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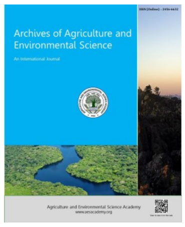

ORIGINAL RESEARCH ARTICLE

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# Impact of climate change on yield of different crops grown in Cachar district of Assam, India

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**ABSTRACT**

Impact of climate change on crop yield threatens food security which is detrimental to agricultural sector. Cachar district of Assam is a climate susceptible district due to its unique geographical location and hydrological regime in north-eastern India. So, the present study was carried out to assess impact of climate change on crop yield for sustainability of agriculture. Climatic data *viz.,* rainfall, maximum-minimum temperature and sunshine hours were collected from an observatory of Tea Research Association, Silcoorie, Cachar district for 2007-2012. Statistical and correlation analysis was employed to evaluate potential climate change impact on productivity of twenty three major crops of the study site. The correlation coefficient (*r*, Pearson's Product Moment) between any climatic parameter and crop yield implied that climate has strong linear correlation with yield of crops resulting in twenty-two strong correlations. Among the climatic parameters rainfall was found to have most significant impact on yield. Noteworthy reduction was observed in yield of Autumn Paddy and Winter Paddy by 8.75 and 20.44 during the year 2008-2009 due to 3.98 and 36.22% decrease of rainfall with *r* values 0.95 and -0.76, respectively. Also, a quantum leap of 145.32% increase of rainfall during *Rabi* season of 2007-2008 decreased the yield of Potato and *Rabi* vegetables by 22.96 and 16.89%, respectively. The study revealed that climate change has significant impact on crop yield which could be alleviated by adopting rainwater harvesting technology at the top and foot hills of the hilly areas.



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## INTRODUCTION

Global climate change induced by increasing concentrations of greenhouse gasses in the atmosphere is likely to increase temperatures, change precipitation patterns and increase the frequency of extreme events. Climate change refers to all forms of climatic inconsistency regardless of their statistical nature (Mitchell *et al*., 1966). It may be conveyed as changes in the climate over time whether due to the natural variability or a result of human induced activities (IPCC, 2007). Anthropogenic greenhouse gas emissions as a result of industrialization and urbanization have made significant contributions to global warming and further changes in the global climate (Kumar and Chopra, 2009; Gohari *et al*., 2013). As a result, global temperature rose by 0.74°C ranging from 0.56 to 0.92°C during the tenure 1906 to 2005. By the end of 21st century, the global air surface temperature will continue to increase by 1.8 to 4°C (IPCC, 2007). Global warming also causes changes in precipitation levels and patterns due to higher evapotran spiration and water vapour amounts in the atmosphere with several implications for the global hydrological cycle. Through the impacts on agro-climatological parameters, concomitantly crop yield is also affected, thus jeopardizing food security.

As agriculture is one of the most vulnerable sectors susceptible to climate change and also the major water consumer of the developing world and some developed countries. Olarenwaju (2012) had declared that many of the problems facing agricultural sector are climate related. It can be concluded that climate parameters are the major environmental factors capable of affecting agriculture. Kumar *et al.* (2015) concluded in their study that scientists concurred with the fact that climate changes ushered in additional stress on the already fragile systems of agriculture as well as affected crop physiology. Changes in temperature and precipitation may either benefit or harm agricultural systems depending on the location in the world (Chavas *et al*., 2009, Ruane *et al*., 2013, Mishra *et al*., 2013). Climatic parameters such as solar radiation, temperature, moisture, rainfall etc. determine the global distribution of crops and livestock as well as crop yield and livestock productivity (Ajadi *et al.,* 2011). Agricultural crop production might be significantly affected by changes in climate and rising $CO_2$ levels. The increased $CO_2$ levels enhance photosynthesis rates (i.e. $CO_2$ enrichment effect), yields in some and water use efficiency (WUE) under water stress conditions. Therefore, the overall effect of increased $CO_2$ levels and climate change on crop yields will depend on local climatic conditions as well as cropping systems and practices like biomass burning, crop residue removal (Manna *et al*., 2015). To ensure sustainability of agriculture, studying the possible climate change impacts on this sector is essential. Thus, the present study was undertaken to ascertain the impact of climate on agriculture in Cachar district, Assam.

