Impact of Climate Change as Perceived by Farmers in Distress Prone Districts of Vidarbha

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ABSTRACT

Climate change has caused distress amongst farmers in suicides prone districts of Vidarbha region. 53 percent of the crop failure has been accrued to untimely rainfall, moreover more than 58 per cent of the farmers suicides were reported during monsoon months. This paper analyses the impacts of climate change as perceived by farmers in two highly suicide prone districts of Vidarbha namely Akola and Yavatmal. The data were collected in actual field situation followed by in depth interviews with the 300 farmers scattered over 10 villages of 5 tahsils. More than 90.00 per cent farmers' in group discussion expressed that warming days are increasing, rainfall pattern is unpredictable, changing seasons, incidence of drought has increasing, hail storm occurs abnormally, wind pattern getting warmer, decreasing water sources, emergence of new pests and diseases. The major impact of climate change perceived by farmers were decreasing soil nutrients, soil structure, decreasing ground water table, increased soil salinity, drying up of rivers, early maturity of green gram/black gram and cotton crop and short stalk of wheat and sorghum. Findings of the present study have an important policy implication in framing appropriate adaptation strategies to progress adaptation process in this distress region in mitigating the impacts of climate change.

Key words: *Climate change; Impact; Distress prone districts.*

The climatic conditions in Vidarbha are slowly but steadily making a shift towards unusual spatial and temporal distribution of rainfall during the monsoon months. More than 50 per cent of the crop failure has been accrued to an untimely rainfall (TERI, 2009) and more than 58 per cent of the farmers' suicides were reported during monsoon months (Poonam Pandey and Akermann, 2010). Drought study conducted by Satpute and Vanjari (2011) indicated the reduction in crop yields of cotton, sorghum, soybean, tur and gram to the extent of 12 to 54 per cent during wide spread drought years over the normal years. Under such scenario, it was felt essential to study the impacts of climate change in distress region of Vidarbha from the farmers' point of view in actual field situations so as to develop suitable adaptation strategies to progress adaptation process in this region.

METHODOLOGY

The study was conducted in two distress districts of two different agro-climatic zones based on rainfall, soil types and vegetation namely, Akola from Western Vidarbha zone (rainfall 700 to 950 mm) and Yavatmal from Central Vidarbha Zone (rainfall 950 to 1250 mm). The data were collected from 300 farmers' spread over 10 villages across the 5 tahsils of highly farmers'suicide concentrated districts by conducting field survey and applied diagnostic design of social research with the exploratory approach. Apart from in-depth interviews with the randomly sampled 300 farmers', 10 group discussions were also carried out in the study area. The data regarding farmers' perceptions to the impacts of climate change was obtained on parameter/indicators identified from relevancy ratings from the experts. The responses of farmers were recorded on structured and pre-tested interview schedule. The findings are presented considering the summary counts in frequencies and percentages.

RESULTS AND DISCUSSION

Impacts of climate change perceived by farmers are categorized into specific themes. These themes include (1) land resource (2) water resource (3) crop production (4) crop quality (5) health (6) impacts of floods/excessive rains on crop yield. More than 90.00 per cent farmers' in group discussion expressed that warming days are increasing, rainfall pattern is unpredictable, changing seasons, incidence of drought has increasing, hail storm occurs abnormally, wind pattern getting warmer, decreasing water sources, emergence of new pests and diseases. Some older farmers' observed the less amount of dew in recent years, which also indicates the warmer nights as clarified by IPCC (2007). Many farmers' reported that there is irregularity in flowering and fruiting of different crops. Early maturity of green gram, black gram and cotton crops, short stalk of wheat, sorghum were some of the examples cited by the farmers'.

1. Impact of climate change on land resource : Through in-depth interviews with selected farmers', it was revealed that climate change has influenced on land resource especially agricultural land in terms of reducing area during summer season (72.22 %), reducing soil moisture due to temperature rise and faster rate of evaporation (85.00%), deteriorated soil structure due to excessive use of fertilizers, pesticides (68.00%). Besides, land is also becoming drier, less coherence and poor structure (Table 1). Shortage of farm yard manure in recent years reduced the soil nutrients from the soil (84.00%).Due to excessive leaching and use of fertilizers, salinity of soils also has been increased (79.00%).

