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Impact of Climate Change in Bangladesh: Rainfall

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Abstract – **The objective of this study was to assess the changing trend of annual and monthly rainfall pattern due to climate change in Bangladesh. The updated yearly rainfall data of last 10 years (2002-2011) and monthly rainfall data of five years (2007-2011) for seven selected divisional district weather stations of Bangladesh used in this study. The yearly and monthly total amount of rainfall widely varies over the time and place of the country. Highest yearly rainfall occurred in Sylhet station in 2002, 2003, 2004, 2005, 2006, 2008, 2010 & 2011 but Chittagong station in 2007, 2009 & 2011. Maximum amount of yearly total rainfall (4939 mm) was recorded at Sylhet station in 2010 and lowest at Rajshahi station in all the years during 2002 to 2011. The highest average monthly rainfall occurs in July followed by June, August & September. Lowest amount of monthly rainfall occurs in January followed by December and February. The highest rainfall occurred in monsoon season (June-September) and lowest rainfall in winter season (December-February). Rainfall widely varied over different parts of the country.**

Keywords – **Climate change, annual rainfall, monthly rainfall, trend, Bangladesh.**

I. INTRODUCTION

Bangladesh is located in South Asia. The country is divided into seven administrative divisions. Bangladesh enjoys a sub-tropical monsoon climate characterized by rain-bearing winds, moderately warm temperatures, and high humidity. The annual temperature averages between 7^0C to 36^0C. April is normally the warmest and January is the coolest month. Storms of very high intensity often occur in the early summer and late in the monsoon season. Based on rainfall Bangladesh can be stratified into three zones. Areas receiving average rainfall between 1,500 to 2000 mm, 2000 to 3,000 mm and more than 3,000 mm. Most of the country receives more than 1,500 mm of rainfall. Large areas of the south, southeast, north, and northeast Bangladesh receive from 2,000 mm to 2,500 mm of rainfall. The northern and northwestern parts of the Sylhet area receive from 3,500 mm to 5000 mm of rainfall [1]. The amount of rainfall received over an area is an important factor in assessing availability of water to meet various demands for agriculture, industry, irrigation, generation of hydroelectricity and other human activities. The distribution of rainfall in time and space is, therefore, an important factor for the economic development of a country [2]. Bangladesh is an agricultural country where about 80% of its 160 million People are directly or indirectly engaged in a wide range of agricultural activities, where rainfall is one of the important natural factors for agricultural production. The variability of rainfall and the pattern of extreme high or low precipitation are important for the agriculture. Heavy rainfall often causes flooding in Bangladesh and the country is one of the most flood-prone countries in the world due to its geographic position [3]. Bangladesh receives some of the heaviest rainfall in the world [4]. The heavy rainfall over this area is an important part of the atmospheric heat source that controls Asian summer monsoon circulations [5],[6]. Drought in northwestern part and heavy rainfall in the northeastern part of the country is also a common phenomenon [7], [8]. Bangladesh is one of the top most nations vulnerable to climate change [9]. SAARC region is the most vulnerable to climate change that is seriously affecting agricultural production, diminishing natural resources and limiting development options for the future in this region [10]. Bangladesh is situated at the interface of two different environments, with the Bay of Bengal to the South and Himalayas to the north. Due to its geographical position, Bangladesh experiences highest amount of country average monsoon and annual rainfall among SAARC countries [11]. Bangladesh's unique geographic location, with the Indian Ocean to the south, the Himalayas to the North and the prevailing monsoons, has made it one of the wettest countries of the world. The mean annual rainfall is about 2320mm, but there are places with a mean annual rainfall of 6000mm or more [12]. A long duration of heavy rainfall associated with "norwester" thunderstorms is very common in Bangladesh [12], [13]. The precipitation patterns are of great importance for an agro-based economy like Bangladesh. In view of these changes, it is necessary to regularly and systematically compile, monitor and analyze the relevant climatic parameters for assessing the impacts of climate change [14].

II. MATERIAL AND METHODS

The used yearly rainfall data of seven selected weather stations of Bangladesh during the period 2002-2011 (10 years) and monthly data during the period 2007-2011 (5 years) were published by Bangladesh Bureau of Statistics (BBS) that collected from Bangladesh Meteorological Department (BMD).The monthly, seasonal and annual rainfall data are constructed based on the daily rainfall data. The location of the weather stations selected for this study were Dhaka, Barisal, Chittagong, Khulna, Rajshahi, Sylhet and Rangpur (Fig.1). From the meteorological point of view, there are four climatic seasons in Bangladesh.

Fig.1. Location of seven weather stations in Bangladesh.

International Journal of Agriculture Innovations and Research
Volume 2, Issue 5, ISSN (Online) 2319-1473

They are winter (December–February), Pre-monsoon (March–May), Monsoon (June–September) and Post monsoon (October–November). Geographic location of Bangladesh: 20°34′ north latitude to 26°38′ north latitude and 88°01′ east longitude to 92°41′ east longitude.