## MATERIALS AND METHODS

**Study area:** Based on the availability of climatic and crop parameters data, Cachar district of Assam, India was selected as study area for the present study. Cachar district, situated in the southern part of Assam of India is surrounded by hills on three sides with a geographical area of 3786 $km^2$ (Figure 1). Its longitude extends from 92° 24' to 93° 15' E and latitude from 24° 22' to 25° 8' N. The altitude of the highest point is 36.5 m from MSL. The soil is mainly acidic in reaction, with pH range 4.5-5.9.

The southern part of Assam enjoys a hot and humid climate with high relative humidity. The maximum temperature ranges from 35-37°C and minimum temperature from 9-11°C. The maximum relative humidity observed during summer is 90-95% and the lowest observed during winter is 65-70%. Apart from the extreme humidity the most distinguishing feature of climate of this region is a high rainfall belt with copious average annual rainfall of 2800 mm. The area is characterized by tropical monsoon climate having two distinct agricultural seasons viz. rainy/*Kharif* (April-September) and winter/*Rabi* (October-March) and three seasons for the staple crop of this region, Paddy viz. *Ahu*/autumn (February-July), *Sali*/summer (June-December) and *Boro*/winter (November-June). Presently less than 2% of the total cropped area is under irrigation and rest 98% of the total cropped area is rain-fed (Anonymous, 2012-2013).

**Cropping pattern and crop yield:** Wide variation of physiographic features and climatic characteristics have resulted in three distinct growing seasons of rice (*Oryza sativa*) which is grown in plenty: *Ahu* or Autumn, *Sali* or Winter and *Boro* or Summer. Apart from paddy, various other cereals, pulses, oil seeds, fibers and vegetables are grown in this region. In the present study, twenty three crops were considered to study the impact of climate change on their yield. The various crops along with their cropping pattern that have been considered in this study have been summarized in Table 1. The yields of various crops were sourced from the Status Paper of Cachar district for the period available viz. 2007-2010 and 2011-2012 published by the Department of Agriculture, Cachar district, Silchar on an annual basis.

**Assessment of climate variability:** The climate variability of the study area was assessed for the climatic parameters like rainfall, maximum and minimum temperature and sunshine hours recorded per day observed in the study site. The observed data were collected from the Tea Research Association (TRA) observatory, Silcoorie, Cachar district. The data of daily rainfall, daily maximum and minimum temperature and sunshine hours recorded per day were collected for the duration 2007-2012 to analyze the impact of climate change on the crop yield during the years under purview.

**Analysis of agriculture-climate relationship:** Various methods have been reported for establishing agriculture-climate relationship (Ajadi *et al*., 2011). One endeavour is to establish fundamentals of plant-climate relationship in the terms of moisture balance of various crops in different climatic conditions and solar radiation (Olaniran, 1981). The other method involves analysing the crop yield for a particular area for a particular period of time (as much constant record of agricultural crop yield data and climatic data would permit) and arrive at an agro-climatological relationship. The latter method was employed in the present study: correlation was used in showing the relationship between climatic parameters and crop yield, the trend and variation in crop yield over the years 2007-2012 (duration for which the data of crop yield was available) in the study area. These statistical techniques were employed in the analysis of both crop yield data and climatic parameters because of their vital roles in revealing the relationship and variation among variables.

