Farmers' Perception on Climate Variability and Their Coping Strategies -An Assessment in Assam, India

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ABSTRACT

The study was carried out in two districts of Assam viz- Karbi Anglong and Jorhat to assess farmers' perception regarding climate variability and coping strategies adopted to mitigate its' effect. A total of 120 farmers were selected randomly by taking 60 farmers from each district. The study reveals that majority of farmers of both districts perceived that rainy days, its quantities were decreased with uneven distribution but dry spell period was increased at present as compare to past 30 years. Further majority perceived as increase of warm days but decrease in cold days in two districts. Most of the farmers (72.50%) of the two districts had experienced frequently increase of temperature during summer but reversely perceived in case of low temperature during winter. Scorching sunshine was experienced frequently by majority farmers (60.8%) in study area. Farmers characteristics like 'age (r = 0.258)', 'farming experience(r= 0.315)' 'mass media exposure(r= 0.326)' and 'training exposure (r=0.202)' were found positive and significant correlation with their perception level on climate variability. Analysis of observed data about rainfall and temperature in both districts also indicate the variation from the normal. In monsoon rainfall during 1984-2013 showed an increasing trend at Karbi Anglong and slight increasing trend at Jorhat district. Similarly, the temperature had increased around 1.4^{0}C at Karbi Anglong and around 1.7^{0}C at Jorhat district during last 30 years. The trend of minimum temperature during 1984-2013 was increasing in both the districts. The annual trend of temperature increase in Karbi Anglong was higher (+0.7) than Jorhat district (+0.3). In order to cope up with adverse effect of climate variability farmers adopted own strategies such as varietal adjustment, change in planting time, community mobilization for mitigating effect of climate variability. Farmers' Awareness programme, timely farm advisory service and agro-meteorology advisory service to farmers might be helpful for farmers to reduce the adverse effect of climate variability.

***Key words**: Farmers' perception; Climate variability;*

Climate is one of the important factors influencing agricultural production and has large-scale impacts on food production and overall economy. Most of the agricultural crops are sensitive to their growing conditions especially rainfall and temperature which are key factors influenced by the climate change. So, variation of annual weather and changing climate may affect agriculture growth and production. Even slight fluctuation in weather during critical phases of crop development can also have substantial impact on yields. Indian agricultural production and consequently the country's GDP show a strong link with the year to year variations of climate and weather. The year to year variability of rainfall and temperature is primarily responsible for the year to year fluctuations in the agricultural production. The analysis of past climatic records from the country revealed significant warming trends in surface air temperatures including night temperatures and extreme precipitation events. All India rainfall does not show any significant trends, however, there are significant regional and sub-seasonal rainfall trend. The variations in monsoon rainfall and surface temperatures influence the food grain production. The Indian monsoon is one of the most dominant climate systems in the general circulation of the atmosphere. The country receives more than 80 per cent of the annual

rainfall during a short span of four months during the southwest monsoon season (June to September). The year to year variations in the onset, withdrawal, total amount of rainfall and distribution during the season have profound impacts on the agricultural sector. Food production in India is sensitive to climate change like variations in temperature and monsoon rainfall. Recent studies indicate that there is a possibility of a loss of 4-5 million tons in wheat production in future with every 1°C rise in temperature during the growing period (*Kalra et al, 2007*). Agriculture in Assam is mainly rain fed farming and farmers of Assam are dependent on rainfall for their crop production. So fluctuation in the rainfall pattern will have a significant impact on the crop yield and farmers livelihood. Floods affect an annual average of 0.8 million hectares of land, but in some year they affect more than 4 million hectares of Assam's total area of 7.54 million hectares. But in the recent year the state also faces drought like situation due to deficient rainfall and the increasing temperature which mostly affect the agriculture of the state. For any losses in the field, farmers are the main victims. Rural people usually take up farming as occupation for their livelihood. But due to variation in the climatic parameters such as rainfall and temperature they do not get the expected yield and sometimes face great losses. Considering the adverse effect of climate variability in farming this study has been designed to assess farmers' perception regarding climate variability and their coping strategies adopted to mitigate its' effect.

