J. Environ. Sci. & Natural Resources, 6(2): 149-155, 2013 ISSN 1999-7361

Impact of Climatic Elements on Winter Crop Productivity in Rangpur Area of Bangladesh

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Abstract: This study was carried out to identify the impact of climatic elements (temperature and rainfall) on winter crop productivity of HYV-boro, wheat and tomato in Rangpur area of Bangladesh. From regression analysis, an insignificant positive correlation between HYV boro productivity and winter rainfall was found during 1973-1990 and negative correlation during1991-2008 period. For correlation between wheat productivity and winter rainfall, an insignificant positive relationship during 1973-1990 and negative relationship during 1991-2008 was observed. The relationship between tomato productivity and winter rainfall was lower positive insignificant during 1973-1990 period and higher positive insignificant during 1991-2008 period. In the case of temperature, an insignificant negative correlation during 1973-1990 and positive correlation during 1991-2008 was found between HYV boro productivity and winter temperature. For wheat productivity, winter temperature showed significant negative correlation during 1973-1990 and insignificant positive correlation during 1991-2008. However, tomato productivity and winter temperature was positively insignificant during 1973-1990 and negatively insignificant during 1991-20008. From this study, it is concluded that the rainfall of recent period (1991-2008) was not suitable for boro and wheat but suitable for tomato. Similarly, temperature of the same period was favorable for boro and wheat but disfavorable for tomato in Rangpur area of Bangladesh.

Key Words: Productivity, Temperature, Rainfall, Correlation.

Introduction

Agriculture is one of the sectors, which is most vulnerable to climate variability and change since it is inherently sensitive to local climate (Challinor *et al.*, 2007). The climate of Bangladesh is changing and it is becoming more unpredictable every year. Drought affects annually 2.5 million ha in *kharif* and 1.2 million ha in dry season. Kharif drought affects T. *aman* rice production severely. Besides, about 2.6 million ha are affected by flood (Karim, 1997). Global warming induces changes in temperature and rainfall, which is already evident in many parts of the world, as well as in our country (Ahmed, 1999). These entirely have profound impact on agriculture (McCarthy *et al.*, 2001). Since the great majority of the people of Bangladesh depend on agriculture for their livelihood, agriculture crop in this region is highly susceptible to variations in climatic system. It is anticipated that crop production would be extremely vulnerable under climate change scenarios, and as a result, food security of the country will be at risk (Karim *et al.*, 1996). Despite being highly vulnerable, very little efforts have so far been made to understand potential of agricultural adaptation in Bangladesh. Present development efforts aim to increase food production through the expansion of irrigation, flood protection embankments, with the support of modern agriculture technology especially HYV seeds and fertilizers to achieve national self-sufficiency in food grains. Threat from undefined climate change can terribly hinder this national target. For this reason, it is of utmost significance to investigate about the trend of climate change together with model predictions and the probable impacts on the agriculture production (Karim *et al.*, 1994). Agriculture of Bangladesh is highly vulnerable to variation in weather patterns and is therefore extremely at risk from climate change, which will affect food security (Ahmed, 2006), particularly in the southern coastal and northern drought-prone areas of Bangladesh (NAPA, 2005). Food productivity will be particularly sensitive to climate change, because crop yields depend directly on climatic conditions (temperature and rainfall patterns). In tropical regions, even small amounts of warming will lead to decline a large amount of crops production. In cold areas, crop harvests may increase first for moderate increase in temperature but then fall. Higher temperatures will lead to large decline in cereal (e.g. rice, wheat) production around the world (Stern, 2006).

Different varieties of crops are grown in Bangladesh throughout the year in three distinct growing seasons where Boro season (winter) covering the months from December to May. The non major crop like wheat covers the months from November to mid April. This study was carried out to find out the impact of climatic elements on winter crop productivity in Rangpur area of Bangladesh.