The mean value was calculated by using Arithmetic Mean Method. If $X_1, X_2, X_3 \ldots X_N$ are the measured values of day 1, 2, 3…$N$, then their mean value ($\overline{x}$) is given by:

$$\overline{X} = \frac{X_1 + X_2 + X_3 + \ldots + X_N}{N} \quad (1)$$

The standard deviation, (σ) was estimated using the following equation:

$$\sigma = \sqrt{\frac{N\,[\overline{X^2} - (\overline{X})^2]}{N-1}} \quad (2)$$

Coefficient of variation ($C_v$) compares the degree of variation from one data series to another, even if the means are drastically different from each other. It shows the extent of variability in relation to mean of the population. It is computed as under:

$$Coefficient\ of\ Variation = \frac{\sigma}{\overline{X}}\ x\ 100 \quad (3)$$

Correlation shows whether and how strongly pairs of variables are related. The numerical measure of correlation is called the coefficient of correlation ($r$). The correlation (Pearson's Product Moment) between any two parameters $X$ and $Y$ can be expressed as:

$$r = \frac{n(\sum XY) - \sum X \sum Y}{\sqrt{[\{n\sum X^2 - (\sum X)^2\}\ x\ \{n\sum Y^2 - (\sum Y)^2\}]}} \quad (4)$$

Where n= total number of observations on $X$ and $Y$ and $-1 \leq r \geq 1$. The interpretation of values of $r$ is:

Here, 0 indicates no linear relationship; +1 indicates a perfect positive linear relationship: as one variable increases in its values, the other variable also increases in its values; -1 indicates a perfect negative linear relationship: as one variable increases in its values, the other variable decreases in its values; Values between 0 and 0.3 (0 and -0.3) indicate a weak positive (negative) linear relationship; Values between 0.3 and 0.7 (0.3 and -0.7) indicate a moderate positive (negative) linear relationship; Values between 0.7 and 1.0 (-0.7 and -1.0) indicate a strong positive (negative) linear relationship.

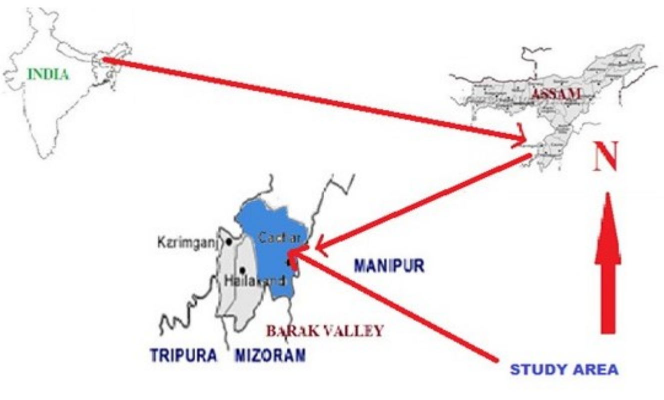


**Figure 1.** *Location of the study area (Source: Google maps).*

## RESULTS AND DISCUSSION

**Temporal variation of crop yield:** The temporal (yearly) variations of yield of various crops were collected and analyzed for the years 2007-2010 and 2011-2012. Table 2 shows the descriptive analysis of the available crop yield data of Cachar district (2007-2010 and 2011-2012) for twenty-three major crops grown in this region. Out of the various cereals, Summer/*Sali* Paddy has the highest mean value of production (186226.5 tonne; 1 tonne = 1000 kg), followed by Autumn/*Ahu* Paddy (15131.5 tonne) which concurs with the fact that rice is the staple food of the region and hence grown in abundance. Among the different pulses Black Gram has the highest mean yield (497.75 tonne) and Lentil the lowest (12.25 tonne). Rape and Mustard have the highest mean yield of 1222.75 tonne and Niger the lowest (7.75 tonne) among the oilseeds. Cachar district with its unique climatological features and soil is highly conducive to Jute cultivation and among the fibrous crops Jute has the highest mean yield of 548.5 bales (1 bale = 170 kg), while Cotton and Mesta have 37.5 bales and 30.5 bales, respectively. Potato is also widely grown in the region with a mean yield of 12434.5 tonne. *Kharif* and *Rabi* vegetables have a mean yield of 51767.25 tonne and 103876.8 tonne, respectively. For the years under consideration *Rabi* Vegetables has the highest deviation (29908.0), as its yield has increased with time and the lowest deviation was observed for Green gram (0.81). This suggests that the dispersion characteristics of crop yield in Cachar district can range from very high to low. The coefficient of variation (*Cv*) which indicates the relative deviation among the various crops is highest for Mesta (31.73%) and lowest for Sesamum (2.44%). This heterogeneity of *Cv* in the crop yield produced in the study years can be attributed to various factors, climate change being foremost of them. Ajadi *et al.* (2011) observed the changes in climatic parameters such as solar radiation, temperature; moisture, rainfall etc.