Table 1

Farmers' opinion on impact of climate change on land resource (N=300)

Sr. No.	Impact indicators	Yes	
		Frequency	Percentage
1	Decreasing of agricultural land in summer	218	72.66
2	Reduces soil moisture	255	85.00
3	Deteriorate soil structure	204	68.00
4	Reducing soil nutrients	252	84.00
5	Increased soil salinity	237	79.00

Multiple choice responses. (Source: In - depth interview, 2012)

It was explored that long dry spells along with scorching heat led to fast increase in evaporation rate, especially in medium and shallow soils like that in some parts of the study area. It was noticed through observation that farmers' even could not walk on their bare feet through their field because of extreme heat on land surface. Besides, farmers' expressed that crops grow slowly or even could not develop due to dry and hot soil. The present findings are in conformity with the findings of Phuong (2011) who also noticed the similar observations. Similarly farmers articulated that compared to olden days, hard pan are formed on the soil in recent years might be due to excessive heat. It was noticed that big cracks of almost 1 to 1.5 feet were present in the study area in deep black soils. Literature pointed out that the soils deeper than 1.5 m and clay in texture pose problem of water logging. Such conditions frequently occurred in saline tract of Purna valley in Akola district. Deep soils are poor in infiltration and permeability. Vertisols is predominant in some pockets of the research area with montmorillonite/smectite clay. Soils swells after wetting and shrinkage following drying results in deep and wide cracks. Soils of the region have been degraded due to their susceptibility to soil and water erosion, inadequate restoration of soil organic matter due to hot climate. In some pockets, there is excessive accumulation of salts making soils saline and alkaline. Farmers' also mentioned that cultivation of input-intensive cotton crops resulted in non-stop consumption of soil nutrients. Additionally, cotton is very susceptible to pest attacks and needs a lot of chemical inputs to be viable. The nonstop long-term use of high doses of chemical fertilizer is affecting the physical, chemical and biological properties, as well as the structure and texture of the soil. Thereby, the water holding and transmitting capacity and the aeration of soils has been hampered. Analysis of soil samples carried out by Soil Testing laboratory of State Agriculture Department for the period 2005-2009 in both the study districts also supported the above findings. Results of soil samples revealed that that the pH of 57.13 per cent soil samples of Yavatmal district and 55.59 per cent soil samples of Akola district had pH intensity in between 7.01 to 7.5. Electrical conductivity (Ec) dem of soils in 85.00 per cent soils in Yavatmal district also showed Ec less than 1 .In 99.44 per cent samples of Akola district the Ec was found below 1. Regarding major nutrients fertility level, Akola district had medium Nitrogen (1.37%), low in Phosphorus (1.16%) and very high in potash level. In case of Yavatmal N level was low (1.20%), Phosphorus level was also low (1.13%) & high in potash (2.47%).As far as micro-nutrient deficiency status, Akola district had 4.46% less Copper, 22.46 per cent less Iron, 0.97 per cent less Magnesium & 47.98 per cent less Zinc status. Yavatmal district showed 1.52 per cent less Cu., 98.18 per cent less Fe, 18.48 per cent less Mg & 4.55 per cent less zinc status (Anonymous, 2012a)

2. Impact of climate change on water resource :

Table 2 exhibited the impact of less amounts of total rains on water resource. Group discussion with elder peoples and personal interviews with individual farmers' expressed that in recent years, the water level in summer season has been much lower in majority of ponds, wells and lakes. Previously water level in their wells/ponds did not change much between summers and winter seasons. The fluctuation of water level between summer season and winter season was quite large. Furthermore, wells, lakes, rivers also dried in the years of less rainfall (48.33%). In study area, many farmers' did not have irrigation system, hence increasing drought like condition negatively influence on agricultural production. Literature on climate change indicated that in recent year's drought like conditions frequently occurs in Vidarbha (Mayande, 2009; Satpute and Vanjari 2011). In farmers'views, increasing long dry spells and regular drought like conditions (21.66%) leading to them to dug deeper wells and deepens existing wells (6.66 and 4.00 % respectively). Besides, increasing drought like state also had influenced ground water level in the study area. The level of groundwater went downward because of excessive lifting of water and lack of efforts to replenish removed water. As per survey done by the office of the Geologist, Akola during pre-monsoon during May and after the monsoon in October 2012 indicated that there was drastic reduction in the water table in Akola district (Anonymous, 2012b). Irrigation

