Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 3088-3094

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-7 pp. 3088-3094**
Journal homepage: http://www.ijcmas.com

Original Research Article

Impact of Climate Change on Developmental Parameters of Farmers

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A B S T R A C T

The present study was conducted during 2012-13 in Nagpur district of Vidarbha region in Maharashtra State. The sample consisted of 120 farmers from 10 different villages of the district. The respondents were randomly selected and personally contacted to collect the data regarding environmental factors and developmental parameters of the farmers to access the impact of climate change on five major crops of Nagpur district viz citrus, cotton, soybean, wheat and gram. It was observed that production and productivity of all five crops were decreased in last ten years as an effect of climate change. Cropping intensity showed declination from 156.94 to 129.28 per cent over a period of time. Cropping pattern was also substantially changed, area under orange and cotton were shifted to non-cereals i.e. oilseed crops. Remarkable decrease was recorded in the number of livestock possessed by farmers. Milch animals and farm animals were lower down by 61.25 per cent and 46.84 per cent, respectively.

Keywords

Environmental parameters, climate change

Introduction

Agriculture is one of the sectors that directly depends on climate conditions like rainfall and temperature, and thus adversely affect by climate change. Climate change is already being observed in the form of increased temperature/heat, increased rainfall variability, rising incidence and intensity of extreme climatic events like drought and storms, resulting in water scarcity and floods, increased evapo-transpiration, crop loss and changing ecology of agricultural pests and diseases. These direct impacts translated to other impacts like decreased food and livelihood security and projection of future climate change indicate an intensification of these changes. These impacts will also interact with multiple exposures to other livelihood risks like market failure and weak institutional framework. Therefore, the climate change is really a matter of great concern for formulation of desired strategies to deal with the technological and environmental challenges together pertaining to agriculture and allied sectors which are depends heavily on climatic conditions.

This is the most important complex issue which is affecting the farming community. It is difficult to the common man to understand the effects of climate change. Most of the farmers confuses 'weather' with 'climate' and ultimately farmers may find difficulty to identify the changes occurred by the climatic factors on their own farm

activities. Thus this study focused on to evaluate the effect of climate change on developmental parameters of farmers.

Materials and Methods

The research study was carried out in Nagpur district of Vidarbha region in Maharashtra State. The district is situated at $20^0$35' to $21^0$44' North Latitude and 78^0 15' to 79^0 40' East Longitude. Geographical area of Nagpur district is 9897 Sq. Km. Based on the Thornthwaite system of climatic classification, Nagpur is classified under the category of Tropical Dry-sub-humid climate.

The study was conducted in 10 villages of Nagpur district which were selected through random sampling method. From each village 12 farmers were randomly selected to make 120 samples of respondents in total. All the respondents were personally interviewed at their home and farms and data was collected on the environmental variables and the developmental parameters of the farmers.

The impact of climate change on developmental parameters of farmers was analyzed on the basis of situation of parameters before ten years and after ten years. The collected data was analyzed with the help of suitable statistical methods i.e. mean, percentage, standard deviation, coefficient of correlation and Z-test.

Results and Discussion

Impact of climate change on developmental parameters of farmers

Production

The data with regards to the impact of climate change on production of major crops have been furnished in Table 1.

It is observed from Table 1 that the average production of soybean crop before decade was 27.25 qt. and after decade it was down to an average production of 22.10 qt. that indicated 18.89 per cent decrease in production over a period of time due the changes in the climatic factors. While in the cotton crop average production before decade was 51.83 qt. and after decade it declined to 43.72 qt. and the change was -15.64 per cent. Regarding wheat crop average production before decade was 42.57 qt. and after decade it was 25.51 qt., the remarkable per cent change of -40.07per cent was recorded. In case of gram crop also average production before decade was 8.92 qt. which was lower down to 6.76 qt. i.e. -24.21 per cent change was recorded. In the citrus crop before decade an average production was 180.9 qt. which was decreased to an average production of 151.08 qt. and the per cent change was -16.08. It was seen from Table 1, that impact of climate change on production was significantly declined over period of ten years at 0.01 level of probability. It clearly indicated that the effect of climate change as perceived by farmers was found negative on the production of all major crops in the area which includes agronomical crops as well as citrus crop which is the worldwide identity of Nagpur district. The effect of changes in climatic factors on the production of major agronomical crops was found comparatively more in rabi season. Decrease in production of crop due to climate change was also found by Chaterjee (1998), Lal (2007) and Butler (2009).