**Temporal variation of climatic parameters:** Table 3 shows that for *Ahu* Paddy with crop growth season February-July, highest rainfall occurred in 2009-2010 (1499.4 mm) and the highest total hours of sunshine was recorded in 2007-2008 (1057.1). For *Boro* Paddy (June-December), highest rainfall occurred in 2008-2009 (2064.9 mm) and highest sunshine hours (1181.3) recorded in 2007-2008. *Sali* Paddy, which has crop growth season of November-June, experienced highest rainfall of 1516.3 mm in 2009-2010 and highest sunshine hours of 1487 in 2007-2008. *Kharif* season (April-September) always experiences the highest amount of rainfall among all the seasons, the peak value being 2095.7 mm in 2007-2008 whereas *Rabi* season (October-March) recorded the lowest rainfall of 203.3 mm in 2011-2012. In all the years under consideration, the average maximum and minimum temperature for the various crop growth seasons did not display much fluctuation. The descriptive pattern of the various climatic data, indicate that some of the climatic parameters vary from one year to another and hence the variation in crop yield.

**Table 1.** The details of the crop and crop growth season of the study area.

| Crop | Botanical name | Crop growth season |
|---|---|---|
| *Ahu*/Autumn Paddy | *Oryza sativa* | February–July |
| *Sali*/Winter Paddy | | June-December |
| *Boro*/Summer Paddy | | November-June |
| Green Gram | *Vigna radiate* | April- September |
| Arahar | *Cajanus cajan* | |
| Black gram | *Vigna mungo* | |
| Ground Nut | *Arachis hypogaea* | |
| Jute | *Corchorus oliotorus* | |
| Maize | *Zea mays* | |
| Sesamum | *Sesamum indicum* | |
| Mesta | *Hibiscus cannabinus* | |
| Cotton | *Gossypium arboretum* | |
| Millet | *Pennisetum glaucum* | |
| *Kharif* vegetables | - | |
| Wheat | *Triticum aestivum* | October-March |
| Lentil | *Lens culinaris* | |
| Pea | *Pisum sativum* | |
| Gram | *Cicer arietinum* | |
| Rape | *Brassica napus* | |
| Mustard | *Brassica juncea* | |
| Linseed | *Linum usitatissimum* | |
| Niger | *Guizotia abyssinica* | |
| Potato | *Solanum tuberosum* | |
| *Rabi* vegetables | - | |