through well water for crops production was decreased at noon hours during summer period (often deficient water while pumping). About 26.00 percent of respondents reported that they have to change time for pumping water. Water has been pumped in the early morning or the later in the afternoon instead of pumping every time before.

Table 2
Farmers' opinion on impact of climate change on water resource (N=300)

Sr. No.	Impact indicators	Yes	
		Frequency	Percentage
1	Dug new well	20	6.66
2	Water Salinity	109	36.33
3	Less water and drying up of ponds/wells/rivers/lakes	145	48.33
4	Changes in pumping time	78	26.00
5	Deepen the existing well	12	04.00
6	Regular droughts	65	21.66

(Source: Field survey, 2012)

Farmers', those having farm ponds, it was noticed by resaearcher that water surface volume in many farm ponds was became drier or reduced water volume. Sometimes excessive and intensive rainfall may cause runoff and severe erosion. In the study area, 36.33% of respondents experienced that drought caused salinity invasion increasing and affected water resource for living and agricultural production. Water quality was also affected especially due to salinity intrusion. A study on groundwater quality carried out in Akola taluka indicated that the overall water quality of the taluka was of poor type in all the three years (2007-2009). The excess level of inorganic pollutants could be due to over applications of fertilizers in farms along with natural weathering of limestone and calcium bearing minerals. Water quality study in Yavatmal district also indicated taluka Babhulgaon, Digras, Kelapur and Ner were consistently seen to be poor. (Anonymous, 2012c). The rest of the respondents perceived that the less amount of rainfall does not impact on the quality of water resource.

3. Impact of climate change on crop production :

Farmers opined that crop productivity was significantly affected by less rainfall and increasing temperature and this had resulted in increased pests and diseases also reduced the crop productivity of many crops.

3.1 Pests and diseases : According to in-depth interview; farmers' experienced that climate change has increased pests and diseases in almost all crops except sorghum and deshi cotton. Jowar and deshi cotton crops had noticed a few pests and diseases during drought like period and they also could stand well. Very few farmers' were using pesticides for these crops.

Table 3 pointed out that pests and diseases appeared and increased during study period in the study area. However, the impact levels depend on different crops. Up to 72.88 and 85.67 per cent of interviewed farmers' expressed that the crops especially green gram/ black gram and sorghum, cultivated in summer season mainly for fodder purpose were least affected by pests and diseases, as the nature of this crop is disease-tolerant. Impact of pests and diseases was observed more in cotton (63.33%) and soybean crop (59.66%), which are the major crops of the study area. Brinjal was cultivated by only some farmers' in summer season for fetching more prices in market used a lot of pesticides to control pests and

Table 3
Farmers' opinions on impact of climate change on pest and diseases and consequences (N=300)

Crop production	Impact on pests and diseases (%)	*Result of pest and disease impacts (%)			
		Increase pesticides	Increase labour	Reduce productivity	No Impact
Cotton	63.33	58.00	59.00	54.67	36.67
Sorghum	14.33	1.22	13.77	32.37	85.67
Tur	52.16	35.14	17.00	27.43	47.84
Mung (green gram)	27.12	15.67	19.00	18.76	72.88
Udid (black gram)	27.12	15.67	19.00	18.76	72.88
Soybean	59.66	42.42	43.54	29.00	40.34
Gram	25.55	21.27	17.50	23.82	74.45
Wheat	16.33	12.59	10.49	15.71	83.67
Summer groundnut	43.33	25.00	19.12	25.95	56.67
Summer brinjal	18.22	17.33	15.24	21.67	81.78

(Source: Field survey, 2012)

diseases to keep productivity stable or increase. Farmers' in the study villages were practicing summer ploughing, one of the important traditional method to control pests and diseases,hibernating pests and disease causing organisms by exposing them to the summer heat. Scientific communities believed that changes in temperature and rainfall created favorable environments for pests, diseases and invasive species to emerge, spread and encroach on agriculture (Maikhuti, 2000 cited in Poonam Pande and Kaspar Akermann, 2010).

