



Relationship between Socio Economic Profile and Adaptation Strategies of Maize Farmers to Climate Change in Maharashtra, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/ijecc/2024/v14i94402>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/121621>

Original Research Article

Received: 10/06/2024

Accepted: 14/08/2024

Published: 29/08/2024

ABSTRACT

Maize, the third most important cereal crop in the world following 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

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Cite as: Mounika, B., M. C. Ahire, Kotha Shravani, and Chinni Venkata Sai Bharath. 2024. "Relationship Between Socio Economic Profile and Adaptation Strategies of Maize Farmers to Climate Change in Maharashtra, India". *International Journal of Environment and Climate Change* 14 (9):164-71. <https://doi.org/10.9734/ijecc/2024/v14i94402>.

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 its correlation with the adaptation 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 in Maharashtra, 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 exposure and 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 variables such 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. As extension and social participation are positively related to adaptation strategies followed, we can infer that creating awareness on climate change adaptation strategies by organizing more extension campaigns, training programs and providing subsidies or incentives for farmers will be motivate them to better adapt to climate change.

Keywords: Adaptation strategies; climate change; correlation; Maharashtra; maize.

1. INTRODUCTION

Climate change 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. One of the policy options to mitigate the adverse impact of climate change is adaptation [1]. According to the IPCC's recent report, there are some potential adaptation strategies which can be implemented at a low cost and have high benefit-to-cost ratios [2]. Use of new crop types and livestock breeds that are more suited to drought conditions, crop diversification, integrated farming systems, and altering planting dates are all common agricultural adaptation strategies [3].

Maize is a plant that grows well in warm weather. The best temperature for germination is 21°C, and the best temperature for growth is 32°C. Maize is particularly sensitive to heat stress during the anthesis (flowering) stage by reducing the pollen germination [4]. 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 [5]. Similarly, it was reported that yield in maize decreased by 8.3 per cent with every 1 °C rise in temperature from the optimum growth temperature [5]. Since maize is left in the field to dry up before harvesting, it is usually insensitive to heat stress and drought in

the final period of the cropping season [6]. Drought can cause considerable delays in maize female organ development [7]. During the reproductive stage, water shortage can also result in the inhibition of 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.

2. 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 a sample 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 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 in SPSS software. Furthermore, statistical methods such as frequency, percentage, standard deviation, and mean were employed for data analysis.

3. RESULTS AND DISCUSSION

Table 1 showed that the majority, 58.34 percent of maize farmers, belonged to the middle age group, with 24.16 percent of them categorized 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 [8].

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 Satyanarayan et al. [9].

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 in middle age group. Parallel findings were reported by Dhodia et al. [10].

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. [11].

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 [12].

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), 40.83 percent possessed 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 [11].

Table 1. Distribution of the Maize Growers according to their age, family size and farming experience

Variable	Category	Frequency	Percentage
Age	Young (15 to 35)	21	17.50
	Middle (36 to 55)	70	58.34
	Old (56 and above)	29	24.16
Family size	Small (up to 4)	43	35.84
	Medium (5 to 10)	44	36.66
	Large (11 and above)	33	27.50
Farming experience	Low (up to 14)	16	13.33
	Medium (15 to 39)	82	68.34
	High (40 and above)	22	18.33

Table 2. Distribution of the Maize Growers according to their Education and Annual Income

Level of education(standard)	Respondent (n=120)	
	Frequency	Per cent age
Illiterate (No education)	5	4.17
Primary school (up to 4 th std.)	7	5.83
Middle school (5 th to 7 th std.)	9	7.50
Secondary school (8 th to 10 th std.)	47	39.17
Intermediate (11 th to 12 th std)	11	9.17
Under graduation and above	41	34.16
Total	100	100
Annual Income		
Low (up to 1.00lakh)	29	24.16
Medium (1.01 to 4.93lakhs)	65	54.17
High (4.94lakhs and above)	26	21.67
Total	100	100

Table 3. Distribution of the maize growers according to their size of the landholding and area under maize

Variable	Category	Frequency	Percentage
Size of the landholding	Marginal (up to 1.0ha)	11	9.16
	Small (1.01 to 2.0 ha)	49	40.83
	Semi-medium (2.0 to 4.0 ha)	31	25.84
	Medium (4.01 to 10.0 ha)	25	20.84
	Large (10.01ha and above)	5	3.33
Area under maize	Small (up to 1.0ha)	87	72.50
	Medium (1.01 to 2.0ha)	17	14.17
	Large (2.01ha and above)	16	13.33

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 4 indicates that, majority, 62.50 percent of maize growers had medium mass media exposure, while 20.00 percent 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 following the mass media like newspaper and Agricultural Magazines. This finding is in consistent with the Badhe [13].