METHODOLOGY

The study was carried out in two districts of Assam namely Jorhat and Karbi Anglong representing plain and hill district respectively. Random sampling technique was followed to select 120 respondents from two districts selecting 60 farmers from each district. In order to assess farmers perception about climate variability compared to 30 year ago, a structured schedule was prepared that contains statements relating to various aspects of rainfall and temperature. Aspects of rainfall considered for the study were number of rainy days, amount of rainfall, dry spells during rainy season, rainfall pattern, distribution of rainfall. Aspects of temperature considered were number of warm days in summer, number of cold days in winter, increase in temperature during summer, very low temperature during winter and experienced scorching sunshine. For measurement of perception level of farmers towards climate variability against each statement of different aspect of rainfall and temperature score has been assigned as '0'for incorrect and '1'for correct, thus total score ranges from 0-35. For assessing the correlation between perception level with selected farmers' characteristics, Pearson product moment co-efficient of correlation was used. Symbiotically, the formula is as follows:

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left\{\sum x^2 - \frac{(\sum x)^2}{n}\right\}\left\{\sum y^2 - \frac{(\sum y)^2}{n}\right\}}}$$

Where,
r = co-efficient of correlation
x= Independent variable
y = Dependent variable
åx = Sum total of x
åy = Sum total of y
åxy= Sum total of product of x and y
åx²= Sum total of square of x
åy²= Sum total of square of y
n= Total number of respondents.

In order to find out the trend of change the monthly meteorological data of rainfall and temperature for last 30 years of both districts were collected from Department of Agriculture meteorology, AAU, Jorhat and RARS, Diphu and analyzed for interpretation. Frequency, percentage, mean and t-test were used in analyzing and interpreting the data.

RESULTS AND DISCUSSION

Profile of sample respondents: The study reveals that mean age of sample farmers were 60.28 years with range of 50-76 years. Educational experience of sample farmers were ranging from 0 (zero) to 12 years which indicates illiterate to Higher secondary level. The mean educational experience of sample farmers was 3.11 years indicates primary level of education. The farming experience of sample farmers was ranging from 20 to 47 years indicating vast experience in farming. The average land holding size was 2.13ha and it was ranging from 0.4 ha to 4.67 ha indicates farmers were marginal to big farmers categories. The average annual income of sample farmers was Rs. 55,195.00 but they were distributed in between Rs. 20000.00 to Rs. 1,80,000.00. The mean value of degree of commercialization (36.47%) indicates less commercial in their occupation. The average exposure to mass media per month was 4.77 indicates less uses mass media as source of information. The uses of mass media by farmers was 2 to 9 nos. per month. The extension contact per month of sample respondents was 0 to 3 times and mean value

(0.56) which was less one in a month. The average days of training attended by farmers were 0.6 days indicates very low level of training exposure.

Table 1 : Profiles of sample respondents (N=120)

Profiles	Range value	Mean
Age	0-76	60.28
Educational experience	0-12	3.11
Farming experience	20-47	29.03
Land holdings (ha)	0.4-4.67	2.13
Annual Income (Rs. in thousand))	20-1,80	55,195
Degree of commercialization (%)	15-67	36.47
Mass media exposure (No/month)	2-9	4.77
Extension contact (No/month)	0-3	0.56
Training exposure (days)	0-7	0.6

Farmers' perception regarding change of rainfall pattern: The study revealed that majority of the respondents (82.5%) of both districts perceived that the number of rainy days had decreased as compared to 30 years ago. Similar findings reported by *Gbetibouo (2009),* and *Sipho FM et al (2015).* Few proportion of respondents (11.7%) were not aware about change of rainy days. Similar trend of perception on rainy days was reported by majority of farmers of Karbi anglong and Jorhat districts. Majority of the respondents (76.67%) felt that the amount of rainfall had low level while 18.3% respondents perceived as medium level. Majority (63.3%) of respondents perceived that dry spells were of longer duration as compared to 30 years ago. More than 80.00 % respondents perceived that the rainfall pattern was unpredictable and rainfall distribution was uneven (Table-2). This finding is accorded with the findings of *Sipho FM et al (2015)* and *Shashidhara K.K et al. (2012).* This reveals farmers' concern about change of rainfall and its effect in their livelihood as farming of study area is mostly rain fed farming.