Materials and Methods

Secondary data were used in this study. Data for crop production and climatic elements of Rangpur were collected from different organizations. Climate data (rainfall and temperature) was collected from Bangladesh Meteorological Department (BMD). Production data of boro, wheat and tomato was taken from the Department of Agricultural Extension

(DAE) and Bangladesh Bureau of Statistics (BBS). These data were computed year wise (1973-2008) and plotted by MS Excel Programme. After that, regression analysis was done to find out the probable linkage between climate data and agricultural productivity.

Results and Discussion

In Rangpur area, rice and wheat play a vital role in food security. These are the principal food crops. Success and failure of these crops have significant impact on food security.

For, rice production needs a high amount of water which is highly dependent on rainfall and a certain temperature. This study identified the impact of temperature and rainfall on winter crop productivity through correlation analysis over Rangpur area of Bangladesh.

Correlation of Crop Productivity with Rainfall in Rangpur

The variations of annual productivity of HYV boro, wheat and tomato in different periods with respect to winter rainfall are given in Figures 1-6.

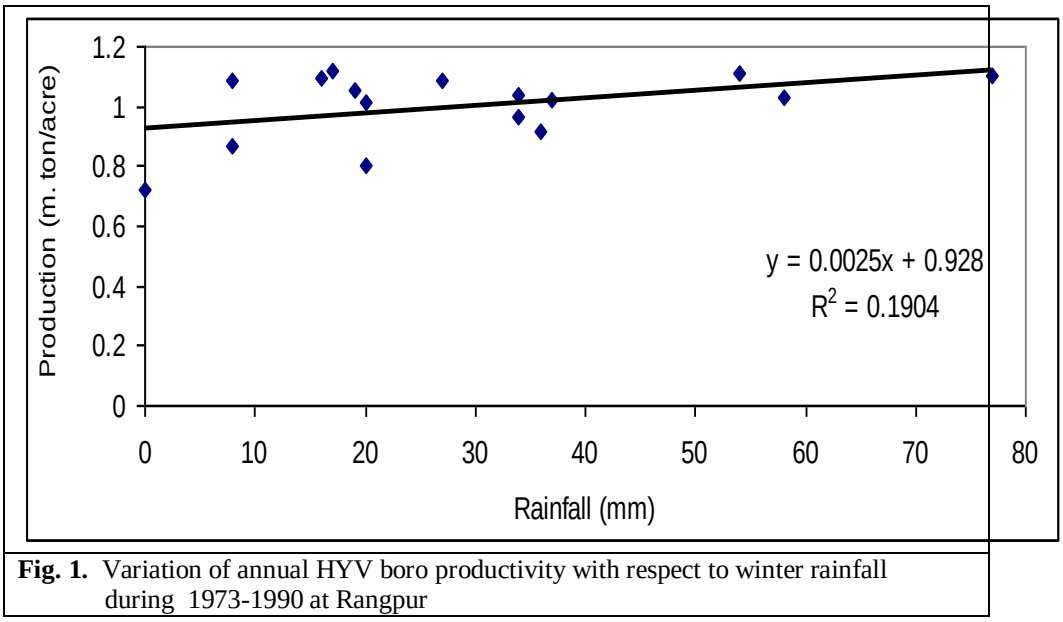

Fig. 1. Variation of annual HYV boro productivity with respect to winter rainfall during 1973-1990 at Rangpur

