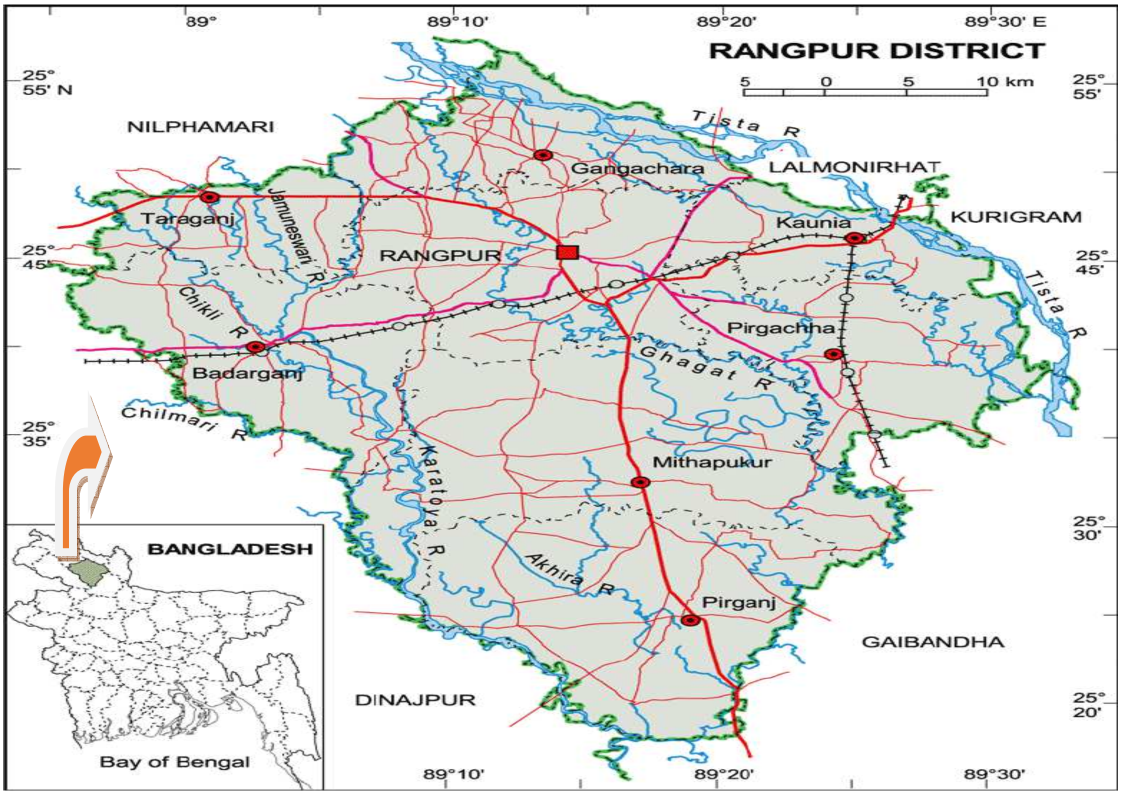


Fig. 1. Location of the study area (BBS, 2011)

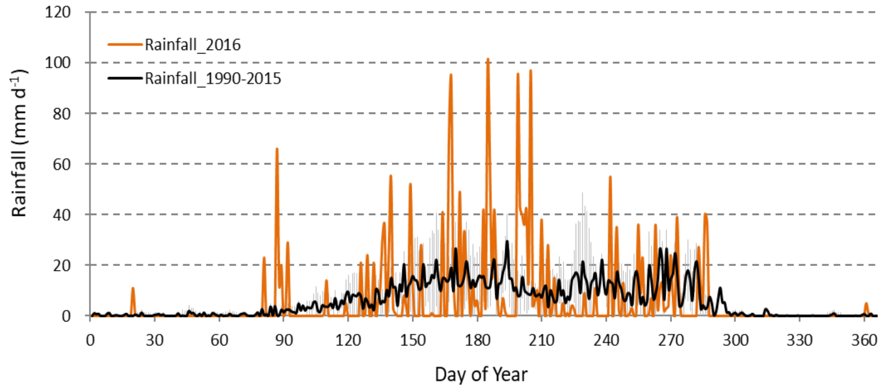
Data Source and Quality Control: For this study, the valid and process rainfall data was provided by Bangladesh meteorological department (BMD) in the interval of 1990 to 2020. No data missing was found in the study period of Rangpur District.