Farmers' perception regarding change of temperature: The Table-3 reveals that out of the total respondents 82.5 per cent believed that the number of warm days had increased while 9.7 per cent respondents perceived as decreased. About 8.3 per cent respondents perceived as no change in temperature. This gives clear evidence that majority of the respondents of both the district had felt the change. *Mengistu (2011)* and *Sipho FM et al (2015)* reported similar findings in their study.

Around 85.00 percent of the respondents perceived that the number of cold days had decreased. Only 4.2 percent of the respondents believed that there was no change in number of cold days. It was also seen that majority of the respondents of both the districts had same perception towards cold days which gives an evidence of observable change.

Table 2: Distribution of respondents based on perception on variability of rainfall

Parameters	Perception as compared to last 30 years				Total (N=120)	
	A (n=60)		B (n=60)			
	No.	%	No.	%	No.	%
No. of rainy days(>2.5mm)						
More	4	6.7	3	5.00	7	5.8
Less	51	85.00	48	80.00	99	82.5
No change	5	8.3	9	15.00	14	11.7
Amount of rainfall						
High	2	3.3	3	5	5	4.2
Medium	14	23.3	8	13.3	22	18.3
Low	43	71.7	49	81.7	92	76.7
No change	1	1.7	0	0	1	0.8
Dry spells during rainy season						
Long	39	65	37	61.7	76	63.3
Medium	14	23.3	10	16.7	24	20
Short	1	1.7	4	6.7	5	4.2
No change	6	10	9	15	15	12.5
Rainfall pattern						
Predictable	0	0	1	1.67	1	1.7
Unpredictable	56	93.3	51	85	107	89.7
No change	4	6.7	8	13.3	12	10
Distribution of rainfall during rainy seasons						
Even	6	10	5	8.3.	11	9.2
Un even	50	83.3	47	78.3	97	80.3
No change	4	6.7	8	13.3	12	20

NB: A=Karbi Anglong District; B= Jorhat District;

Majority respondents (72.5%) had perceived as increase in temperature very frequently while 15.00 per cent of the respondents perceived that change was less frequent. This gives clear evidence that majority of the respondents of both the district has felt the change in temperature. *Gbetibouo (2009), Bhusal (2009)* and *Shashidhara K.K et al. (2012)* reported similar findings.

Majority of the respondents (70.8%) did not experienced low temperature during winter while 23.3 percent of respondents had experienced low temperature less frequently. A few (2.5%) proportion

believed that they felt low temperature very frequently. This gives a clear evidence that majority of the respondents of both the district had felt the change.

Majority of the respondents (60.8%) had experienced scorching sunshine very frequently while 32.5 percent of respondents had experienced it less frequently. A few proportion (4.2%) of respondents had responded that they did not experienced at all. It was clearly observed that majority of the respondents of both the district had felt the change.

Relationship of farmers' characteristics with their level of perception on climate variability: It is revealed from table -4 that farmers characteristics like 'age(r = 0.258)', 'farming experience(r= 0.315)' 'mass media exposure(r= 0.326)' and 'training exposure(r=0.202)' were found positive and significant correlation at 5% level of probability with their perception level on climate variability. This means with increases of age of farmers there will be more accuracy in perception about climate variability. Likewise, more years of farming experience, more mass media exposures will be more accurate level of perception. Farmers attended more training days will be more accurate level of perception towards climate variability as reported from observed data**.**

Observed rainfall and temperature trend of last 30 years in the sample districts: Analysis of observed rainfall data from 1984-2013, pre-monsoon rainfall showed decreasing trend in Karbi Anglong and an increasing trend at Jorhat (Fig-1& Fig-2). Rainfall trend observed at both the districts showed a great variation than the normal. This indicated amount of rainfall received was insufficient, occurrence of dry spells and unpredictable rainfall. In such situation farmers face risk and uncertainties in crop production. The analysis showed that farmers perception appear to be in accordance with the statistical record in both the districts.

