



## Factors influencing farmers' adoption of adaptation measures towards climate change and variability in distress prone districts of Vidarbha

N R KOSHTI<sup>1</sup> and D M MANKAR<sup>2</sup>

*Dr Panjabrao Deshmukh Krishi Vidyapeeth (Agricultural University), Akola, Maharashtra 444 004*

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### ABSTRACT

This paper analyses the various factors that had influenced the adoption of adaptation measures by the farmers in response to climate change and variability in distress prone districts of Vidarbha region in Maharashtra. The data used in the analysis were obtained through face to face interviews of 300 farmers in 10 villages scattered over 5 tahsils of 2 highly farmers' suicide prone districts in 2012. Influence of 27 independent variables on the adoption of adaptation measures (dependent variable) was studied. The results of regression analysis indicated that the t- value for partial b of adaptive capacity (3.098) was significant. All the 27 variables fitted in a regression equation accounted for 75.30% ( $R^2 = 0.753$ ) variation in adoption of adaptation measures. Regression analysis further revealed that annual income, perception towards climate change, extension contact, farming experience and social participation were the major factors influencing adoption of adaptation measures. Use of different adaptation measures significantly increase for farmers under study area with more access to these factors. Designing policies that aims to improve these factors for small holder farming systems have great potential to improve farmers' adaptation to changes in climate and variability in the region.

**Key words:** Adaptation measures, Adoption, Climate change, Distress prone, Factors, Vidarbha

The six districts out of 11 districts of Vidarbha region in Maharashtra are the hotspots for farmers' suicides since 2001 and declared as distress prone districts. The region experiences extreme climatic conditions and the impacts of climate change further exacerbated its current vulnerability. More than 50% (53.44%) of the crop failure has accrued to an inadequate or untimely rainfall (TERI 2009). Nearly 58% of farmers' suicides in Vidarbha region were reported during monsoon months and are highly sensitive to the changes in climatic conditions (Pande and Akermann 2010). Total 11 737 farmers in Maharashtra committed suicides between the period from 2001-10 and the number of incidences of suicides from Vidarbha were at the top (Talule 2013). Unpredictability of the monsoon, shifting rainfall patterns, drought-like conditions in some areas and excessive rainfall in others has become frequent and regular trend in the region. Considering the brutality of climate change, farmers' have to adopt the adaptation measures in order to reduce the crop loss and make climate resilient farming for sustainable livelihood. There is however, little knowledge about the factors governing their adaptation behaviour in response to climate change. Moreover, the characteristics

of the farmers' influence the adoption of adaptation measures in coping to impact of climate change and this eventually leads to influence their adaptation behaviour. Hence, the present study was planned to trace out the factors determining their adoption of adaptation measures' in the region so as to formulate policies to progress adaptation to climate change.

### MATERIALS AND METHODS

The present study was undertaken in purposively selected Akola and Yavatmal districts of Vidarbha region of Maharashtra state in India during 2012. Six districts namely Yavatmal, Washim, Buldhana, Akola, Amravati and Wardha are declared distress prone in Vidarbha. The study was focused in Yavatmal and Akola districts due to its varying agro-climatic characteristics and the number of incidences of farmers' suicide was found high than other districts. Nearly 85% of the agriculture is rainfed.

The diagnostic research design of social research was used for investigation, since the emphasis of the study was mainly fact-finding operation, where variables were assumed to be known and the hypotheses were formulated and concerned with testing of hypothesis. Exploratory research approach was followed to investigate factors influencing their adaptations to climate change as well as to secure greater insight into the practical aspects of the problem.

<sup>1</sup>Associate Professor (e mail: nitinkoshti@ymail.com), Directorate of Extension Education, <sup>2</sup>Head (e mail: dilipmankar@hotmail.com), Department of Extension Education.

Sample survey method was followed in gathering the information. On the basis of climate variability and extremities, decadal annual rainfall, incidences of farmers' suicides total five talukas were selected from both districts. Yavatmal district is a larger district having geographical area 13 582 sq km than Akola with geographical area having 10 567sq km. Therefore, three talukas were selected from Yavatmal district and two from Akola district purposively. A list of villages was obtained from five talukas. Proportionate numbers of villages were randomly selected on the basis of number of villages in each selected taluka; (five from Akola, five from Yavatmal). Thereafter official list of farmers' were obtained from respective villages and within each selected village, 30 farmers' were identified for data collection. Following the procedure in 10 selected villages, total of 300 farmers' were selected for this investigation. The data were collected with the help of structured and pre-tested interview schedule developed for this purpose. All the data were collected from the respondents at their residence or at farm through personal interview. Two focused group discussions were carried out for realistic decision-making process.