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 [12].

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 of Kirmirwar [14].

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 agents and agricultural officers for the information. The findings of this analysis are more or less in consistent with the findings of Nirmala [15].

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 and above)	24	20.00
Scientific orientation	Low (up to 20)	25	20.84
	Medium (21-26)	76	63.33
	High (27 and above)	19	15.83
Social participation	Low (up to 3)	32	26.66
	Medium (4 to 8)	69	57.50
	High (9 and above)	19	15.84
Extension contact	Low (up to 4)	37	30.84
	Medium (5 to 8)	63	52.50
	High (9 and above)	20	16.66

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

Independent Variable	Correlation Coefficient
Age	0.018 ^{NS}
Education	0.382 ^{**}
Family Size	-0.075 ^{NS}
Farming experience	0.191 [*]
Land Holding	0.205 [*]
Annual income	0.399 ^{**}
Area Under maize Crop	0.231 [*]
Social participation	0.269 ^{**}
Extension Participation	0.325 ^{**}
Mass media participation	0.195 [*]
Scientific Orientation	0.426 ^{**}

4. 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) correlation 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 Suganth K. and Philip, H [16].

Education vs Adaptation strategies followed: Education of the maize farmers had highly significant and positive correlation with adaptation strategies followed at 0.01 probability level (0.382^{**}). This emphasizes the importance of education in adopting adaptation strategies, as educated individuals tend to be more open to new concepts and technological innovations.

Family size vs Adaptation strategies followed: There is negative and nonsignificant (-0.075^{NS}) correlation between family size and adaptation 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. The same findings were reported by Suganth K. and Philip, H [16].

Farming experience vs Adaptation strategies followed: The farming experience of farmers showed a statistically significant positive correlation with adaptation strategies followed at 0.05 probability level (0.191^{*}). This result depicts that, as the experience of the respondent increases, he may have been aware of climate change and its consequences on the maize crop, motivating him to follow adaptation strategies to minimize the effects of climate change while also increasing output. This finding is consistent with Maddison findings [17].

Landholding vs Adaptation strategies

followed: The landholding of maize farmers exhibited a positive and significant correlation with the adaptation strategies followed at 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 different adaptation strategies. The same findings were reported by Abid et al. [18].

Annual Income and Adaptation Strategies

followed: The annual income of maize growers showed a significant positive correlation 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 Ravi, S. K [19].

Area under maize cultivation vs Adaptation strategies:

The area of land under maize cultivation among farmers showed a positive and statistically significant correlation 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 correlation with the adaptation strategies followed at the 0.01 probability level (0.269**). This could be because farmers with active participation in various organizations have made themselves aware of different adaptation strategies and their importance in their own farming situations. This finding is in consistent with the results of of Kranthi K. [20].

Extension contact vs Adaptation strategies

followed: There is a positive and highly significant correlation 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. [21].

Mass media vs Adaptation strategies followed:

The mass media exposure of farmers showed a positive and significant correlation 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 K. [20].

Scientific orientation vs Adaptation strategies

followed: The scientific orientation of maize farmers demonstrated a positive and highly significant correlation with the adaptation strategies followed at the 0.01 probability level (0.426**). Higher education and media exposure of farmers have influenced their attitude positively towards scientific procedures, which in turn influenced their willingness to implement adaptation strategies. This finding is in accordance with the results of Trilochana K.C. [22].

5. 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 strategies followed, 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 correlation with the adaptation strategies followed. Whereas, age is positively and non-significantly correlation with the adaptation strategies followed and family size is negatively correlated with adaptation strategies followed.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that generative AI technologies namely ChatGPT version 3.0 used for grammars editorials.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/121621>