3.2 Crop productivity : Table 4 revealed that the farmers' perception regarding the effects of climate change on crop productivity in the study area.

Table 4
Farmers' opinion on impact of climate change on crops productivity

Crop production	Yes	Level of increasing (%)	Level of decreasing (%)
Cotton	55.13	18.90	36.23
Sorghum	20.00	18.21	01.79
Tur(red gram)	43.67	15.66	28.01
Mung(green gram)	28.17	07.20	20.97
Udid(black gram)	28.17	07.20	20.97
Soybean	43.67	14.55	29.12
Gram	27.66	17.22	10.44
Wheat	17.15	06.27	10.88
Summer ground nut	09.30	00.50	08.80

It was exposed that the mung, udid crop productivity were more severely impacted due to increasing long dry spells than others. For Bt cotton, 55.13 per cent of respondents experienced a productivity loss due to less rainfall. Level of cotton productivity loss was the highest among crops with 36.23 per cent. In high temperature and lack of water conditions or excessive rains, cotton crop often has "lalya" (reddening of cotton) disease. This disease cannot be controlled and yields of cotton crop remain low. Sorghum and deshi cotton were least affected by less rainfall because of drought-tolerant nature of these crops. Productivity was reduced in crops like tur and soybean (28.01 and 29.12 %). Productivity was also reduced in few crops but the level was the lowly, because farmers' applied traditional adaptation techniques and it also has high capacity to stand against less or high rains. During interviews, farmer provided the information on the existence of indigenous wheat known as deshi gehu (local wheat), or lal gehu (red wheat).Deshi or indigenous wheat has just about vanished from this region and was not planted in any of the visited villages. According to elderly women, this wheat variety grows with far less water than modern wheat, and might be life saving in drought years.

3.3 Productivity analysis of selected crops : In order to verify farmers' opinion regarding the crop productivity of selected crops under study area, productivity analysis was undertaken by collecting the yield data of study districts. The pertaining results are presented in the succeeding Tables.

From Table 5 below, it could be revealed that productivity of crops, like sorghum groundnut, tur, and green gram was reduced over the last decade. Linking productivity of sorghum, groundnut, tur and green gram crop with the average annual rainfall of the district, it was observed that the productivity of these crops were high during the year 2002-2003 and 2007-08, when there was normal rainfall in Akola and

Table 5
Productivity analysis of selected crops

Year	Ak	Ytl	Ak	Ytl	Ak	Ytl	Ak	Ytl	Ak	Ytl	Akola	Yavatmal
	Jowar		Groundnut		Tur		Gram		Green gram		Average Annual Rainfall(mm)	
1999-00	1.52	1.20	1.26	0.92	1.26	1.22	0.76	0.54	0.57	0.65	1081.7	1115.4
2000-01	1.65	1.10	0.69	0.75	0.71	1.16	0.31	0.54	0.40	0.41	666.8	625.0
2001-02	1.42	1.09	1.14	1.03	0.89	1.27	0.58	0.63	0.55	0.28	915.0	1108.2
2002-03	1.95	1.18	2.00	1.55	0.91	1.01	0.66	0.52	0.41	0.35	726.2	1155.0
2003-04	1.96	0.90	1.00	1.06	0.85	0.80	0.63	0.69	0.47	0.54	422.1	1084.8
2004-05	1.32	0.98	0.60	0.67	0.53	0.65	0.38	0.50	0.22	0.26	453.6	674.2
2005-06	-		1.44	1.71	0.73	0.81	0.91	0.61	0.15	0.42	659.0	1171.3
2006-07	2.43	0.98	1.27	1.09	0.94	0.98	0.87	0.83	0.51	0.47	1041.8	1232.9
2007-08	2.93	1.08	1.10	1.13	1.08	1.08	0.89	0.85	0.61	0.58	753.6	865.9
2008-09	2.21	0.97	-	1.00	0.31	0.60	0.23	0.74	0.07	0.14	630.7	684.0
2009-10	1.62	0.53	-	1.00	1.20	0.69	1.25	0.64	0.26	0.24	686.9	692.2
2010-11	0.77	0.77	-	-	0.85	0.74	1.43	1.16	0.74	0.56	1014.3	1044.4