Table 4: Correlation of farmers' characteristics with their level of perception on climate variability

Profiles	r- value	t- value
Age	0.258	2.90*
Education	-0.049	0.53
Farming experience	0.315	3.61*
Land holding	-0.021	0..23
Annual Income	0.039	0.42
Degree of commercialization	0.109	1.19
Mass media exposure	0.326	3.75*
Extension contact	0.108	1.18
Training exposure	0.202	2.24*

Table 3 : Distribution of respondents based on perception on variability of temperature

Parameters	Perception as compared to last 30 years				Total (N=120)	
	A (n=60)		B (n=60)			
	No.	%	No.	%	No.	%
No. of warm days in summer						
More	54	90.00	45	75.00	99	82.5
Less	4	6.7	7	11.7	11	9.2
No change	2	3.3	8	13.3	10	8.3
No. of cold days in winter						
More	7	11.7	6	10	13	10.8
Less	49	81.7	53	88.3	102	85.00
No change	4	6.7	1	1.7	5	4.17
Increase in temperature during summer						
More experienced	48	80	39	65.00	87	72.5
Less experienced	8	13.3	10	16.7	18	15.00
Not experienced	0	0	2	3.3	2	1.7
No change.	4	6.7	9	15.00	13	10.8
Very low temperature during winter (excessive cold)						
Very frequently experienced	0	0	3	5.00	3	2.5
Less frequently experienced	17	28.3	11	18.3	28	23.3
Not experienced	42	70.00	43	71.7	85	70.8
No change	1	1.7	3	5	6	5
Experienced scorching sunshine						
Very frequently experienced	36	60.00	37	61.7	73	60.8
Less frequently experienced	21	35.00	18	30.00	39	32.5
Not experienced	3	5.00	2	3.3	5	4.2
No change	0	0	3	5	3	2.5

NB: A=Karbi Anglong District; B= Jorhat District;

Analysis of rainfall during monsoon season during 1984-2013 showed an increasing trend at Karbi Anglong and slight increasing trend at Jorhat (Fig-3 &Fig-4). It was observed that during the period 1988-91 and 2005-07 at Karbi Anglong there was a substantial decrease in the amount of rainfall than the normal. At Jorhat same substantial decreased was observed during the period 2003-06. Rainfall trend observed at both the districts

