Relationship between Socio economic profile and Adaptation strategiesof Maize farmers to climate changein Maharashtra.

Abstract

Maize, the second most important cereal crop inthe worldfollowing wheat and rice, is particularly affected by climate change. Maize is particularly sensitive to heat stress during the anthesis (flowering) and grain filling phase,which may result in decreased yields.Intergovernmental Panel on Climate Change (IPCC) emphasizes the critical importance of adaptation in agriculture to climate change.The present study investigated the socio-economic profile of maize growers and examined itscorrelation with theadaptation strategies followed by them to mitigate the impact of climate change. This study was conducted in three tehsils namely Niphad, Nandgaon and Yeola of Nashik district inMaharashtra, involving a sample of 120 respondents from 12 villages.The study findings indicated that most maize growers were in the middle age group, had education up to secondary school level, belonged to medium family size, possessed medium farming experience, small landholding and medium annual income. Additionally, it was found that the majority of farmers had medium level of social participation, extension participation, mass media exposureand medium level of scientific orientation.As regards to relationship between socio-economic profile of maize growers and adaptation strategies followed, the study depicted that, independent variablessuch as education, farming experience, land holding, annual income, area under maize, social participation, extension contact, mass media exposure and scientific orientation demonstrated significant positive correlation with the adaptation strategies followed. Whereas, age is positively and non-significantly associated with the adaptation strategies followed and size of the family is negatively correlated with adaptation strategies followed.

Keywords: Adaptation strategies, Climate change, Correlation, Maharashtra,Maize,

Introduction

Climatechangereferstolong-termclimaticchangethatlastsdecadesorlongerandisdefinedbychangesinthemeanorvariabilityofitsparameters. Climate change is placing agriculture and food security at threat. One of the policy options to mitigate the adverse impact of climate change is adaptation (Adger et al., 2003). AccordingtotheIPCC'srecentreport,therearesome potentialadaptationstrategieswhichcanbeimplemented at a low cost and have high benefit-to-cost ratios (IPCC, 2007). Use of new crop types and livestock breeds that are more suited to droughtconditions,cropdiversification,integrated farmingsystems,andaltering plantingdatesareallcommonagriculturaladaptationstrategies(Bradshawetal.,2004;Nhemaetal.,2004).

Maizeisaplantthatgrowswellin warmweather.The best temperature for germination is 21°C, and the besttemperature for growth is 32°C. Maize is particularly sensitive to heat stress during the anthesis(flowering) stage by reducing the pollen germination (Gourdji et al., 2013). During the grain fillingperiod,hightemperaturesshortenkernelfillinganddecreaseyield.Every1°Criseintemperaturewas found to negativelyinfluencethemaizeyield(Lobell*et*al.,2011).Similarly,itwasreportedthatyield in maize decreased by 8.3per cent with every 1 °C rise in temperature from the optimum growthtemperature(Lobell*et*al.,2011).Sincemaizeisleftinthefieldtodryupbeforeharvesting,itis usuallyinsensitivetoheatstressanddroughtinthefinalperiodofthecroppingseason(e.g.,Ceglaretal., 2018).Droughtcancauseconsiderabledelaysinmaizefemaleorgandevelopment(Barnabas *etal.*,2008).Duringthereproductivestage,watershortagecan alsoresultintheinhibitionof photosynthesis, thus also reducing the nutrient supply to generative organs.

In order to adapt to the climate change, maize farmers are required first to notice that climate has been altered and then identify potential useful adaptation measures and implement them. This paper attempts to know the socioeconomic profile of the maize farmers and how it is correlated to adaptation strategies followed by maize growers to mitigate the effect of climate change.