(Cotton: Bales/Hect) (Other crops: Tonnes/Hect.) Ak - Akola, Ytl - Yavatmal
#Average annual rainfall of Akola district 710.00mm.
#Average annual rainfall of Yavatmal district 912.00mm.
(Source: AGRID-NIC, Ministry of Communications & IT, Govt. of India)
(Source: SDDS-DES, Ministry of Agriculture, Govt. of India)
(Source: IMD, Pune and Department of Agronomy, Dr. PDKV, Akola)

Yavatmal district. The productivity of gram was relatively high in 2006-07 and 2010-11 of Akola and Yavatmal district, when average annual rainfall of the district was higher than the normal .Mung showed low productivity in the year 2008-09 and 2009-10 when the rainfall was below the normal annual rainfall of the Akola and Yavatmal district. Overall productivity of gram, groundnut, tur, green gram and sorghum over the decade showed that the productivity was relatively sustainable for sorghum and green gram in Akola district as compared to Yavatmal district. Productivity of crops like groundnut and tur was relatively stable in Yavatmal district compared to Akola district, while the productivity of crop gram was stable over the decade in both the districts. It implied that under current climatic conditions crops like sorghum and green gram are hopeful crops for Akola district and crops like groundnut and tur was relatively hopeful crops for Yavatmal district in kharif season. Gram appeared to be promising crop for both the districts and the region to withstand variability in climate for rabi season.

3.4 Area and productivity of soybean and cotton crop of study area : Soybean and cotton are the two major crops under the study area. Productivity analysis of these two crops is given in Table 6 and Table 7 respectively.

It could be observed from Table 6 that productivity of major crop, soybean of the study area had increased in 2010-2011 compared over the base year 1999-00 in both the districts. However, it was also noticed that the productivity was relatively low in six years and four years in Akola and Yavatmal districts, respectively out of last 12 years. It was observed that the productivity was high in Akola district whenever there were normal rains or rains over the average annual rainfall. In respect of Yavatmal district; mixed scenario about the soybean productivity was seen. The productivity was high during the normal rainfall as well as whenever there were heavy rains than the normal. During very low rainfall period, the productivity of crop suffered drastically. It implied that there is urgent need to find alternatives for this crop, because of its yield uncertainty under climatic changes particularly in the last decade. It was observed that the farmers' of the region are growing the soybean variety JS-335 since long time. It needs to be replaced immediately to avoid segregation and pest/disease attacks. Moreover soybean crop stands better in both districts, only if there were normal rains.

It could be noticed from Table 7 above that productivity of most important crop cotton under the study area had increased in 2010-2011 over base year 1999-00. However, It was also noticed, that the productivity was relatively stable in last 6 years, but was very low compated to country national average (494 kg/ha).Analysis of rainfall data with cotton productivity revealed that the productivity of crop was better in Akola district in those years, whenever there was normal amount of rains or above the normal rains. Whereas, in Yavatmal district, it was observed that the productivity of cotton was better whenever, there was normal rainfall or rainfall slightly below the normal. The crop suffered in excess or very low rainfall. The plausible reason for differences in crop productivity with varied rainfall scenario of both districts might be due to fact that the soils in Yavatmal district were very deep and black cotton soil, while the soils of Akola district were deep and shallow. Thus during excess rainfall, wilting of crop may occurred in Yavatmal district due to water stagnation in the fields. Whereas,