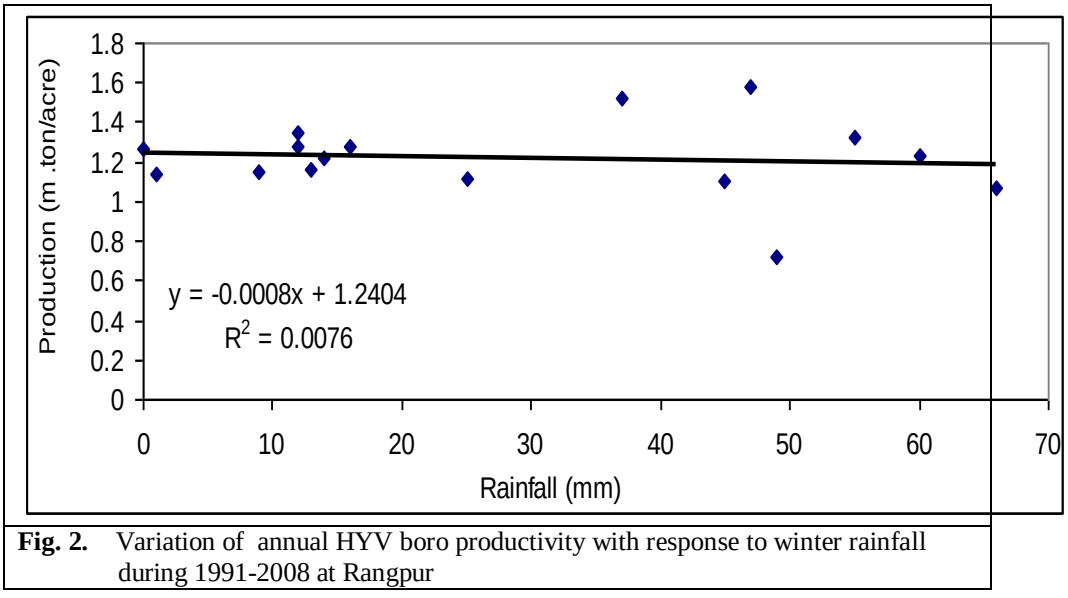

Fig. 2. Variation of annual HYV boro productivity with response to winter rainfall during 1991-2008 at Rangpur

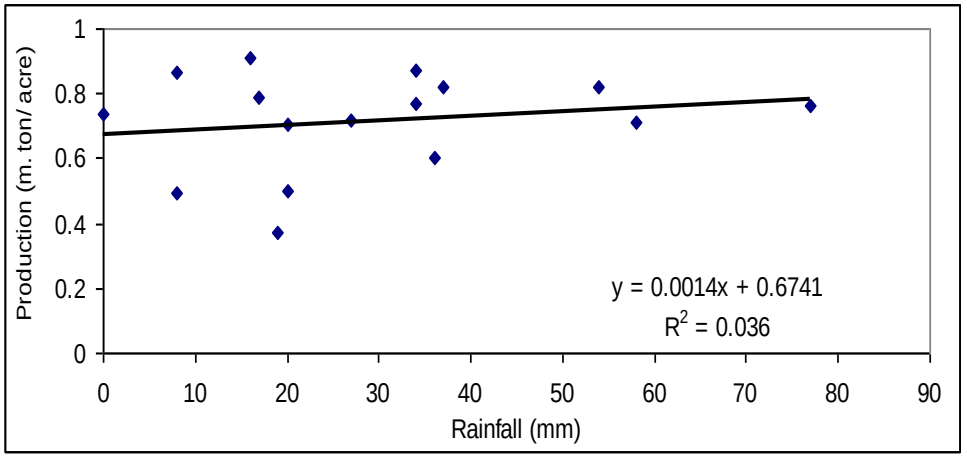

Fig. 3. Variation of annual wheat productivity with respect to winter rainfall during 1973-1990 at Rangpur