Data Analysis: Data organized in different rice growing season such as *Boro* rice season (December to May), *Aus* rice season (March to August) and *Aman* rice season (June to November) (Sarker *et al*., 2012; Islam *et al*., 2022).To find out the clear graphical trends which compared with 26 years average (1990 to 2015) data to recent five years data (2016 to 2020). Data processing, formatting and statistical analysis were done by Excel 2019.

Results and Discussion

Diurnal Variation of rainfall in the study area: The comparative study of rainfall in 2016, 2017, 2018, 2019 and 2020 with the twenty-six years average 1990 to 2015 are displayed in Fig. 2.

(a)



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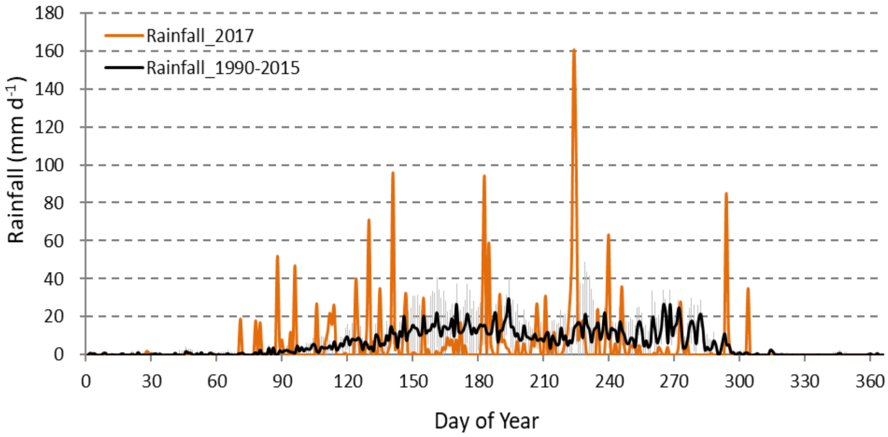

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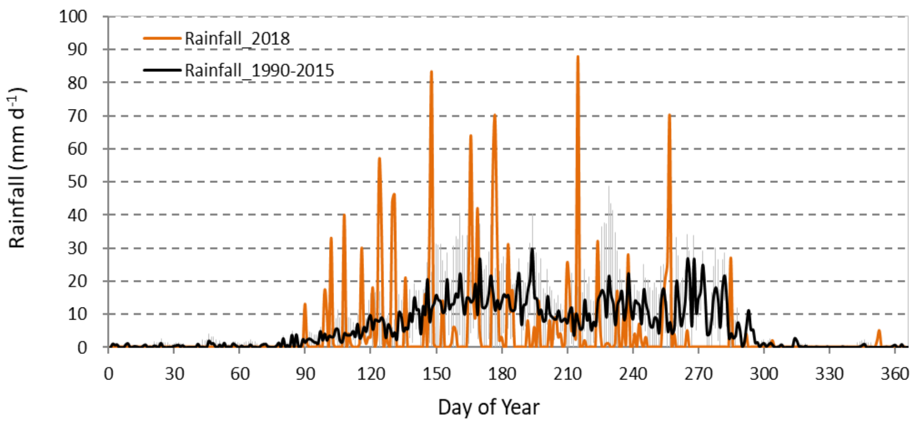

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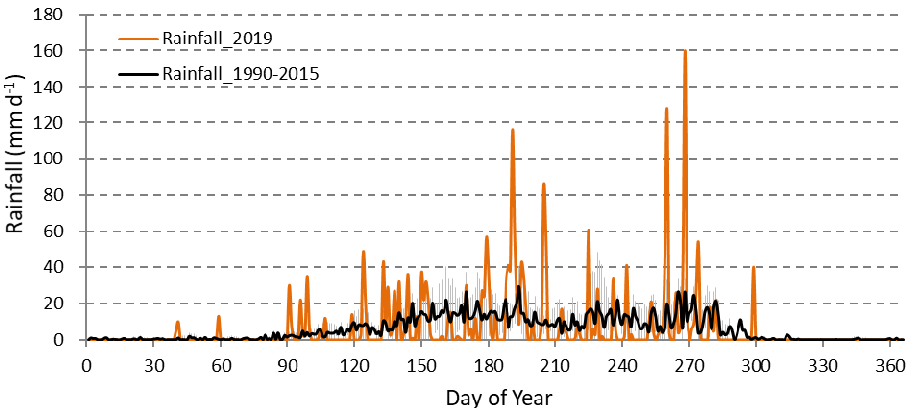