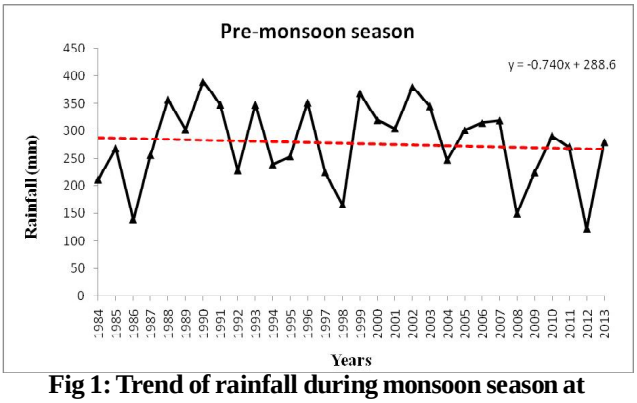

Fig 1: Trend of rainfall during monsoon season at K.Anglong during 1984-2013

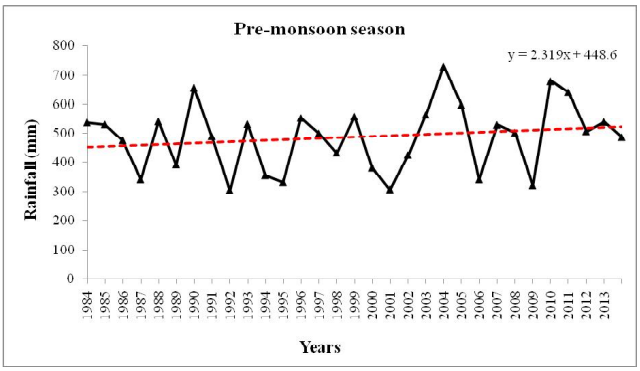

Fig 2: Trend of rainfall during monsoon season at Jorhat during 1984-2013

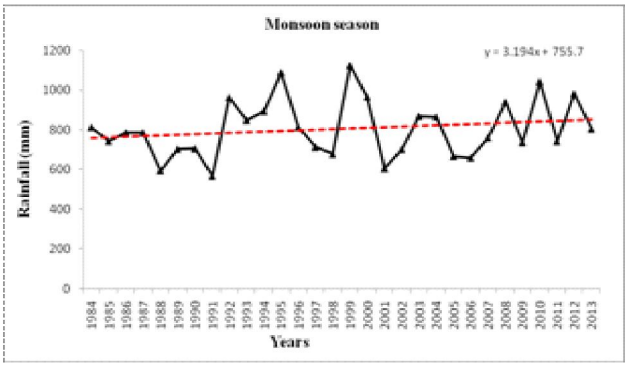

Fig 3: Trend of rainfall during monsoon season at K.Anglong during 1984-2013

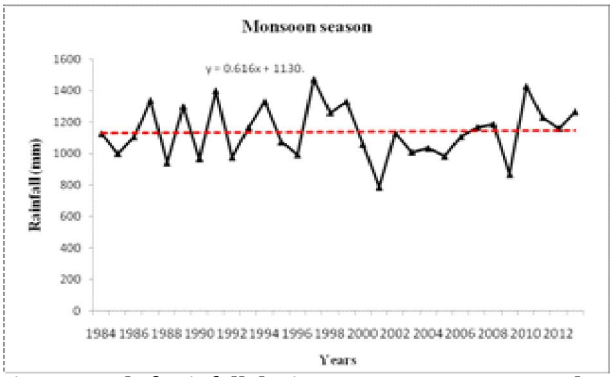

Fig 4: Trend of rainfall during monsoon season at Jorhat during 1984-2013

showed great variations. This strongly indicated that farmers in such scenario couldn't predict the usual rainfall pattern. This gave an evidence of occurrence of dry spells, un-even distribution of rainfall during the season, excessive and unpredictable rainfall pattern which leads to unfavourable situations for crop production.

Analysis of rainfall data during post-monsoon season during 1984-2013 indicated decreasing trend in both the districts. It was observed that the year to year variability of rainfall during this season was very high in Karbi Anglong district (Fig-5 Fig-6). This clearly indicated occurrence water scarce situation for *rabi* crop production in the district.

During winter season the rainfall showed a decreasing trend at both districts with higher year-to-year variability during last two decades (Fig-7 Fig-8). It gave a clear evidence of water scarcity during *rabi* season. From the analysed data it is revealed that the annual rainfall at Karbi Anglong was 1252.0 mm and at Jorhat it was 1824.8 mm. An increasing rainfall trend was observed at Jorhat district while at Karbi Anglong district a decreasing trend was observed (Fig-9 & 10). Also a great variation of annual rainfall trend was observed at both the districts. This strongly indicated that the variability in annual rainfall at both districts had favoured occurrence of dry spells, excessive rainfall, unpredictable rain, un even distribution of rainfall throughout a season over the past 30 years (1984-2013)

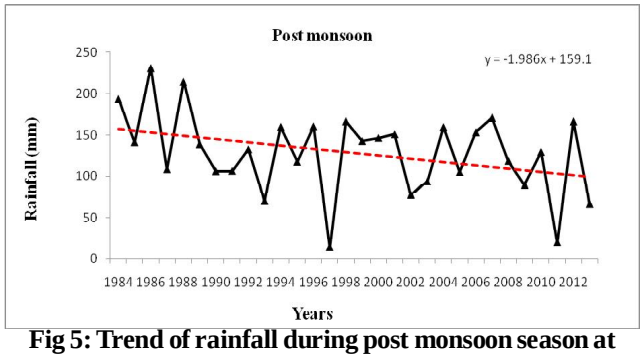

Fig 5: Trend of rainfall during post monsoon season at K.Anglong during 1984-2013

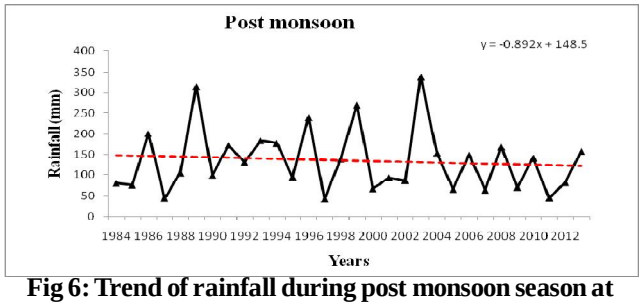

Fig 6: Trend of rainfall during post monsoon season at Jorhat during 1984-2013

which directly affected the farming community as majority of farmers of both the districts depends on rainfall for successful crop production.