**Table 2.** Descriptive statistics of the crop yield data.

| Crop | 2007-2008 | 2008-2009 | 2009-2010 | 2011-2012 | Mean yield | σ | Cv (%) |
|---|---|---|---|---|---|---|---|
| **Crop yield (Cotton, Jute, Mesta in bales*, others in tonne** )** | | | | | | | |
| Ahu Paddy (Feb-July) | 15701 | 13808 | 16457 | 14560 | 15131.5 | 1177.50 | 7.78 |
| *Sali* Paddy (June-Dec) | 157287 | 199711 | 204084 | 183824 | 186226.5 | 21165.9 | 11.37 |
| *Boro* Paddy (Nov-June) | 18941 | 21126 | 16448 | 13645 | 17540 | 3224.16 | 18.38 |
| **Kharif crops ( April-September)** | | | | | | | |
| Millets | 13 | 14 | 15 | 14 | 14 | 0.82 | 5.83 |
| Green Gram | 16 | 17 | 18 | 17 | 17 | 0.81 | 4.8 |
| Arahar | 91 | 86 | 87 | 82 | 86.5 | 3.7 | 4.27 |
| Black Gram | 489 | 521 | 518 | 463 | 497.75 | 27.29 | 5.48 |
| Ground-nut | 13 | 17 | 16 | 15 | 15.25 | 1.71 | 11.19 |
| Jute | 409 | 571 | 579 | 635 | 548.5 | 97.26 | 17.73 |
| Sesamum | 100 | 97 | 95 | 95 | 96.75 | 2.36 | 2.44 |
| Maize | 53 | 50 | 50 | 59 | 53 | 4.24 | 8.00 |
| Mesta | 44 | 23 | 31 | 24 | 30.5 | 9.68 | 31.73 |
| Cotton | 42 | 35 | 34 | 39 | 37.5 | 3.7 | 9.86 |
| *Kharif* Vegetables | 46945 | 50236 | 50343 | 59545 | 51767.25 | 5419.74 | 10.46 |
| **Rabi crops (October-March)** | | | | | | | |
| Wheat | 164 | 128 | 168 | 169 | 157.25 | 19.62 | 12.48 |
| Lentil | 13 | 11 | 12 | 12.768 | 12.25 | 0.96 | 7.81 |
| Chickpea | 28 | 28 | 28 | 32 | 29 | 2 | 6.89 |
| Pea | 241 | 224 | 250 | 216 | 232.75 | 15.52 | 6.67 |
| Linseed | 12 | 14 | 14 | 12 | 13 | 1.15 | 8.88 |
| Niger | 7 | 7 | 9 | 8 | 7.75 | 0.96 | 12.35 |
| Rape and Mustard | 1210 | 1341 | 1297 | 1042 | 1222.5 | 132.07 | 10.80 |
| Potato | 8679 | 12082 | 15290 | 13687 | 12434.5 | 2825.52 | 22.72 |
| *Rabi* Vegetables | 86324 | 90354 | 90177 | 148652 | 103876.8 | 29908.0 | 28.79 |

** 1 bale = 170 kg; *1 tonne = 1000 kg

**Table 3.** Pattern of agro-climatic data considered to study the impact on crop yield.

| Duration/ Crop growth season | Year | Total rainfall, mm | Average maximum temperature, °C | Average minimum temperature, °C | Hours of sunshine |
|---|---|---|---|---|---|
| Season of *Ahu* Paddy (Feb – July) | 2007-2008 | 1419.3 | 30.91 | 20.70 | 1057.1 |
| | 2008-2009 | 1347.1 | 31.34 | 21.00 | 989.9 |
| | 2009-2010 | 1499.4 | 32.8 | 20.98 | 993.9 |
| | 2011-2012 | 1346.2 | 32.60 | 23.46 | 844.8 |
| Mean | - | 1403.0 | 31.91 | 21.54 | 971.43 |
| Season of *Sali* Paddy (June-Dec) | 2007-2008 | 1824.3 | 30.94 | 22.22 | 1181.3 |
| | 2008-2009 | 2064.9 | 31.44 | 22.10 | 1146.2 |
| | 2009-2010 | 1761.8 | 31.82 | 22.31 | 1161.1 |
| | 2011-2012 | 1433.4 | 31.83 | 21.86 | 1108.2 |
| Mean | - | 1771.1 | 31.51 | 22.12 | 1149.2 |
| Season of *Boro* Paddy (Nov-June) | 2007-2008 | 1047.3 | 29.38 | 18.27 | 1487 |
| | 2008-2009 | 933.1 | 30.76 | 18.09 | 1467.5 |
| | 2009-2010 | 1516.3 | 29.72 | 17.81 | 1254.8 |
| | 2011-2012 | 1307.3 | 29.62 | 17.37 | 1330.3 |
| Mean | - | 1463.1 | 30.58 | 19.33 | 1247.78 |
| *Kharif* season (April-Sept) | 2007-2008 | 2095.7 | 32.21 | 24.06 | 938.5 |
| | 2008-2009 | 2135.8 | 32.92 | 24.05 | 936.2 |
| | 2009-2010 | 1936 | 33.37 | 24.15 | 966.3 |
| | 2011-2012 | 1906.1 | 32.91 | 24.02 | 775.2 |
| Mean | - | 1644.83 | 31.77 | 22.17 | 950.03 |
| *Rabi* season (Oct-March) | 2007-2008 | 601.4 | 27.88 | 16.46 | 1122.4 |
| | 2008-2009 | 284.4 | 29.74 | 16.46 | 1135.4 |
| | 2009-2010 | 289.6 | 29.52 | 16.34 | 1091.2 |
| | 2011-2012 | 203.3 | 29.52 | 16.34 | 1112 |
| Mean | - | 245.15 | 29.58 | 16.37 | 1112.65 |