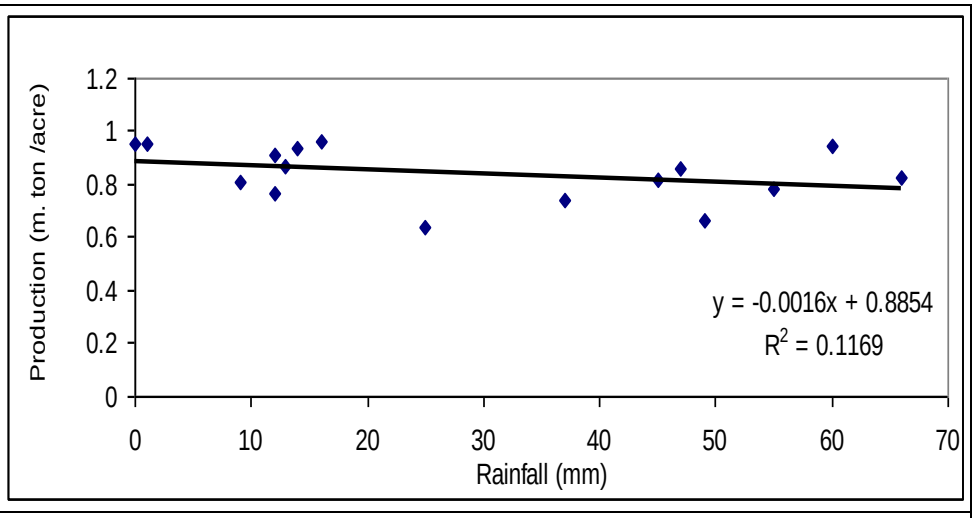

Fig. 4. Variation of annual wheat productivity with respect to winter rainfall during 1991-2008 at Rangpur

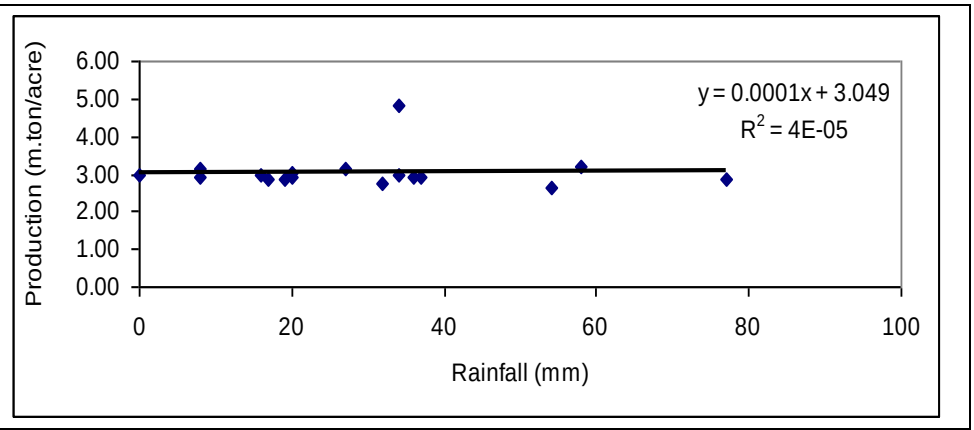

Fig. 5. Variation of annual tomato productivity with respect to winter rainfall during 1973-1990 at Rangpur

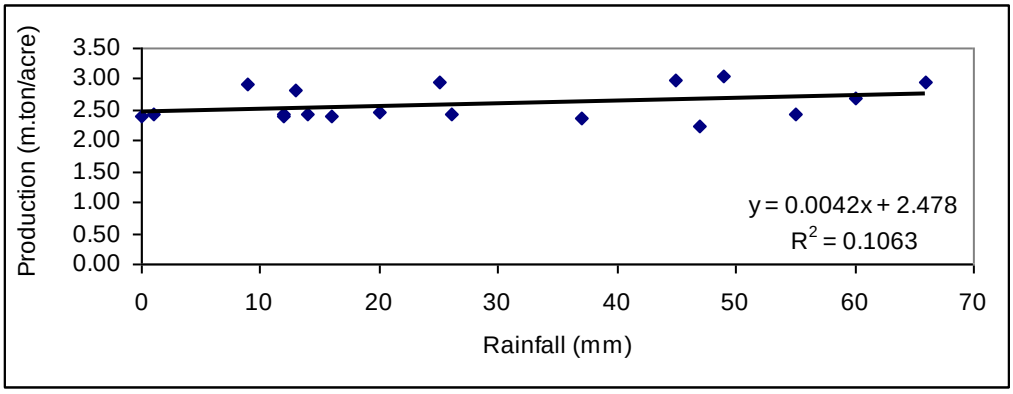

Fig. 6. Variation of annual tomato productivity with respect to winter rainfall during 1991-2008 at Rangpur

Productivity of HYV boro with response to winter rainfall exhibited an insignificant positive correlation ($r = 0.44$, $p>0.05$) during 1973-1990 (Fig.1) and negative correlation ($r = -0.09$, $p> 0.05$) during 1991-2008 (Fig.2).