The independent variables were quantified by adopting the scoring procedure. The dependent variable adoption of adaptation measures were assessed with the help of standardized scale developed for the purpose of this research. The scale consists of 40 adaptation measures. Each given adaptation measure on the scale was rated on five point response continuum, viz. adapted before the impact of climate change, adapted after the impact of climate change, under current consideration, no adaptation and no plans to adapt in future with score of 5, 4, 3, 2 and 1 respectively. The farmers' were asked to respond to each statement in terms of adoption of given adaptation measures and the responses were recorded by a tick mark by the researcher in the appropriate column representing the five categories. The total score for each farmer was calculated by adding up the scores on all statements in the scale. The obtained score of an individual farmer on the scale indicated his adoption of adaptation measures in response to climate change. The adaptation score on the scale ranges from a minimum of 120.1 to maximum of 600.50. The adaptation score of each farmer was then converted into Adoption of Adaptation Measure Index (AAMI) as follows.

$$\text{AAMI} = \frac{\text{Sum of adaptation score obtained by the individual respondent}}{\text{Maximum obtainable adaptation score by the individual respondent}} \times 100$$

To find out the characteristics of farmers influencing their adoption of adaptation measures to the impacts of climate change, multiple regression analysis was carried out. The results of correlation analysis were fitted in a regression equation and regression analysis was run in SPSS 13.

## RESULTS AND DISCUSSION

### *Extent of adaptation measures adopted by the farmers'*

The extent of adaptation measures adopted by the farmers' in the study area in coping to climate change and its variability was assessed with the help of standardized index developed for this study. The observed index range of farmers' overall adaptation ranged from 43.59 to 68.70 with an average of 51.03 and a standard deviation of 7.1314. Data in Table 1 revealed that almost cent per cent (98.33%) of the respondents were in medium level of adoption of adaptation measures followed by meager (1.67%) respondent's falls in high category of adoption of adaptation measures in response to climate change. None of the respondents was found in low category. This indicates that majority of the farmers' in study area had adapted to moderate extent in coping to changes in the climate.

### *Influence of farmers' characteristics upon their adaptations*

This section examines the farmers' characteristics that influence their adaptations towards climate change and variability. A look at Table 2 indicated that  $R^2$  was significant as  $F$  was significant. The  $F$ -ratio tests whether the overall regression model was a good fit for the data. The values showed that the independent variables significantly predicted the dependent variable, ( $F = 30.684$ ,  $P < .0005$  (i.e. the regression model was a good fit of the data). The ' $R$ ' represents the value of multiple correlation coefficients.  $R$  can be considered to be one measure of the quality of the prediction of the dependent variable; in this case adaptation. A value of 0.868 indicated a good level of prediction. The  $R^2$  value, which is the proportion of variance in the dependent variable that can be explained by the independent variables. It was seen from the value of 0.753 that 27 independent variables selected for this research jointly explained 75.3% variation in the dependent variable adaptation. Besides, the coefficient of determination of these variables were found to be highly significant ( $R^2 = 0.753$ ). Multiple regression analysis showed that out of 27 independent variables selected, 6 variables namely

Table 1 Distribution of respondents according to the overall level of adoption of adaptation measures

Level of adoption of adaptation measures (index range)	Respondents (n=300)		Possible index range	Observed index range
	fre- quency	percent- age		
Low (up to 33.33)	00	00	20-100	43.59.-
Medium (33.34-66.66)	295	98.33		68.7
High (above 66.66)	05	1.67		
Total	100.00			

Mean index:51.03, CV:13.97, SD:7.1314.

Table 2 Regression analysis of variables influencing farmers' adaptations to climate change

Independent variables	Partial b	t-value for partial b	Standard partial b values	Rank
Gender	0.0978	0.135	0.004	
Age	0.0730	1.634	0.106	
Education	-0.1620	-1.875	-0.100	
Family size	-0.0764	-1.210	-0.080	
Land holding	-0.00001	-1.683	-0.127	
Farming experience	-0.4360	-2.402*	-0.078	V
Annual income	1.1090	3.188**	0.289	II
Indebtedness	0.00003	1.314	0.063	
Access to credit	-1.4150	-1.675	-0.095	
Agriculture infrastructure facilities	0.0337	1.165	0.052	
Household health	0.0153	0.046	0.001	
Social participation	-1.1770	-2.987**	-0.147	VI
Off farm employment	0.4170	0.605	0.027	
Type of land	-0.5710	-1.781	-0.081	
Cropping system	0.5800	1.206	0.060	
Irrigation facilities	0.5270	1.278	0.082	
Labour availability	0.0165	0.108	0.005	
Livestock ownership	-0.2660	-1.468	-0.066	
Access to electricity	-0.0847	-0.078	-0.003	
Market access	0.0134	0.239	0.011	
Access to weather information	0.0538	0.059	0.002	
Mass media exposure	0.143	0.770	0.038	
Extension contact	0.279	2.685**	0.140	IV
Mean annual rainfall	-0.00202	-0.879	-0.042	
Vulnerability	0.157	-1.188	-0.151	
Adaptive capacity	0.157	3.098**	0.363	I
Perception towards climate change	15.056	4.079**	0.208	III

R:0.868, R<sup>2</sup>:0.753 (with 27 independent variables), F:30.684\*\*. \*\* Significant at 0.01 level of probability, \*Significant at 0.05 level of probability.