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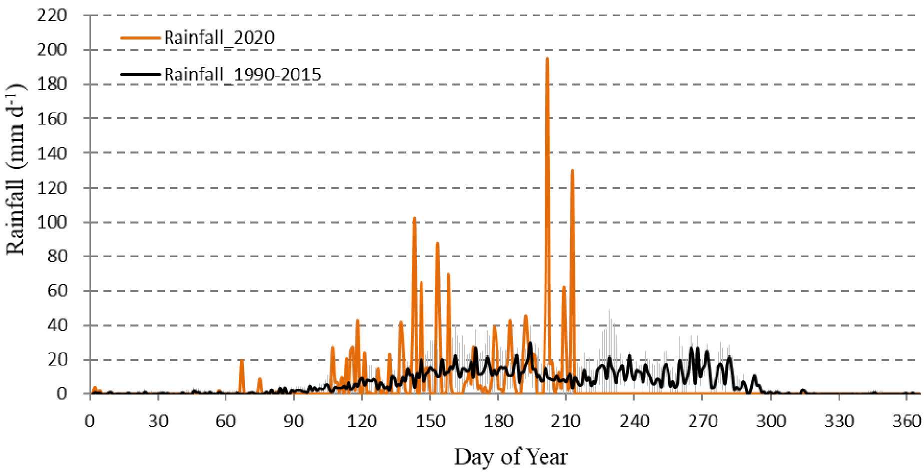

Fig. 2. Seasonal variation of daily rainfall in (a) 2016, (b) 2017, (c) 2018, (d) 2019 and (e) 2020 with the average from 1990 to 2015. Bars represent standard deviation for the twenty-six years

Fig. 2 (a) shows that the highest amount of rainfall in 2016 at DOY 185 was 100 mm d^{-1} where the 26 years average value was 11 ± 13.6 mm d^{-1} (the mean ± SD) while the lowest amount of rainfall was zero in dry season. From Fig. 2 (b), the highest value of 2017 in DOY 224 was observed 159 mm d^{-1}, while the value of 26 years average was 14.1± 27.7 mm d^{-1} (the mean ± SD). In 2018, the huge amount of rainfall in DOY 215 was observed 88 mm d^{-1}, at the same day 26 years average value of rainfall was 7.8 ± 20.9 mm d^{-1} (the mean ± SD) [Fig. 2 (c)]. In 2019 the highest value of rainfall in DOY 268 was 159 mm d^{-1}, while the 26 years average value was 21.8 ± 50.6 mm d^{-1} (the mean ± SD) [Fig. 2 (d)]. From Fig. 2 (e), in 2020 the highest value of rainfall in DOY 202 was 195 mm d^{-1}, while the 26 years average value was 10.2 ± 17.6 mm d^{-1} (the mean ± SD). The highest 26 years average value of rainfall in DOY 194 was 29.5 ± 34.8 mm d^{-1} (the mean ± SD) and the lowest 26 years average value compared with the year of 2016 to 2020 were zero in several days of dry season has shown in Fig. 2 (a, b, c, d, e).

Monthly Variation of rainfall in the study area: Huge amount of rainfall is observed in rainy season, while rainfall is very low in dry season. This seasonality is clearly shown in monthly statistics of rainfall (Fig. 3). As shown in the standard deviation from 1990 to 2015, year-to-year variations in monthly rainfall during the rainy season were generally large. In July the total rainfall in 2016 was 721 mm $month^{-1}$, 2017 was 344 mm $month^{-1}$, 2018 was 169 mm $month^{-1}$, 2019 was 594 mm $month^{-1}$ and 2020 was 674 mm $month^{-1}$. The highest rainfall was observed in 2016 July was 721 mm $month^{-1}$ than other years were shown in Fig. 3. The 26 years average maximum rainfall was found in the month of June (443 ± 189 mm $month^{-1}$; the mean ± SD) which was larger than other years (Fig. 3).