In the case of wheat, the correlation analysis showed an insignificant positive relationship ($r = 0.19$, $p>0.05$) during 1973-1990 period (Fig.3) and insignificant negative relationship ($r = -0.34$, $p>0.05$) during 1991-2008 period (Fig.4) between wheat productivity and winter rainfall.

The relationship between tomato productivity and winter rainfall was lower positive insignificant ($r = 0.0062$, $p>0.05$) during 1973-1990 period (Fig.5) and higher positive insignificant ($r = 0.33$, $p>0.05$) during 1991-2008 period (Fig.6).

From this analysis, it is found that rainfall of the recent period 1991-2008 was disfavorable for boro and wheat, and favorable for tomato. A study over Satkhira by Rimi *et al.* (2008) revealed an insignificant negative correlation between boro production and winter rainfall. Moreover, the study of Quadir *et al.* (2003) showed that the crop yield is low for low rainfall. The yield increase with increase of rainfall up to a certain optimum level and further increase of rainfall causes decrease of crop yield. The result of the present study of Rangpur area is found to have similarity with Satkhira district.

Correlation of Crops Productivity with Temperature in Rangpur

The variations of annual productivity of HYV boro, wheat and tomato in different periods with respect to winter temperature are given in Figures 7-12.

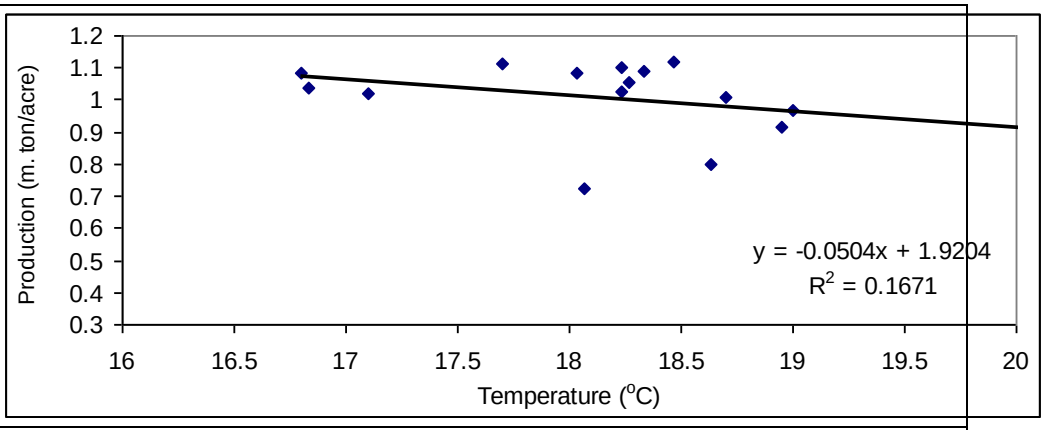

Fig. 7. Variation of annual HYV boro productivity with respect to winter temperature during 1973-1990 at Rangpur

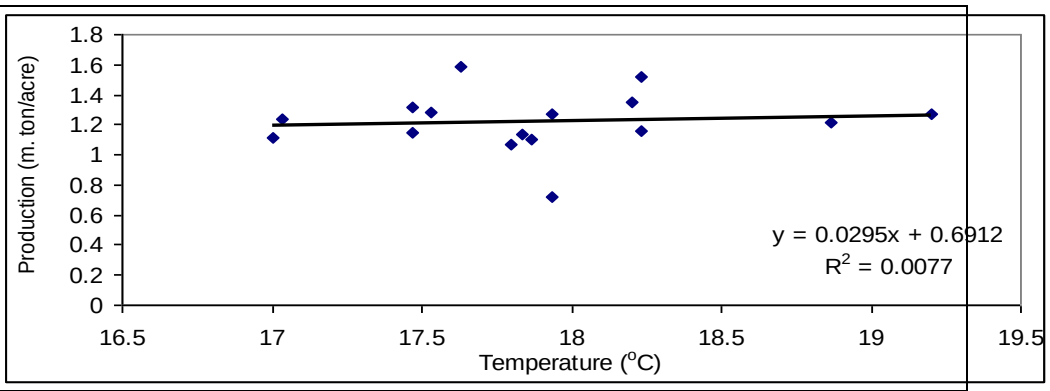

Fig. 8. Variation of annual HYV boro productivity with respect to winter temperature during 1991-2008 at Rangpur