Analysis of maximum temperature data for the period 1984-2013 revealed an increasing trend which indicated a warming trend at both the districts (Fig-11 & 12**)**. In both the districts there was increasing trend of maximum temperature in summer and winter season. During the study period of 30 years, the temperature has increased around 1.4^{0}C at Karbi Anglong district and around 1.7^{0}C at Jorhat. The changes of minimum temperature during 1984-2013 showed an increasing trend at both the districts. The annual trend in Karbi Anglong was higher (+0.7) compared to Jorhat (+0.3) district. The analysis showed that the perception regarding changes in different aspects of temperature appears to be in accordance with the observed temperature data. This indicates that majority farmers had awareness about the climate change and variability in the region and accordingly farmers were adapted measure to cope with the adverse effect of climate change.

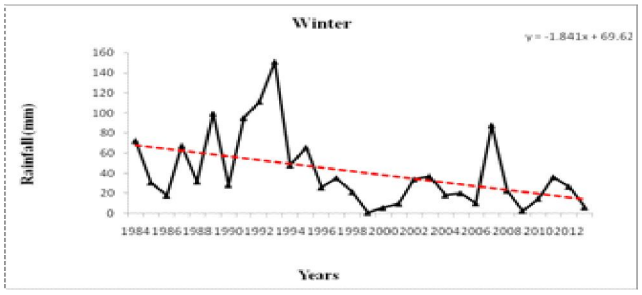

Fig-7: Trend of rainfall during winter season at K.Anglong during 1984-2013

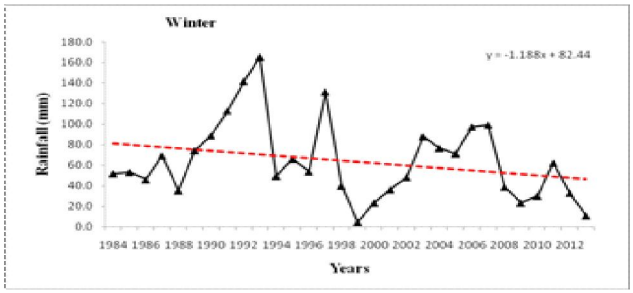

Fig 8: Trend of rainfall during winter season at Jorhat during 1984-2013

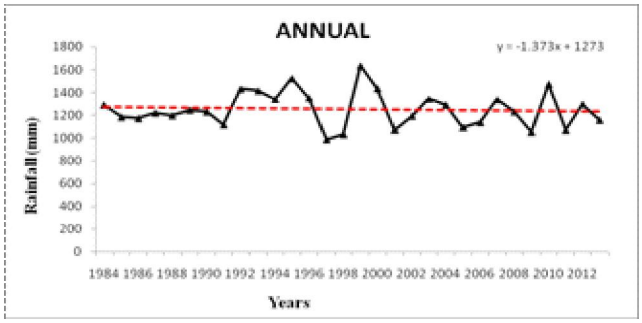

Fig 9: Trend of annual rainfall at K.Anglong during 1984-2013

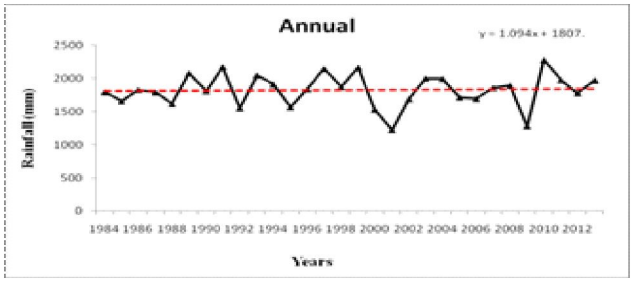

Fig 10: Trend of annual rainfall at Jorhat during 1984-2013

Coping strategies adopted by farmers: Farmers of the study area adopted some coping strategies for mitigating effect of climate variability are presented in the Table-4. In late onset monsoon situation farmers adopted some local varieties instead of HYV varieties. Local variety like "*Myongkhi*" could cultivate as early and late planting of rice. Majority farmers of both