Productivity

The effect of climate change on productivity of major crops in Nagpur district over period of ten years was studied and data presented in Table 2 reveals that the productivity of soybean crop before ten years was 24.91

qt./ha and after decade it became 18.04 qt./ha and the change recorded was -25.57 per cent. In the cotton crop productivity before decade was 24.64 qt./ha and in the last year it was 21.76 qt./ha which counted to 11.68 per cent decrease. Regarding wheat crop, an average productivity was 30.04 qt./ha before decade that came down to 25.51 qt./ha after decade, the per cent change was -19.64. In pulses productivity of gram before ten years was 11.40 qt./ha which was drop down to 8.97 qt./ha, its per cent change was -21.31. In the citrus crop similar down trend was observed, the productivity before decade was 184.7 qt./ha which goes down to 147.2 qt./ha i.e. -20.30 per cent change was noted. It was seen from Table 2, that impact of climate change on per cent change in productivity of major crops in Nagpur district was significantly decreased at 0.01 level of probability over a period of ten years.

Cropping intensity

The data with regards to the impact of climate change on cropping intensity have been furnished in Table 3. It was observed that the average cropping intensity before decade year was 156.94 per cent and after decade it was 129.28 per cent and the per cent change was -17.6. The Z-test was found highly significant (at 0.01 level of probability).

It means that the area under different crops including double and triple cropping to the net cultivated area becomes decreased significantly over period of time due to climate change.

Livestock population

The data regarding impact of climate change on livestock population have been furnished in Table 4. It was noted that average milch animals before decade was 6.91 i.e. seven milch animals possessed by the respondent and after decade the average was lower down to 2.68 i.e. three milch animals per respondent, the decrease was calculated to 61.21 per cent.

While, average population of draft animals before decade was 2.69 per respondent and after decade the average population comes down to 1.43 per respondent that means 46.84 per cent decrease in population of livestock. The Z-test indicates that the livestock population over a period of time was significantly changed at 0.01 level of probability.

As expressed by the farmers, livestock possession were lower down plausibly because of non-availability of green fodder on their own and increase in temperature which made them difficult to maintain the productive level of livestock.

Unhealthy and non-productive livestock built up the economic pressure and liabilities on farmers hence reluctant to keep more livestock.

Relational Analysis

A critical examination of Table 5 shows that among selected variables extremes such as onset of monsoon, drought and flood was negatively significant at 0.01 level of probability with per cent change in production, where as change in temperature, change in humidity, hot and cold wave, availability of irrigation water and pest incidence and virulence were not significant with per cent change in production. It shows that production of major agronomical crops and orange crop in Nagpur district was highly sensitive to the changes in climatic factors in respect of monsoon, draught and flood.

Table.1 Impact of climate change on production of major crops

Sr. No.	Crops	Production mean (qt.)		% change in production	Z value
		Before 10 year	After 10 year		
1	Soybean	27.25	22.10	-18.89	7.9168**
2	Cotton	51.83	43.72	-15.64	8.4720**
3	Wheat	42.57	25.51	-40.07	7.9980**
4	Gram	8.92	6.76	-24.21	9.1896**
5	Citrus	180.9	151.8	-16.08	7.7230**

** *Significant at 0.01 level of probability*

Table.2 Impact of climate change on productivity of major crops

Sr. No.	Crops	Productivity Mean (qt./ha.)		% change in productivity	Z value
		Before 10 year	After 10 year		
1	Soybean	24.91	18.04	-27.57	9.1739**
2	Cotton	24.64	21.76	-11.68	8.9827**
3	Wheat	30.04	24.14	-19.64	9.1686**
4	Gram	11.40	8.97	-21.31	9.1136**
5	Citrus	184.7	147.2	-20.30	7.9456**

** *Significant at 0.01 level of probability*

Table.3 Impact of climate change on cropping intensity

Sr. No.	Category	Cropping Intensity Mean (%)		% change	Z value
		Before 10 year	After 10 year		
1	Cropping intensity	156.94	129.28	-17.62	8.383**

** *Significant at 0.01 level of probability*

Table.4 Impact of climate change on livestock population

Sr. no.	Animals	Livestock population Mean		% change in livestock	Z value
		Before 10 year	After 10 year		
1	Milch animal	6.91	2.68	-61.21	9.3834**
2	Draft animal	2.69	1.43	-46.84	9.4515**

** *Significant at 0.01 level of probability*

Table.5 Correlation coefficient of environmental parameters with their per cent change in production

Sr. No.	Independent variable	Correlation coefficient (r) with % change in production
1	Change in temperature	0.0421
2	Change in humidity	-0.1696
3	Hot and cold wave	-0.1294
4	Availability of irrigation water	-0.0788
5	Pest incidence and virulence	0.1294
6	Extremes such as onset of monsoon, drought and flood	-0.2938**