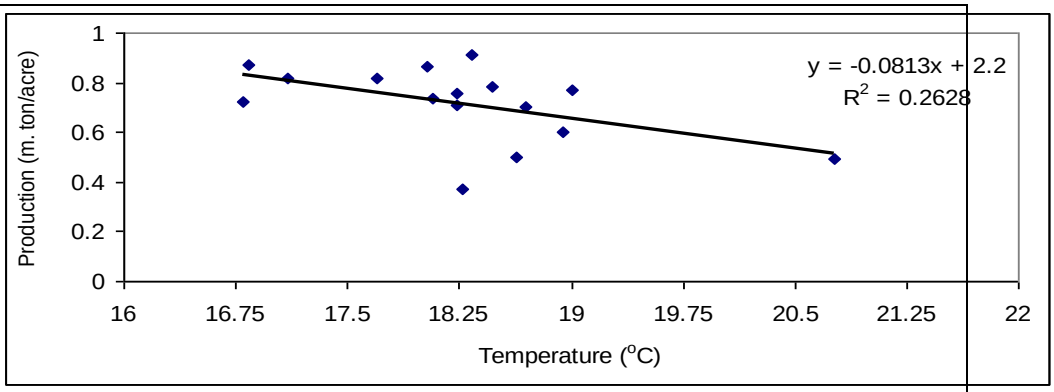

Fig. 9. Variation of annual wheat productivity with respect to winter temperature during 1973-1990 at Rangpur

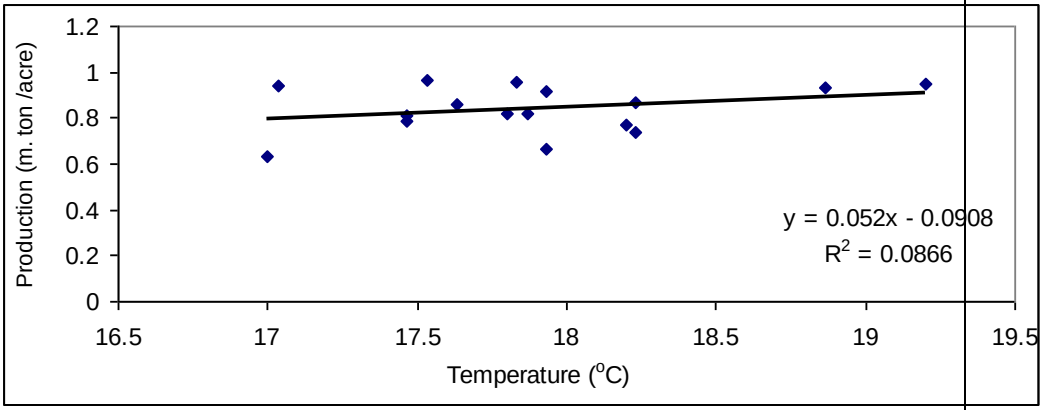

Fig. 10. Variation of annual wheat productivity with respect to winter temperature during 1991-2008 at Rangpur