III. RESULT

Annual Rainfall

The yearly total rainfall data of seven stations covering 2002-2011 did not showed any significant increasing or decreasing trend. The yearly total amount of rainfall widely varies over the seven stations of the country. Comparatively lower amount of rainfall occurred in the west-central part and higher amount was occurred in northeast & southeast part. Increasing trend was observed from west to east part of the country. Considering the rainfall data of last ten years, highest yearly rainfall occurred in Sylhet region in 2002, 2003, 2004, 2005, 2006, 2008, 2010, 2011 and Chittagong region in 2007, 2009, 2011. Lowest amount of rainfall was observed in all the years (2002-2011) at Rajshahi station (Fig.2). Station wise changing trend of rainfall pattern was similar in every year. Some earlier studies have shown that the rainfall of Bangladesh have been increasing during the recent decades [15], [16]. On temporal scale, about eighty percent of the rainfall occurs during the monsoon period, from June to September or early October. During last decade, the annual average rainfall has varied between about 1900 mm to 2800 mm and shows a declining trend over last ten years [1]. The trend of monsoon rainfall patterns in Bangladesh and found that though southeast part of the country shows a changing pattern of rainfall, the overall evidence does not suggest any changing pattern of monsoon rainfall within Bangladesh [17].

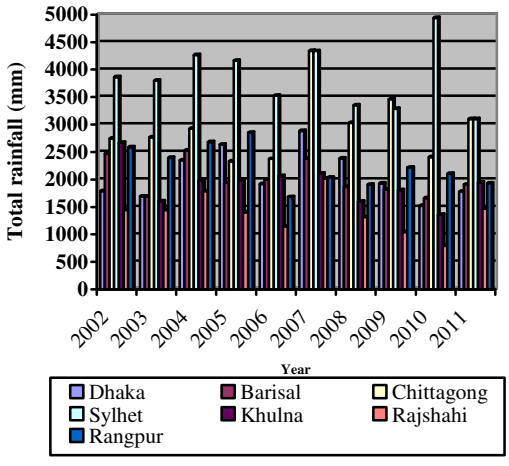

Fig.2. Annual rainfall of seven selected weather stations of Bangladesh (2002-2011)

Monthly Rainfall

The monthly total rainfall amount of seven selected stations varied significantly in observed years (2007-2011). Generally, monthly rainfall increases gradually from the month of January to July and then decreases. The highest amount average monthly rainfall occurs in July followed by June, August & September and lowest amount of monthly rainfall occurs in January followed by December and February. During 2007 to 2011, highest total amount of monthly rainfall was recorded in 2010 at Sylhet (4939 mm) station. The station-wise data shows that the highest amount of monsoon rainfall occurs at Chittagong and lowest occur at Rajshahi. Sylhet receives the second highest rainfall during summer monsoon season .Dhaka, Barisal, Khulna and Rajshahi stations recorded maximum monthly rainfall in July but in June at Chittagong, Sylhet and Rangpur of 2007 (Fig.3). Maximum rainfall observed at Barisal, Chittagong, Rajshahi stations in July; Dhaka and Rangpur stations in June, Sylhet station in August and Rajshahi station in September of 2008 (Fig.4). The highest monthly rainfall was observed at Chittagong station in July of 2009 (Fig.5). Maximum monthly rainfall occurred in July at Dhaka, Barisal, Rangpur, Chittagong. Whereas, Sylhet, Khulna, Rangpur in August but Rajshahi in September of 2010 (Fig.6). Highest monthly rainfall at all observed stations were recorded in August of 2011 (Fig.7). Precipitation data during 1976-2008 showed increasing trend of rainfall for majority of stations during Monsoon and post-Monsoon seasons, while decreasing trend of total rainfall during winter was found for significant number of weather stations. In general, these trends are consistent with the general climate change predictions [14]. Summer monsoon rainfall is characterized by active and weak (break) spells, which are associated with the fluctuation of monsoon rainfall in the time scales of 20-25 and 40-50 days. Such fluctuations are caused due to north-south movement of the monsoon trough [18]. A number of reports have revealed that rainfall patterns have already changed across Bangladesh [19], [20]. While the total annual rainfall of the country has largely remained unchanged [15], [17], [21].

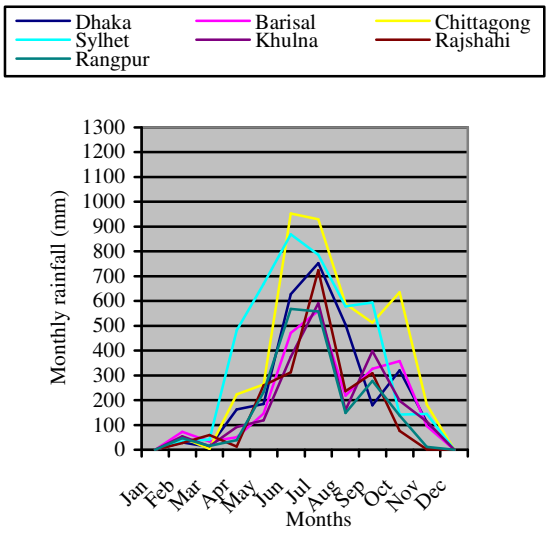

Fig. 3 Monthly rainfall of seven selected weather stations of Bangladesh (2007)