adaptive capacity, annual income, perception, extension contact, farming experience and social participation contributed significantly to the prediction of the dependent variable i.e. adaptation. In order to find out the relative importance of the contributory and significant variables in predicting the dependent variable adaptation, the variables were ranked on the basis of their standard partial b values. Ranking of variables showed that adaptive capacity was the most influencing variable in deciding the adaptation behaviour of farmers' in adoption of adaptation measures in Vidarbha region. The adaptive capacity in the present research was a multi-construct variable that determined the adaptive capacity of farmers' towards their adaptation to climate change and variability. It consisted of five main indicators. Those were social capital, human capital, financial capital, physical capital and natural capital. There were sub-indicators under this main indicators that includes

socio-political participation under main indicator of social capital. In respect of human capital sub-indicators a) medical treatment availability b) access to health facilities (in km) c) means of transport in case of emergency and d) education were examined. In case of financial capital a) indebtedness b) savings c) crop insurance were noticed. Under physical capital a) affordable transport b) type of house c) adequacy of water supply d) source of energy and e) material possession were checked. Regarding natural capital a) type of land b) type of soil were studied. In other words, it could be said that social capital, human capital, financial capital, physical capital and natural capital are the determinants of adaptation. The development on these aspects will be helpful in diminishing the vulnerability of farmers to the impacts of climate change in this distress prone region. Furthermore, Table 2 also revealed that independent variables annual income followed by the perception towards climate change and extension contact; were the key variables influencing adaptations of farmers' towards climate change.

The partial b value indicated the amount of change which shall be brought in the dependent variable, adaptation by one unit change in the independent variable, other things remaining constant. That is, a change in one unit of adaptive capacity shall bring about a change of 0.157 units in the dependent variable adaptation remaining other things constant. Nhemachena and Hassan (2007) noticed that capital, land and labour were served as important factors for coping with and adapting to climate change. A change in one unit of annual income shall bring about a change of 1.109 units in the adaptation remaining other things constant. Gbetibouo (2009) also observed that the farm income of the households has a positive and significant impact on conserving soil, using different crop varieties and changing planting dates. Higher the annual income more likely to adapt better to climate change. The households with dependency over farm income are regarded as sensitivity as agriculture is vulnerable sector to climate change and household with diversified income have higher adaptive capacity (Eakin *et al.* 2008). A change in one unit of the perception towards climate change shall bring about a change of 15.056 units in the adaptation remaining other things constant. Nzeadibe and Ajaero (2010) analyzed that perception is arguably related to awareness level and availability of information on a phenomenon. Farmers' who are aware of changes in climatic conditions have higher chances of taking adaptive measures in response to observed changes. The change in one unit of extension contact shall bring about a change of 0.279 units in the adaptation remaining other things constant. Extension contact enable farmers' to get information about seasonal climate forecasts on time, so that they can make more informed farming decisions and adapt to changing conditions. Enujeke and Ofuoku (2012) also reported the same. The information on climate change is expected to have a significant positive impact on the likelihood of adopting various climate change adaptation measures. Improving access to extension services for farmers' has

the potential to significantly increase farmer awareness of changing climatic conditions as well as adaptation measures in response to climatic changes. These variables ensure the adoption of adaptation measures by the farmers in adaptation to climate change and variability. The variation exerted by farming experience on adoption of adaptation measures was negative and was identified as significant predictor producing negative regression coefficients. This means that for each 01 year increase in farming experience, there is a decrease in 0.4360% adoption of adaptation measures by the farmers towards climate change and variability in the study area. This may be due to reasons that with each year increase in age of farmers. They are more reluctant to take higher risks and cannot adopt new practices on their farm. This might hinder them to adapt to climate change. The mean age of respondents was found 46 years during the investigation which indicated middle aged category. Contrarily Gbetibouo (2009) reported that experienced farmers' have an increased likelihood of using portfolio diversification, changing planting dates, and changing the amount of land under production. The variation exerted by social participation on adoption of adaptation measures was negative and was identified as significant predictor producing negative regression coefficients. This means that for each 01 activity increase in social participation, there is a decrease in 1.177% adoption of adaptation measures by the farmers towards climate change and variability in the study area. The reason might be the diversion of their attention to his farm due to engagement in social activities. Under the changed climate scenario day-to-day vigilance of own farm is almost mandatory for every farmer. *Spodoptera litura* pest attack witnessed two years back in the study area could be cited as best example to support this reality. The soybean crop was completely destroyed because of not giving regular attention to their own farm by few farmers. The farmers who have adopted timely pest control measures saved their crop. Contrarily Dhuware and Pande (2002) noted that social participation had significant association with adoption of watershed management practices.

It is concluded that the variables adaptive capacity, annual income, perception towards climate change, extension contact, farming experience and social participation statistically significantly predicted adoption of adaptation measures in coping the impact of climate change  $F= 32.393$ ,  $P < .0005$ ,  $R^2 = 0.753$ . Use of different adaptation measures significantly increase for farmers' under this distress prone and highly suicidal area with more access to these factors. Designing policies that aim to

improve these factors for small holder farming systems have great potential to improve farmers' adaptation to changes in climate and reducing distress amongst farming community. For example, increasing annual income through more access to credit facilities, information (climatic and agronomic) increasing their perceptions through extension contacts as well as empowering adaptive capacity of farmers' can significantly increase farm-level adaptation.

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