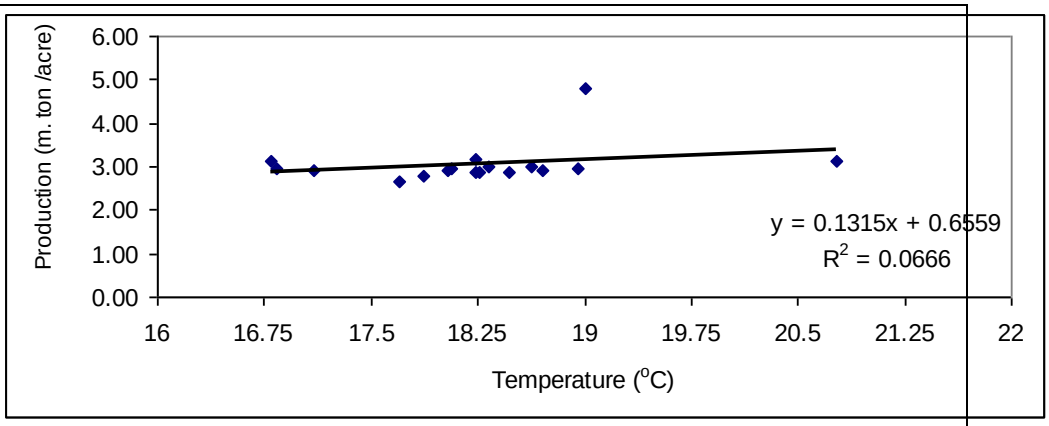

Fig. 11. Variation of annual tomato productivity with respect to winter temperature during 1973-1990 at Rangpur

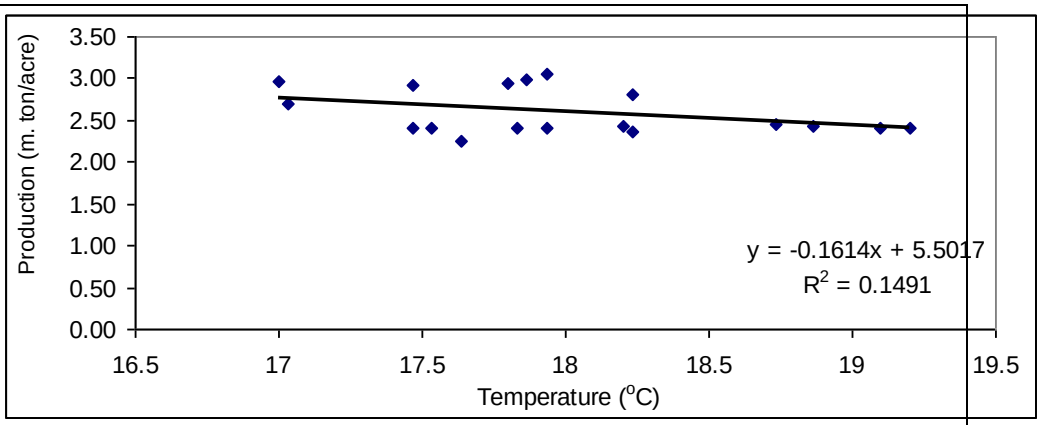

Fig. 12. Variation of annual tomato productivity with respect to winter temperature during 1991-2008 at Rangpur

An insignificant negative correlation (r = -0.41, p>0.05) during 1973-1990 period and positive correlation (r = 0.09, p>0.05) during 1991-2008 period was found between HYV boro productivity and winter temperature (Fig.7 and Fig.8, respectively).

Wheat productivity with response to winter temperature was significant negative correlation (r = -0.51, p<0.05) during 1973-1990 period (Fig.9) and insignificant positive correlation (r = 0.29, p>0.05) during 1991-2008 period (Fig. 10)

The relationship between tomato productivity and winter temperature was positively insignificant (r = 0.26, p>0.05) during 1973-1990 period (Fig.11) and negatively insignificant (r = -0.39, p>0.05) during 1991-2008 period (Fig.12).

From this study, it is concluded that temperature of the recent period 1991-2008 was favorable for boro and wheat but disfavorable for tomato. The same type of findings was found in one study conducted on Satkhira district, which observed a strong positive correlation between boro production and temperature during 1999-2006 periods (Rimi *et al*. 2008).

Conclusion

Correlation of HYV boro and wheat productivity with rainfall was found insignificant positive during1973-1990 and insignificant negative during 1991-2008 in Rangpur area. Tomato productivity exhibited higher positive correlation but insignificant with rainfall during 1991-2008. In the case of temperature, HYV boro and wheat productivity showed an insignificant negative correlation during during1973-1990 and insignificant positive correlation during 1991-2008. Productivity of tomato revealed an insignificant negative correlation with temperature during 1991-2008 but insignificant positive correlation during1973-1990 in the study area.

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