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ASSESSING MAIZE FARMERS ADAPTATION STRATEGIES TO CLIMATE CHANGE IN NASHIK DISTRICT OF MAHARASHTRA

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Abstract:

Long-term climatic change that may popularly know as 'climate change' is currently one of the world's greatest challenges. Agriculture is directly dependent on climate, since temperature, sunlight and water are the main drivers of crop growth. Use of drought and disease resistant varieties, crop diversification, mixed crop livestock farming systems and altering planting dates are common adaptation strategies towards climate change. Maize is the third most important cereal crop in the world which is affected by climate change, particularly sensitive to heat stress during the flowering stage and grain filling period which leads to decreased yield. The current study assessed the level of adaptation strategies followed by maize growers to mitigate the impact of climate change in Nashik district of Maharashtra. Three tehsils namely Niphad, Nandgaon and Yeola were selected with sample size of 120 respondents from 12 villages. Ex-post facto design was used for the study. Farmers were found to be less likely to adopt strategies such as intercropping, constructing bunds to conserve soil moisture, wind breaks and creating rain harvesting structures. This study recommends there is need of creating awareness and conducting training programs to maize farmers regarding these adaptation strategies. Majority of the farmers are not aware of insuring their crop. So, there is need of establishing an institutional arrangement with bank to insure maize crop against weather extremes by the government. Subject matter specialists from KVKs and Agricultural Extension Officers from the line department should visit the farmer's field and collect information on adaptation measures taken by farmers and find the limitations in adapting, as well as guide them to solve the farmer's problem using the resources that are available with farmers. This would reduce the probability of farmers losing crops due to climate change and variability, and hence make them less vulnerable.

Key Words: Maize, Climate Change, Adaptation Strategies, Mitigation

Introduction:

Climate change is one of the world's most challenging issues right now. It refers to long-term climatic change that lasts decades or longer and is defined by changes in the mean or variability of its parameters. Climate change is placing agriculture and food security at threat. In India, water is the most important agricultural input because irrigation is not available in 55 per cent of total cultivated land. Under these varying conditions, we are currently able to secure food supplies. According to the IPCC's recent report, there are potential adaption strategies that can be implemented at low cost and have high benefit-to-cost ratios (IPCC, 2007). The ability of a system to adapt to climate change (including climate variability and extremes) in order to mitigate potential damage, seize opportunities, or cope with the consequences is referred to as adaptive capacity. (Sahu and Mishra, 2013). Use of new crop types and livestock species that are more suited to drier conditions, irrigation, crop diversification, mixed crop livestock farming systems, and altering planting dates are all common agricultural adaptation strategies (Bradshawetal., 2004; Nhemaetal., 2004).

Maize is a plant that grows well in warm weather. It grows from sea level to altitudes of 3000 meters. It can be grown in a variety of environments. The main growing season in northern India is the Kharif (monsoon) season. However, in the south, maize can be planted at any time from April to October because the climate is warm even in the winter. From germination to flowering, maize requires a lot of moisture and heat. The best temperature for germination is 21°C, and the best temperature for growth is 32°C. Ranging between 28° C and 32° C, the optimum day time temperature to grow maize is higher than for the other important grain crops such as wheat and rice (Sánchez et al., 2014). High seasonal temperature anomalies accelerate maize phonological phase transitions reducing yields (Tebaldi & Lobell, 2018). Daily temperatures above 32 °C can induce heat stress reducing maize photo synthetic rate and increases leaf transpiration (Crafts-Brandner & Salvucci, 2002), compromising water use efficiency. Maize is particularly sensitive to heat stress during the anthesis (flowering) stage by reducing the pollen germination (Gourdji et al., 2013). During the grain filling period, high temperatures shorten kernel filling and decrease yield. Every 1°C rise in temperature was found to negatively influence the maize yield (Lobell et al., 2011). Similarly, it was reported that yield in maize decreased by 8.3per cent with every 1 °C rise in temperature from the optimum growth temperature (Lobell et al., 2011). Since

maize is left in the field to dry up before harvesting, it is usually not sensitive to heat stress and drought in the final period of the cropping season (e.g., Ceglar et al., 2018). Maize yields are also affected by drought (Zipper et al., 2016) and its non linear interactions with heat stress (Iizumi & Ramankutty, 2016; Lesk et al., 2016; Matiu. et al., 2017) earlier in the growing season. Drought can cause considerable delays in maize female organ development (Barnabas et al., 2008). During their productive stage, water shortage can also result in the inhibition of photosynthesis, thus also reducing the nutrient supply to generative organs. In addition, reducedsoil moisture availability can further increase the likelihood of heat stress (Lobell et al., 2013; Ray etal.,2002; Zampieri et al., 2009, 2016).

To adapt to the climate change, maize farmers are required first to notice that climate has altered and then identify potential useful adaptation measures and implement them. With unpredictable weather, the farmers should keep changing crop management practices by growing resistant varieties and are prepared for constant change in the farming practices.

Materials and Methods:

The study was conducted in Nashik district of Maharashtra. Three tehsils were selected from Nashik district and further four villages from each tehsil were selected randomly. From each village, ten farmers having experience of maize cultivation were selected randomly. Thus, a total of 120 farmers were selected for study. An interview schedule by including appropriate statements was prepared to identify the various adaptation strategies used by farmers in order to determine the extent of adaptation strategies used by farmers towards climate change and ex post facto research design was used. The survey included queries on crop management practices, soil and water conservation measures, plant protection and other adaptation strategies adapted by farmers towards climate change. Two continuums were used to measure the level of use of adaptation strategies by maize growers, and numerical values were assigned to the responses received. A numerical score of 1 was assigned to ‘yes,' and a numerical score of 0 was assigned to ‘no.' Each farmer's total score was computed. Based on per cent age of maize growers adopting particular activity, they were categorized in 3 groups using Mean and S.D. Statistical tools like frequency, percentage, standard deviation and mean were used to analyze the data.