Methodology

The present study was conducted in Nashik district, Maharashtra, where three tehsils were selected, and four villages were randomly chosen from each tehsil. From these villages, ten maize farmers with experience were randomly selected, resulting in asample size of 120 farmers.Primary data was collected through field observations and semi-structured questionnaires, focusing on the socio-economic profile and adaptation strategies employed by maize farmers farmers in response to climate change, covering areas such as crop management, soil and water conservation, and plant protection. The study utilized an ex-post facto research design. Responses from farmers were quantified, with a score of 1 assigned to "yes" and 0 to "no" regarding their adoption of various strategies. Total scores for each farmer were computed. Farmers were then categorized into three groups based on the percentage adopting specific activities, using mean and standard deviation. The relationship between socioeconomic variables and adaptation strategies is done by using correlation coefficient inSPSS software. Furthermore, statistical methods such as frequency, percentage, standard deviation, and mean were employed for data analysis.

Results and Discussion

Table 1 showed that the majority, 58.34 percent of maize farmers, belonged to the middle age group, with 24.16 percentof themcategorized as old age and 17.50 percent as young age group.This finding may be explained by the fact, that maize farmers aged 36-55 years bear the majority of family responsibility and are more involved in farming than other age groups.This finding was more or less in conformity with Daanya and Ramachandran (2015)

The data indicated that 36.66 percent of maize farmers belonged to medium-sized families, while 35.84 percent were from small-sized families, and 27.50 percent belonged to large-sized families.The possible reason might be due to the fact that smaller families are more expected to escape poverty traps due to upward income mobility, as household resources are shared among fewer members, so joint families are rare now.This finding is in consistent line with Satyanarayana *et al.*(2010)

Regarding farming experience, the majority, 68.34 percent of maize growers, had a medium level of experience, followed by 18.33 percent with high experience, and 13.33 percent with low experience.The majority of maize farmers were having medium farm experience which might be due to most of them were inmiddle age group.Parallel findings were reported by Dhodia*etal.* (2014)

Table 1. DistributionoftheMaizeGrowersaccordingtotheirage, family size and farming experience.

Age	Young(15 to35)	21	17.50
	Middle(36 to55)	70	58.34
	Old(56 andabove)	29	24.16
Family size	Small (upto 4)	43	35.84
	Medium(5 to 10)	44	36.66
	Large(11 andabove)	33	27.50
Farming experience	Low(up to 14)	16	13.33
	Medium(15 to 39)	82	68.34
	High(40 andabove)	22	18.33

Table 2, shows that among maize farmers, 4.17 percent were illiterate, while 5.83 percent had education up to primary school level, 7.5 percent up to middle school, 39.17 percent up to secondary school, 9.16 percent up to intermediate, and 34.16 percent up to undergraduate levels.It could be inferred that**;**majority of maize growers were educated. This could be due to a greater awareness of farmers about the importance of education and the availability of a school in the village.This finding is similar to finding of Painkra*et al.*(2010)

It was observed that 54.17 percent of maize farmers reported a medium annual income, while 24.16 percent had a low income and 21.67 percent had a high income.The majority of maize farmers were likely in the medium-income category because they earned moderate incomes from maize cultivation as well as from other crops such as grapes and wheat.The findings were in consistent with those of Singh and Pandey (2013)

Table 2. DistributionoftheMaizeGrowersaccordingtotheirEducation and Annual Income

Levelofeducation(standard)	Respondent(n=120)	
	Frequency	**Percentage**
Illiterate(Noeducation)	5	4.17
Primaryschool(up to4thstd.)	7	5.83
Middleschool(5th to 7thstd.)	9	7.50
Secondaryschool(8th to10th std.)	47	39.17
Intermediate (11th to12thstd)	11	9.17
Undergraduationandabove	41	34.16
Annual Income		
Low(up to1.00lakh)	29	24.16
Medium(1.01to4.93lakhs)	65	54.17
High(4.94lakhsandabove)	26	21.67
Total		**100.00**

Table 3 shows that 9.16 percent of farmers had marginal land holdings, while 40.83 percent had small land holdings, 25.84 percent had semi-medium land holdings, approximately 20.84 percent had medium land holdings, and 3.33 percent had large land holdings.Based on the findings, it can be stated that the majority of maize growers (nearly two-fifth), 40.83percentpossessed small size of land (up to 2.00 ha). Subdivision and fragmentation of farm land from one generation to the next may be the most likely cause of each farmer's land holding size reduction in rural areas.The findings were in consistent with those of Painkra et al (2010)

If we see the area under maize cultivation, majority 72.50 percent of the maize growers had low area under maize cultivation, while 14.17 percent had medium area under maize crop and only 13.33 percent had high area under maize cultivation.