Table 6
Area and productivity of soybean crop of study area

Year	Akola		Yavatmal		Akola	Yavatmal
	Area	Yield	Area	Yield	Average Annual Rainfall(mm)	Average Annual Rainfall(mm)
1999-00	28400	1.40	77700	1.30	1081.7	1115.4
2000-01	28900	1.08	75900	1.19	666.8	625.0
2001-02	31300	0.98	69600	1.30	915.0	1108.2
2002-03	27200	1.50	80700	1.36	726.2	1155.0
2003-04	30800	1.22	97900	1.45	422.1	1084.8
2004-05	50300	0.62	176300	0.54	453.6	674.2
2005-06	54100	0.72	212500	1.11	659.0	1171.3
2006-07	59800	1.65	268100	1.09	1041.8	1232.9
2007-08	826	2.00	266600	1.25	753.6	865.9
2008-09	137500	0.21	311800	0.33	630.7	684.0
2009-10	151500	0.97	311800	0.41	686.9	692.2
2010-11	126600	1.88	198500	1.38	1014.3	1044.4

(Productivity: Tonnes/Hect. Ton-1000 kg.), (Source: AGRID-NIC, Ministry of Communications & IT, Govt. of India), (Source: SDDS-DES, Ministry of Agriculture, Govt. of India). (Source: IMD, Pune and Department of Agronomy, Dr.PDKV, Akola)

in Akola district excess rains above the normal may results in moisture availability for the crop during dry period stress and quick drainage of excess water from the fields due to shallow soil type. It could also be noticed that the productivity was low in 6 years out of last 12 years. It implied that there is urgent need to find varieties for this crop, which stands better under climatic changes that witnessed, particularly in the last decade. It was observed that the farmers' of the region were adopting the Bt cotton variety since 6 -7 years. Farmers' opined that due to Bt cotton, their productivity was definitely increased, however expenses are also increased simultaneously. Farmers' reported the old varieties of cotton like NHH-44, PKV-AHH-468, and H8 were better than the present cotton varieties. They expressed, though the bollworm attack was reduced, sucking pests are increased terribly at the same time and they have to undertake continuous spraying, thereby increasing production cost. Farmers further expressed that non-Bt cotton seeds were not available even if they desires to sow.

It could be noticed from Table 7 above that productivity of most important crop cotton under the study area had increased in 2010-2011 over base year 1999-00. However, It was also noticed, that the plausible reason for differences in crop productivity with varied rainfall scenario of both districts might be due to fact that the soils in Yavatmal district were very deep and black cotton soil, while the soils of Akola district were deep and shallow. Thus during excess rainfall, wilting of crop may occurred in Yavatmal district due to water stagnation in the fields. Whereas, in Akola district excess rains above the normal may results in moisture availability for the crop during dry period stress and quick drainage of excess water from the fields due to shallow soil type. It could also be noticed that the productivity was low in 6 years out of last 12 years. It implied that there is urgent need to find varieties for this crop, which stands better under climatic changes that witnessed, particularly in the last decade. It was observed that the farmers' of the region were adopting the Bt cotton variety since 6 -7 years. Farmers' opined that due to Bt cotton, their productivity was definitely increased, however expenses are also increased simultaneously. Farmers' reported the old varieties of cotton like NHH-44, PKV-AHH-468, and H8 were better than the present cotton varieties. They expressed, though the bollworm attack was reduced, sucking pests are increased terribly at the same time and they have to undertake continuous spraying, thereby increasing production cost. Farmers further expressed that non-Bt cotton seeds were not available even if they desires to sow.