** *Significant at 0.01 level of probability*

Table.6 Correlation coefficient of environmental parameters with their per cent change in productivity

Sr. No.	Independent variable	Correlation coefficient (r) with % change in productivity
1	Change in temperature	-0.0457
2	Change in humidity	-0.0118
3	Hot and cold wave	-0.0410
4	Availability of irrigation water	0.0751
5	Pest incidence and virulence	-0.2075*
6	Extremes such as onset of monsoon, drought and flood	-0.0767

***** *Significant at 0.05 level of probability*

Table.7 Correlation coefficient of environmental parameters with their change in cropping pattern

Sr. No.	Independent variable	Correlation coefficient (r) with change in cropping pattern
1	Change in temperature	-0.1002
2	Change in humidity	-0.2218*
3	Hot and cold wave	0.1329
4	Availability of irrigation water	-0.0654
5	Pest incidence and virulence	0.1007
6	Extremes such as onset of monsoon, drought and flood	-0.1881*

***** *Significant at 0.05 level of probability*

Table.8 Correlation coefficient of environmental parameters with their per cent change in cropping intensity

Sr. No.	Independent variable	Correlation coefficient (r)
1	Change in temperature	-0.0672
2	Change in humidity	-0.1579
3	Hot and cold wave	-0.0519
4	Availability of irrigation water	-0.1049
5	Pest incidence and virulence	0.1767
6	Extremes such as onset of monsoon, drought and flood	-0.0420

Table.9 Correlation coefficient of environmental parameters with their per cent change in livestock population

Sr. No.	Independent variable	Correlation coefficient (r)
1	Change in temperature	-0.1928*
2	Change in humidity	-0.2232*
3	Hot and cold wave	0.1641
4	Availability of irrigation water	0.1289
5	Pest incidence and virulence	-0.1162
6	Extremes such as onset of monsoon, drought and flood	0.0883

***** *Significant at 0.05 level of probability*

It was seen from Table 6 that among selected variables, pest incidence and virulence was negatively significant and associated at 0.05 level of probability with per cent change in productivity while, change in temperature, change in humidity, hot and cold wave, availability of irrigation water, extremes such as onset of monsoon, drought and flood were found not significant with the per cent change in productivity. The findings give the clear picture that increase in pest incidence and virulence decreases the yield per unit area of major crops in Nagpur district.

It is seen from Table 7 that among selected variables change in humidity and extremes such as onset of monsoon, drought and flood were significantly but negatively correlated with change in cropping pattern at 0.05 level of probability. Change in temperature, hot and cold wave, availability of irrigation water, pest incidence and virulence were found not related to change in cropping pattern. It indicates that increase in humidity and extremes such as onset of monsoon, draught and flood had been responsible to change the cropping pattern in the Nagpur district.

It was seen from Table 8, that among the selected variables no one was found significantly correlated with per cent change in cropping intensity. It clearly indicated that the selected climatic factors have no effect on cropping intensity. It was expected that availability of irrigation water has significant effect on cropping intensity, but due to the rainfed farming situation in study area ultimately affected with climate change farmers were unable to increase the area under cultivation in rabi and summer season.

It was seen from Table 9, that among selected variables change in temperature and change in humidity were negatively significant and associated at 0.05 level of probability with per cent change in livestock population. Other variables like hot and cold wave, availability of irrigation water, pest incidence and virulence, extremes such as onset of monsoon, drought and flood were not significantly related with per cent change in livestock population. As reported by the farmers in the study area increase in temperature and humidity could have been create the difficulty in survival of animals and gradually decreases the livestock population as observed in Table 4 the temperature and humidity in Nagpur District is increased over period of last ten years.

It is concluded that the effect of climate change as perceived by farmers of Nagpur District was found negative on the production, productivity, cropping intensity and livestock population. Production and productivity of major crops like cotton, soybean, wheat, chickpea and worldwide popular Nagpur orange crop were decreased over period of ten years. The major changes in cropping pattern that have been observed in district were a substantial area of cotton and orange crop shifted to oilseed crops. Eventually the cropping intensity was lower down from 156.94 to 129.28 per cent over a period of time. As expressed by the farmers, livestock possession were lower down plausibly because of non-availability of green fodder on their own and increase in temperature which made them difficult to maintain the productive level of livestock. Unhealthy and non-productive livestock built up the economic pressure and liability on farmers hence farmers were reluctant to keep more livestock with them.

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