Table 3. Distributionofthemaizegrowersaccordingtotheirsize of the landholding and area under maize

Size of the landholding	Marginal(upto1.0ha)	11	9.16
	Small(1.01 to 2.0 ha)	49	40.83
	Semi-medium(2.0 to4.0 ha)	31	25.84
	Medium(4.01to 10.0 ha)	25	20.84
	Large(10.01haandabove)	5	3.33
Area under maize	Small(up to 1.0ha)	87	72.50
	Medium(1.01to 2.0ha)	17	14.17
	Large(2.01haandabove)	16	13.33

Table 4 indicates that,majority, 62.50 percent of maize growers had medium mass media exposure, while 20.00percent had high exposure, and 17.50 percent had low exposure to mass media.Majority of maize growing farmers had medium level of exposure due to medium level of social participation and very few regularly reading of new paper and Agricultural Magazines.This finding is in consistent with the Badhe (2012)

It was found that, approximately 63.33 percent of maize farmers demonstrated a medium level of scientific orientation, whereas 20.84 percent exhibited a high scientific orientation, and the remaining 15.83 percent showed low scientific orientation.majority 79.16 per cent of maize growers had medium to high scientific orientation. This may be due to the high literacy level and good extension contact of the maize growers.Similar findings were seen in the Singh and Pandey (2013)

In terms of social participation,a majority, 57.50 percent, of maize farmers exhibited medium social participation, while 26.66 percent had low participation, and only 15.84 percent showed high social participation.This may be due to only a few organizations are active in villages which were affluent to large farmers whereas majority are small farmers with low level of interest towards participation.The findings were in consistent with results ofKirmirwar (2019)

It was also noted that 52.50 percent of maize growers maintained a medium extension contact, while 30.84 percent had low contact, and 16.66 percent had high contact with extension services.The probable reason might be that, the majority of the maize growers were seeking information from opinion leaders and few of them were contacting authentic sources like extension agentsandagricultural officers for the information.The findings of this analysis are more or less in consistent with the findings of Nirmala (2012)

Table 4. Distribution of the maize growers based on their mass media exposure, scientific orientation, social participation and extension contact

Variable	Category	Frequency	percentage
Mass media exposure	Low(up to 4)	21	17.50
	Medium(5 to 8)	75	62.50
	High(9 andabove)	24	20.00
Scientific orientation	Low(up to 20)	25	20.84
	Medium(21-26)	76	63.33
	High(27 andabove)	19	15.83
Social participation	Low(up to 3)	32	26.66
	Medium(4 to 8)	69	57.50
	High(9 andabove)	19	15.84
Extension contact	Low(up to 4)	37	30.84
	Medium(5 to 8)	63	52.50
	High(9 andabove)	20	16.66

Relationship between socioeconomic profile and adaptation strategies followed by maize farmers towards climate change

Age vs Adaptation strategies followed

Table 5 indicated a non-significant but positive (0.018) association between age and adaptation strategies followed.This could be attributed to the fact that farmers are influenced not only by age but also by other factors when adopting adaptation strategies. Similar findings were reported by Suganthkumar(2018).

Education vsAdaptation strategies followed

Education of the maize farmers had highly significant and positive association withadaptation strategies followed at 0.01 probability level (0.382**). This emphasizes the importance of education in adopting adaption strategies, as educated individuals tend to be more open to new concepts and technological innovations.

Family size vs Adaptation strategies followed

Thereisnegativeandnonsignificant(-0.075^{NS}) associationbetweenfamilysizeandadaptation strategies followed. This may be attributed to the challenge of navigating diverse family perspectives as family size increases, potentially hindering the prompt implementation of adaptation measures. Thesamefindings were reportedby Suganth kumar(2018).