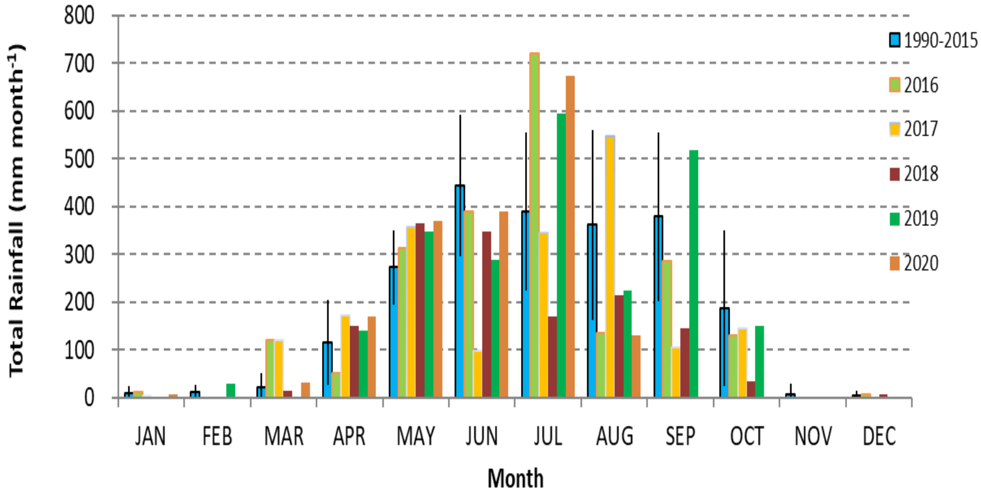

Fig. 3. Monthly variation of rainfall in 2016, 2017, 2018, 2019 and 2020 with the average from 1990 to 2015. Bars represent standard deviation for twenty-six years

Seasonal Trends of rainfall variation: The total rainfall in three growing seasons and fallow periods are presented in the Fig. 4. Rainfall in *Boro* season was less than 700 mm $season^{-1}$, and smaller than both in *Aus* and *Aman* season. A huge amount of rainfall exceeded 1500 mm $season^{-1}$ in the experimental year 2016, 2017, 2019, 2020 in *Aus* season and 2016, 1019 and 2020 in *Aman* season while 26 years average also exceeded 1500 mm $season^{-1}$ both *Aus* and *Aman* season. The rainfall was also observed in the fallow period in rainy season, while rainfall in the fallow period in dry season was not considerable.

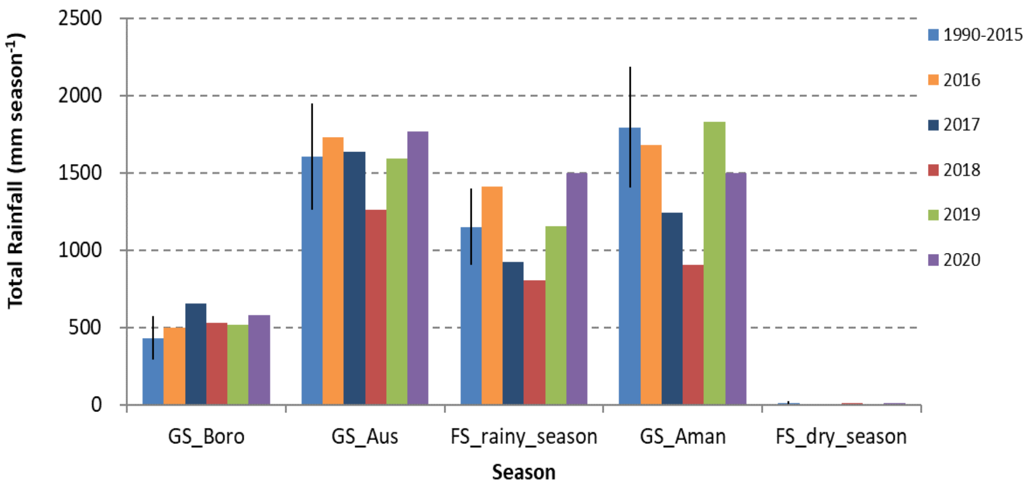

Fig. 4. The total rainfall in growing and fallow periods of 2016, 2017, 2018, 2019 and 2020 with the average from 1990 to 2015. Bars represent standard deviation for the twenty-six years.