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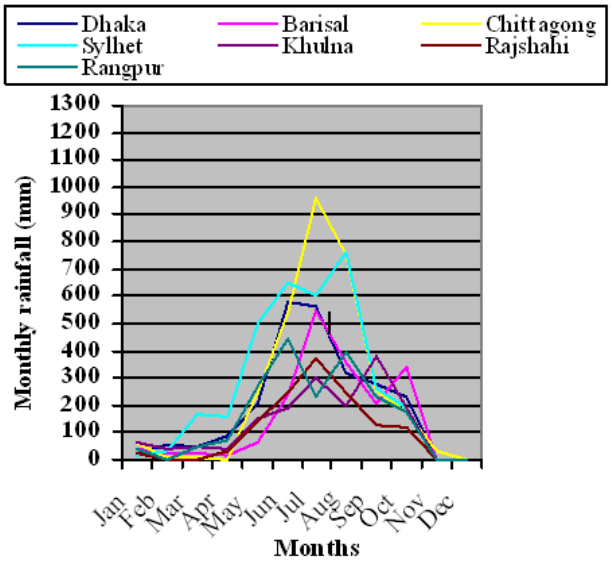

Fig.4. Monthly rainfall of seven selected weather stations of Bangladesh (2008)

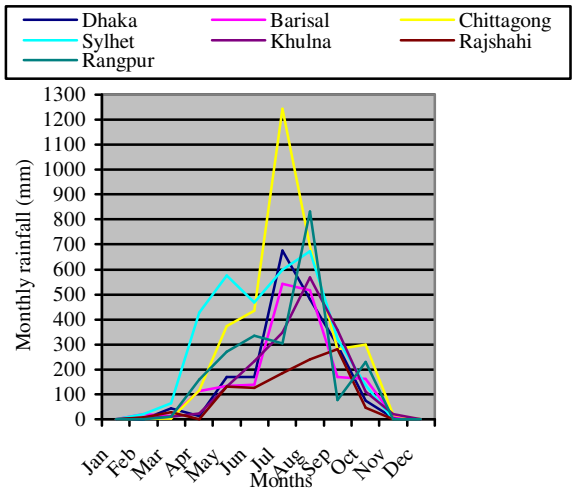

Fig. 5 Monthly rainfall of seven selected weather stations of Bangladesh (2009)

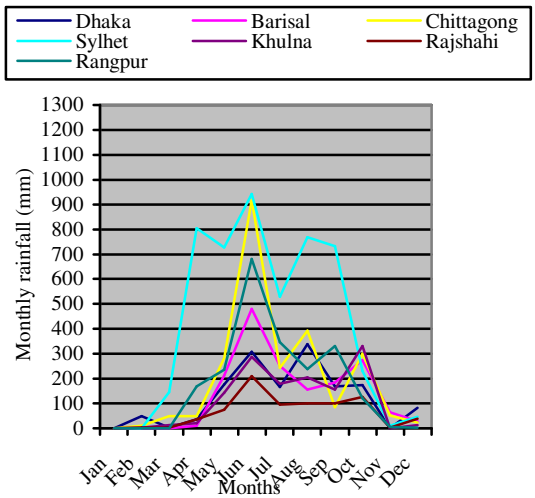

Fig. 6 Monthly rainfall of seven selected weather stations of Bangladesh (2010)

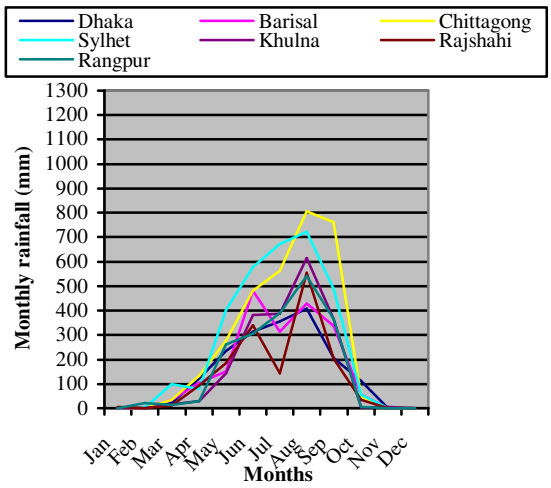

Fig .7 Monthly rainfall of seven selected weather stations of Bangladesh (2011)

IV. Conclusion

Annual total rainfall of last ten years (2002-2011) did not show any significant changing trends. Highest amount of rainfall occurred at all station in 2007. The monthly total country average rainfall was highest in July followed by June, August and September and lowest in January followed by December and February. The highest rainfall occurs in monsoon season (June- September) and lowest rainfall in winter season (December-February). Summer monsoon rainfall widely varies over different parts of the country with lowest over Rajshahi and highest over Chittagong of the country followed by Sylhet.

Acknowledgements

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