Farming experience vs Adaptation strategies followed

The farming experience of farmers showed a statistically significant positive associationwithadaptationstrategiesfollowed at 0.05 probability level (0.191*).This result depicts that, as the experience of the respondent increases, he may have been aware ofclimatechangeanditsconsequencesonthemaizecrop,motivatinghimtofollow adaptationstrategiestominimizethe effects of climatechangewhile also increasing output.Thisfinding is consistentwith Maddison's findings (2011).

Landholding vs Adaptation strategies followed

The landholding of maize farmers exhibited a positive and significant association withtheadaptationstrategiesfollowedat 0.05 probability level (0.205*).This could be because the large farmers are highly affected by climatic change in a large area compared to small farmers. Due to this, large farmers are more conscious in adapting differentadaptationstrategies.Thesamefindingswerereported byAbid *etal.*(2015).

Annual Income and Adaptation Strategies followed

The annual income of maize growers showed a significant positive association with the adaptation strategies they implemented, significant at the 0.01 level (0.399**). The reason might be, the higher income of farmer motivated him to follow adaptation strategies.These results were in consistent with the results of Ravishankar (2013)

Area under maize cultivation vs Adaptation strategies

The area of land under maize cultivation among farmers showed a positive and statistically significant association with the adaptation strategies followed at the 0.05 probability level (0.231*).

Social participation vs Adaptation strategies

The social participation of farmers exhibited a positive and highly significant association with the adaptation strategies followed at the 0.01 probability level (0.269**).Thiscouldbebecausefarmerswith activeparticipationinvariousorganizationshavemadethemselves awareof differentadaptationstrategies and theirimportancein their ownfarming situations.Thisfindingisinconsistentwiththeresultsof Kranthikumari(2014)

Extension contact vs Adaptation strategies followed

There is a positive and highly significant association between extension contact and adaptation strategies followed at the 0.01 probability level (0.325**). This could be attributed to the regular interaction of maize farmers with extension personnel, which likely motivates them to implement adaptation strategies. Similar results were noted by Dhaka et al. (2010).

Mass media vs Adaptation strategies followed

The mass media exposure of farmers showed a positive and significant association with the adoption of adaptation strategies at the 0.05 probability level (0.195*). This might be because increased exposure to mass media has raised awareness among farmers about the benefits of adopting adaptation strategies to mitigate the effects of climate change. This finding supports the findings of Kranthi Kumari (2014).

Scientificorientation vs Adaptation strategies followed

The scientific orientation of maize farmers demonstrated a positive and highly significant association with the adaptation strategies followed at the 0.01 probability level (0.426**).Highereducationandmediaexposureof farmers haveinfluencedtheir attitudepositively towardsscientific procedures,which inturninfluencedtheirwillingness toimplement adaptionstrategies.This finding is in accordance withtheresultsofTrilochankarkichetri(2019).

Table 5. correlation between socioeconomic profile and adaptation strategies followed by maize growers

IndependentVariable	CorrelationCoefficient
Age	0.018^{NS}
Education	0.382**
FamilySize	-0.075^{NS}
Farmingexperience	0.191*
LandHolding	0.205*
Annualincome	0.399**
AreaUndermaizeCrop	0.231*
Socialparticipation	0.269**
ExtensionParticipation	0.325**
Massmediaparticipation	0.195*

ScientificOrientation	0.426**

Conclusion

The study findings indicated that most maize growers were in the middle age group, had education up to secondary school level, belonged to families of medium size, possessed moderate farming experience, small landholding and reported medium annual incomes. Additionally, it was found that the majority of farmers had medium level of social participation with medium level of extension participation, had medium exposure to mass media, and exhibited a moderate level of scientific orientation.

As regards to relationship between socio economic profile of maize growers and adaptation strategiesfollowed, the study depicted that, independent variables such as education, farming experience, land holding, annual income, area under maize cultivation, social participation, extension contact, mass media exposure, and scientific orientation showed positive and significant correlationwiththeadaptationstrategiesfollowed.Whereas,ageispositivelyandnon-significantlyassociatedwiththeadaptationstrategiesfollowedandfamilysizeisnegativelycorrelated withadaptationstrategiesfollowed.

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