Annual Trends of rainfall variation: The annual total rainfall variation in *Aus*, *Aman* and *Boro* season of the study area from 1990 to 2020 has shown in Fig. 5. The lowest annual total rainfall in *Aus* season was 957 mm in 2014, while the greatest annual total was 2486 mm in 2002. The co-efficient has a growing trend throughout the *Aus* season and had a value of 10.85. With a co-efficient value of -13.75 with a declining tendency in the *Aman* season, the highest total rainfall measurement was 2408 mm in 2005 and the lowest was 906 mm in 2018. The lowest total rainfall was 169 mm in 1995, while the greatest was 718 mm in 2002. The co-efficient value is 6.48 and it increased during the *Boro* season.

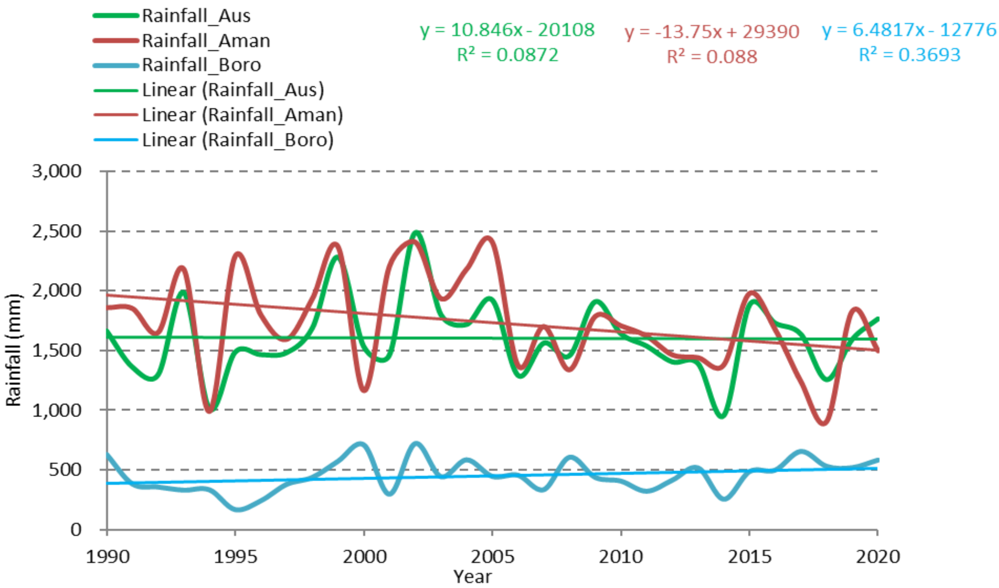

Fig. 5. Annual trends of rainfall variation in *Aus*, *Aman* and *Boro* season

According to the study, there were more anomalies in the diurnal variation of the rainfall pattern in the years 2016, 2017, and 2018 compared to 2019 and 2020 (Fig. 2), the monthly variation was also high (Fig. 3), and the amount of seasonal rainfall was higher in the season of *Aman* and *Aus* compared to the *Boro* season (Fig. 4). The annual total rainfall from 1990 to 2020 was also found to have many anomalies (Fig. 5) while this indicated that slightly upward trend throughout the *Aus* and *Boro* season and a downward trend in the *Aman* season due to the unusual monsoon pattern in the study area. In recent years, rice yield has been a major concernment due to climate change because a substantial amount of rice yield may be impeded for anomalies in rainfall (Siddik *et al.*, 2013). On the other hand, rainfall in monsoon season displayed an upward trend, while slightly decreased in the dry season (November to March) (Rahman *et al.*, 2017). Rainfall pattern gradually increased both *Aus* and *Boro* season and decreased in *Aman* season that has adverse impact on rice production (Islam *et al.*, 2022).

Conclusion

The result of the study revealed that diurnal, monthly and seasonal variation of rainfall were found much anomalies where in *Aus* and *Boro* season increased annual rainfall but decreased in the *Aman* season in the study area. To formulate the new policy, new knowledge, and different crop model for increasing the rice production and sustainable agricultural management in Bangladesh these findings may be used by the researcher, academician, and policy maker.

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