**Table 4.** Coefficient of correlation (*r*) between crop yield (tonne/bale) and climatic parameters for the various selected crops.

| | **Names of crops** | **Total rainfall, mm** | **Average maximum temperature, °C** | **Average minimum temperature, °C** | **Hours of sunshine** |
|---|---|---|---|---|---|
| Paddy | *Ahu* | 0.95 | 0.30 | -0.35 | 0.40 |
| | *Sali* | 0.19 | 0.76 | 0.07 | -0.34 |
| | *Boro* | -0.76 | 0.62 | 0.89 | 0.74 |
| *Kharif* crops | Millets | -0.57 | 0.99 | 0.66 | 0.13 |
| | Sesamum | 0.78 | -0.88 | -0.19 | 0.43 |
| | Maize | -0.52 | -0.26 | -0.68 | -0.95 |
| | Green Gram | -0.57 | 0.99 | 0.66 | 0.13 |
| | Arahar | 0.61 | -0.51 | 0.40 | 0.82 |
| | Black Gram | 0.46 | 0.40 | 0.65 | 0.87 |
| | Groundnut | 0.02 | 0.79 | 0.21 | 0.13 |
| | Jute | -0.61 | 0.80 | -0.06 | -0.53 |
| | Mesta | 0.26 | -0.67 | 0.23 | 0.43 |
| | Cotton | 0.14 | -0.90 | -0.56 | -0.35 |
| | *Kharif* Vegetables | -0.70 | 0.35 | -0.47 | -0.92 |
| *Rabi* crops | Wheat | 0.12 | -0.34 | -0.66 | -0.76 |
| | Lentil | 0.44 | -0.68 | -0.25 | -0.31 |
| | Chickpea | -0.54 | 0.27 | -0.58 | -0.12 |
| | Pea | 0.50 | -0.38 | -0.01 | -0.54 |
| | Linseed | -0.19 | 0.46 | 0.14 | -0.07 |
| | Niger | -0.38 | 0.37 | -0.78 | -0.94 |
| | Rape and Mustard | 0.16 | 0.14 | 0.46 | 0.15 |
| | Potato | -0.86 | 0.83 | -0.84 | -0.67 |
| | *Rabi* Vegetables | -0.59 | 0.33 | -0.60 | -0.13 |

**Impact of climatic parameters on crop yield:** Statistical techniques were employed in the agro-climatic variation analysis of both crop yield data and climatic parameters because of their vital roles in revealing the relationship and variation among variables. The correlation coefficients (*r*) between any of the climatic parameters such as rainfall, maximum and minimum temperature, sunshine hours and the yield of any particular crop were computed by Pearson's product moment (Eq. 4) considering the climatic data for that particular growing season of that particular crop. The values of *r* between 0.7 and 1.0 (-0.7 and -1.0) indicated a strong positive (negative) linear relationship, as had been mentioned earlier. The values of *r* for the twenty-three crops and the climatic parameters have been summarized in a nutshell in Table 4.