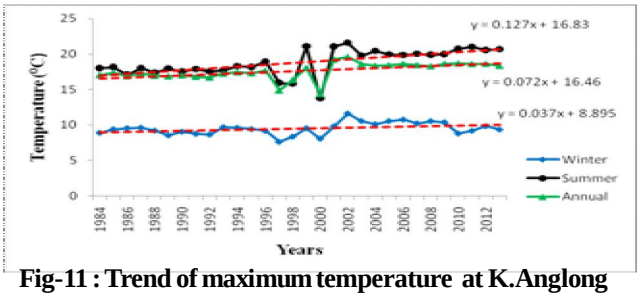

Fig-11 : Trend of maximum temperature at K.Anglong during 1984-2013

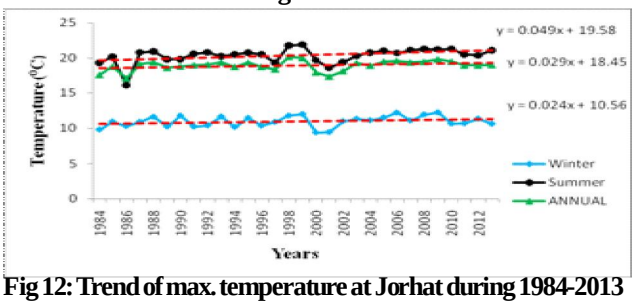

Fig 12: Trend of max. temperature at Jorhat during 1984-2013

districts delayed in sowing/planting time by 7-10 days for s*ali* rice which gave benefit of pre monsoon rainfall in their crop. Farmers also adopted the community or group approach for raising of *sali* rice nursery bed to overcome the problem of water scarcity. Application of wood fine ash in nursery bed, hanging of decayed frogs and crabs were pest management strategies adopted by majority farmer of study areas. Use of pond

Table 4 : Coping strategies adopted by farmers for mitigating the effect of climate variability (N=120)

Coping strategies	No.(%)
Cultivation of traditional varieties which were suitable for late planting situation.	95 (9.17)
Delayed in sowing/planting time for 7-10 days in case of *sali* rice for getting the benefit of rainfall.	80 (66.67)
Community nursery bed preparation for management of water.	45 (37.50)
Application of wood fine ash in nursery bed of rice and vegetables for controlling insects pest like *thrips*	105 (87.5)
Decayed frogs and crabs are hanged in the rice field just after flowering of rice to manage gandhi bug infestation	105 (87.5)
Cultivation of traditional variety called 'Myongkhi'	18 (15.00)
Cultivation of Swarna sub-1 variety of rice	05 (4.17)
Life saving irrigation from farm pond and river during dry spell	67(55.83)
Construction of earthen bund in the natural stream for storage of *in situ* water for escaping effect dry spell on crop.	30(25.00)
Mulching in vegetable crops like okra, chilli and brinjal	18(15.00)
FYM application in nursery beds to improve soil physical conditions and water holding capacity	58 (48.33)
Mobilization in group for adopting water management measures	30 (25.00)
Dewatering the entire pond for fish harvesting as well as irrigation to standing crops	43 (35.83)
Selling of livestock specifically draught animal for escaping the problem of scarcity of fodders.	60 (50.00)

and river water in crop like paddy and vegetables as life saving irrigation were strategies adopted during dry spell. Construction of earthen dam in river and stream was another strategies adopted by farmers to recharge ground water table during dry spell.

CONCLUSION

Awareness programme related to climate issues at community level and massive training programme should be organized on various aspects *viz.* improved cultivation practice, soil and water conservation, pest and disease management etc. in context to climate variability for strengthening the farming community. Extension agency should put efforts to make available climate intelligence either through mass media and information communication technologies. Simultaneously research systems should develop more situation specific technologies and blend the indigenous coping strategies with scientific knowledge which may be more cost effective as well as environment friendly. Extension system should put efforts for adoption of other improved crop varieties like heat tolerance variety, pest and disease resistant variety, drought resistant variety and flood escaping variety. Access to information about climate and weather is a prerequisite for early preparation to adjust with the consequences of climate variability, therefore, extension and other concern agencies should take initiative in providing climate information at right time.

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