Results:

The distribution of maize growing farmers according to their overall use adaptation strategies is given in table 1

S.No	Overall Adaptation Strategies (scores)	Frequency	Percentage
1	Low (up to 16)	22	18.34
2	Medium (17 to 21)	78	65.00
3	High (22 and above)	20	16.66
	Total	120	100.00

Mean = 19.15, S. D = 3.15

From the table 1, it is concluded that majority 65.00 per cent of the maize growing farmers had using medium level use of adaptation strategies, followed by 18.34 per cent of the maize farmers had low and 16.66 per cent of the maize growing farmers had high level use of adaptation strategies to mitigate the impact of climate change.

Table 2: Distribution of Maize growers according to Adaptation of crop management, Soil and Water Conservation Practices

Crop Management Practices					
S.No	**Recommended Adaptation Strategies**	**Adapted**		**Not adapted**	
		Frequency	**Percentage**	**Frequency**	**Percentage**
1	Maize varieties adapted or late sowing particularly due to late on set of monsoon	41	34.17	79	65.83
2	Maize varieties adapted for early sowing particularly due to early onset of monsoon	45	37.50	75	62.50
3	Maize cultivars resistant to drought	39	32.50	81	67.50
4	Maize varieties resistant to disease e	56	46.67	64	53.33
5	Adapted inter cropping	19	15.84	101	84.16
6	Adapted crop Diversification	102	85.00	18	15.00
Soil And Water Conservation Practices					
1	Irrigated in Alternate rows in Maize to conserve water.	0	0	120	100.00
2	Constructed bunds to conserve soil moisture	0	0	120	100.00
3	Adapted micro-irrigation	51	42.50	69	57.50
4	Adapted Mulching	21	17.50	99	82.50
5	Applied organic fertilizers	99	82.50	21	17.50

6	Adapted crop rotation	103	85.84	17	14.16
7	Adapted windbreaks / shelterbelts	22	18.34	98	81.66
8	Created rain water harvesting structure	0	0	120	100.00

The table 2 revealed that maize farmers were following crop management practices like late cultivars (34.17 per cent), early cultivars (37.50 per cent), drought resistant varieties (32.50percent), disease resistant varieties (46.67 per cent), intercropping (15.84 per cent), crop diversification (85.00 per cent). The reason for this could be a lack of awareness of the varieties and their benefits and farmers were not interested in inter cropping. The study is in accordance with Archana (2012) and Satindra kumar (2017).

From the table 2, it was found that Soil and water conservation practices like providing irrigation in alternate rows, constructing bunds for conserving moisture were not following by all the 120 farmers. The adaptation strategies like micro irrigation (42.50 per cent), mulching (17.50 per cent), applied organic fertilizers (82.50 per cent), crop rotation (85.84 per cent), windbreaks / shelterbelts (18.34 per cent).From the above table, it was evident that none of the farmers were using rain harvesting structure. The reason for this could be that farmers may felt that cost of drip is high and lack of awareness about the mulches and rainwater harvesting structure and its advantages.

These findings were in accordance with Archana (2012). The plant protection measures and other adaptation strategies followed by the maize farmers to mitigate the effect of climate change are presented in Table 3.

Table 3: Distribution of Maize growers according to Adaptation of plant protection measures and other adaptation strategies

Plant Protection Practices Followed		**Adapted**		**Not adapted**	
S.No	**Recommended adaptation Strategies**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
1	Seed treatment with chemical fungicide	90	75.00	30	25.00
2	Applied bio control agents	42	35.00	78	65.00
3	Adapted any practice to control the attack of Fall Army Worm	95	79.17	25	20.84
4	Adapted any practice to control leaf blight of maize.	109	90.84	11	9.16
Other strategies					
1	Adapted Crop Insurance	47	39.16	73	60.84
2	Weather agro advisory services	47	39.17	73	60.83
3	Received Technical Support from Government / Private agencies	43	35.83	77	64.16

From the table 3, the majority (75.00 per cent) were following seed treatment with chemical fungicide, applied bio control agents (35.00 per cent), practices to control the attack of Fall Army Worm (79.17 percent), practices to control leaf blight of maize (90.84 percent).Other strategies followed by the maize growers were, crop insurance (39.16 per cent), Weather agro advisory services (39.17 percent), received technical support from Government / Private agencies (35.83 per cent). The most likely reason is that farmers have less contact with extension agencies and IMD, which lead to a lack of awareness among maize growers about crop insurance and the services provided by IMD and Research Station. These findings were in accordance with Archana (2012) and Satindra kumar (2017).

Conclusion:

This study examined the adaptation strategies of maize farmers to mitigate the climate change in Nashik district of Maharashtra using primary data collected from 120 maize farming households by the interview schedule. Specifically, this study assessed the percentage of the maize farmers adopting each of the identified climate change adaptation strategies using descriptive statistics. This study concluded that majority, 65.00 percent of the respondents had using medium level, 18.34 percent of the respondents had low level and 16.66 percent of the respondents had high level use of adaptation strategies towards climate change. As regards to relationship between profile of maize growers and adaptation strategies followed, the study indicated that, variables such as education, farming experience, land holding, annual income, area under maize cultivation, social participation, extension contact, mass media exposure and scientific orientation were positively and significantly correlated with the adaptation strategies followed. Whereas, age is positively and non-significantly associated with the adaptation strategies followed and family size is negatively correlated with adaptation strategies followed.

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