Rainfall was found to have a strong positive correlation with *Ahu* Paddy (*r* = 0.95), Sesamum (*r* = 0.78), Arahar (*r* = 0.61) implying that as rainfall increased, the yields of the aforementioned crops also increased, and bore a strong negative correlation with *Boro* Paddy (*r* = -0.76), Jute (*r* = -0.61), Potato (*r* = -0.86) and *Kharif* vegetables (*r* = -0.70). Hours of sunshine was found to have strong positive correlation with *Boro* Paddy (*r* = 0.74), Arahar (*r* = 0.82), Black Gram (*r* = 0.87) and strong negative correlation with Maize (*r* = -0.95), *Kharif* vegetables (*r* = -0.92), Niger (*r* = -0.94) and Wheat (*r* = -0.76). Barring Lentil (*r* = -0.68) and Potato (*r* = 0.83), average maximum temperature did not have any strong correlation with any of the other *Rabi* crops. On the other hand, average maximum temperature had strong positive correlation with *Sali* Paddy (*r* = 0.76), Millet and Green Gram (*r* = 0.99 for both), Groundnut (*r* = 0.79), Jute (*r* = 0.80) and strong negative correlation with Sesamum (*r* = -0.88) as well as cotton (*r* = -0.90). Strong negative correlation was observed for average minimum temperature with Niger (*r* = -0.78), Potato (*r* = 0.84) and a positive correlation with *Boro* Paddy (*r* = 0.89). The results are in agreement with Mishra *et al.* (2013) who reported the spatial variation in different climate variables and their impacts on the yield of rice and wheat in the Indian Ganga Basin.

Among the four considered climatic parameters, rainfall was found to have most effects due to its fluctuations on the yield of various crops. During the year 2008-2009 and 2011-2012, 3.98 and 4.04% decrease of rainfall (1347.1 mm and 1346.2 mm, respectively) during the crop growth season of *Ahu* Paddy resulted in 8.75 and 3.78% decrease of crop yield (13808 tonne and 14560 tonne). This justifies the strong positive correlation (*r* = 0.95) between *Ahu* Paddy and rainfall during that particular crop growth season. *Boro* Paddy which bears a strong negative correlation (*r* = -0.76) with rainfall exhibited 20.44% increase in crop yield (21126 tonne) during the year 2008-2009 due to 19.07% decrease of rainfall (1433.4 mm). Also, a drastic 145.32% increase of rainfall (601.4 mm) from the mean value of 245.15 mm during *Rabi* season of 2007-2008, resulted in 22.96 and 16.89% decrease in yield of Potato (*r* = -0.86) and *Rabi* vegetables (*r* = -0.59), respectively during that year. Thus, analysis of the values of coefficient of correlation with strong positive/negative association with various crops suggest, perceptible variation in crop yield could be attributed to climatic changes and comparatively an insignificant part pertaining to non-climatic factors like soil fertility and farm techniques of the study region. Chavas *et al.* (2009) reported the long term impact of climate change on agricultural productivity of different agricultural crops in eastern China. Gohari *et al.* (2013) also reported the changes in the crop yield of various crops in Iran's Zayandeh-Rud River Basin.

## Conclusions

The results obtained from correlation analysis reveal that though there has been increase in the area of cultivation of crops and provision of farm inputs to farmer, however climate has taken its toll on the selected crops. Taking into consideration the array of factors mitigating crops' yield in Cachar district, Assam, climate has been identified as the major perpetrator that is impossible to control in the open field. This analysis of climate change and its impact on crop yield can help to deal with the repercussions and the crop production changes can be specified in different conducive regions, thus strengthening the sustainability of agricultural production. As a result, this study recommends the following measures towards improving crop production and agriculture in the study area: Rainwater harvesting in top and foothills of hilly areas along with integrated water resources management (IWRM) and crop planning. And vulnerability and adaptation assessments of climate change to prioritize adaptation policies and measures and these adaptations should be mainstreamed in developmental planning.

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