Table 7

Area and productivity of cotton (lint) of study area

Year	Akola		Yavatmal		Akola	Yavatmal
	Area	Yield	Area	Yield	Average Annual Rainfall (mm)	Average Annual Rainfall (mm)
1999-00	239600	0.98	446100	1.00	1081.7	1115.4
2000-01	227800	0.68	447700	0.53	666.8	625.0
2001-02	231400	0.84	437000	0.70	915.0	1108.2
2002-03	222900	1.01	403300	0.78	726.2	1155.0
2003-04	217700	0.91	376000	1.02	422.1	1084.8
2004-05	207600	0.66	332800	0.86	453.6	674.2
2005-06	204400	0.69	324000	0.87	659.0	1171.3
2006-07	204900	2.15	413500	1.19	1041.8	1232.9
2007-08	188600	1.97	416500	2.42	753.6	865.9
2008-09	168300	1.72	379400	1.88	630.7	684.0
2009-10	163300	1.70	392100	1.29	686.9	692.2
2010-11	167800	1.60	479800	1.62	1014.3	1044.4

Area in Heetare, (Cotton: Bales/Heet, one bales-170kg each), (Source: AGRIS-NIC, Ministry of Communications & IT, Govt. of India), (Source: NDDS-DES, Ministry of Agriculture, Govt. of India)

productivity was relatively stable in last 6 years, but was very low compated to country national average (494 kg/ha).Analysis of rainfall data with cotton productivity revealed that the productivity of crop was better in Akola district in those years, whenever there was normal amount of rains or above the normal rains. Whereas, in Yavatmal district, it was observed that the productivity of cotton was better whenever, there was normal rainfall or rainfall slightly below the normal. The crop suffered in excess or very low rainfall. The

4. Quality of crop product : Increasing temperature and lacking of water influence not only crop productivity but also quality of crop product in the study area.Table 8 pointed out that the quality of crops product partly depends on affecting pests and diseases on these crops. Thus, sorghum and tur crops were not influenced under normal rainfall .However the grain

quality is greatly affected if there are excess rains. In addition, the quality of crop products was affected not only in terms of pests and diseases development, but also directly on plants' growth and development stages. For instance, quality of red gram and soybean is reduced because of increasing proportion of unfilled grains. Tur and soybean seeds remain smaller and lighter than normal. Dahiya and lalya disease in cotton crop severely affected the boll opening and quality of cotton. A heavy rain at harvesting stages of green gram, black gram and soybean made the grains whitish and fetches fewer prices in market.

Table 8
Farmers' opinion on impact of climate change and it's variability on quality of crop product

Sr. No.	Impact of climate change on quality of crops	Yes	No
1	Cotton	25.13	74.87
2	Sorghum	22.00	78.00
3	Tur(red gram)	13.64	86.36
4	Mung(green gram)	28.13	71.87
5	Udid(black gram)	28.13	71.87
6	Soybean	23.67	76.33

5. Health : Farmers' resorted to using water from water tankers for drinking purposes during drought periods which reportedly caused diarrhea diseases. Under normal circumstances, farmers' fetch drinking water from deep wells, most of which are located within their homesteads. Rajankar et al, (2011) studied the groundwater quality from different parts of Yavatmal district revealed that the groundwater quality in the district showed that, the water in these areas are bacteriological not safe and need treatment before it should use for drinking. This was reported to have caused general poor health in a number of households, more so in Akola and Yavatmal with cholera identified in the former and malaria in the latter. Research findings of this survey in both districts have revealed that climate change associated diseases were cholera, dengue fever, malaria and skin diseases. In the same context, access to potable water and sanitation in Akola district is very low during droughts, causing an increase in the frequency of epidemics and enteric diseases.

6 Impact of floods/excessive rains on crop yield :

Similar to the impact of drought, it was reported by farmers' in two districts that excessive rains had led to very low yields due to water logging and leaching. For some farmers', there was total failure of crops. In Gonapur village of Akola district and Shelu village of Arni tahsil of Yavatmal district, crop growths stunted during excessive rains. Moreover, farmers' in both districts did not get time to weed their fields during surplus raining.

CONCLUSION

To conclude the impacts of climate change in distress prone districts indicated increasing reduced cultivated area in summer and decreasing soil fertility; water resources in terms of volume and time for taking water. Crop production was also influenced in terms of increasing diseases and pests in crops, decreasing productivity and quality products of crops. The responses given by the farmers' needs further verification to conclude that the impact perceived by the farmers are actually occurred due to climate change.

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