RESEARCH ARTICLE

Dryland Farmers' Adaptive Behaviour towards Climate Variability

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ABSTRACT

Dryland agriculture is adversely affected by climate variability. To sustain their livelihood, farmers must adapt to climate change to manage its ill effects. The present study aimed to bring out the adaptive behavior of dryland farmers towards climate variability. Five villages were randomly selected in Palladam block of Tiruppur district. The sample of 120 respondents was selected by using proportionate random sampling. The ex-post facto study was adopted as a research design. A well-structured interview schedule was used for data collection. The findings revealed that dryland farmers had practiced different adaptation strategies such as cultivating climate-resilient crops, changing the timing of farm operations, changes in cropping patterns, adopting soil and water conservation practices, and reducing the number of farm animals, etc. Therefore, this study provides supportive evidence for policy makers to take into account the changes in farming practices that farmers had adopted to minimize the adverse impacts of climate variability for designing suitable location-specific adaptation strategies.

Keywords: *Climate variability; Dryland farmer; Adaptive behavior; Impacts*

INTRODUCTION

Rapid changes in the earth's climate are increasingly evident from global scientific reports (IPCC, 2014). The increased concentration of greenhouse gases has raised the average temperature and altered the amount and distribution of rainfall globally (Solomon *et al*. 2007). Changes in the distribution and amount of rainfall which have resulted in low precipitation and frequent drought have been affecting the agriculture sector (Kassie *et al*. 2013). Evidence shows that extreme events, such as droughts and floods, have been common incidences (Dasgupta *et al*. 2014). Climate change is projected to have significant economic, social, and environmental impacts on agrarian communities. Smallholder farmers in developing countries who heavily depend on rainfed agriculture were the worst hit as they are very sensitive to climate variability and change (Anderson *et al*. 2010). Impacts of climate change are felt more severely in semi-arid and arid areas (Otto *et al*. 2015). The potential adverse effects of climate change on the nation's agricultural sector are a major concern. To reduce the adverse impacts of climate change, farmers have to make changes in their way of cultivation to effectively deal with the extremely variable climate for ensuring their livelihoods. Climate adaptation policies reduce the adverse consequences of climate impacts that are already underway and help societies proactively prepare for the future. The fact that the exposure to weather forecasts brought out by technological advancements now allows farmers to anticipate a range of potential climate conditions and therefore take action to overcome the predicted impacts in the future. Farmers in developing nations are developing resilience to climate change-related risks like droughts and floods through practicing diverse adaptation strategies. Hence, a better understanding of the farmers' adaptive behavior to climate change is critical to developing well-targeted adaptation policies at the farm level. In this regard, this paper discusses the likely changes in agricultural practices that farmers would adopt to counteract the agricultural production losses incurred as a response to the increasing occurrence of extreme weather conditions due to climate variability.

MATERIALS AND METHODS

The study was conducted in the Tiruppur district of Tamil Nadu. Palladam block was purposively selected

based on the existence of the typical dry farming condition. Five villages were randomly selected for the study. The sample of 120 respondents was selected from the five villages by using proportionate random sampling. In this study, adaptation strategies refer to the adjustments or alterations introduced by the farmers in their farming as well as other livelihood measures to manage the loss or take advantage of climate variations. The possible adaptation measures towards climate variability were collected by discussion with the local extension functionaries and local progressive farmers. The major aspects such as crop diversification, changes in cropping intensity, changes in farm operations, soil and water management practices, strategies followed to cope with animal husbandry, and income diversification activities were finalized for assessing the dryland farmers adaptive behavior towards climate variability. A score of two for adaptation of the individual item and a score of one for non-adaptation of the individual item was given. The scores obtained for each item by an individual respondent were summed up to obtain the total score for adaptive behavior towards climate variability. The respondents were further classified into low, medium, and high using the cumulative frequency method.

RESULTS AND DISCUSSION

The study indicates that the farmers had taken many adaptive measures with respect to crop diversification, cropping intensity, farm operations, soil and water conservation measures and animal husbandry. The adaptation strategies followed by the respondents against climate variability is shown in Table 1.

Table 1. Distribution of respondents based on their adaptive behaviour towards climate variability

Particulars	Number	Per cent
Crop Diversification		
Cultivating climate resilient crops	120	100
Adoption of drought tolerant varieties	13	10.83
Genetic diversity in monoculture	52	43.33
Inter cropping	38	31.67
Integrated farming system	53	44.17
Crop rotation	86	71.67
Changes in Cropping Intensity		
Changes in cropping system	92	76.67
Leave the land fallow	78	65.00
Mid season correction	103	85.83
Changes in Farm Operations		
Changing the timing of farm activities (sowing, planting, spraying, harvesting)	108	90.00
Adoption of seed hardening techniques	20	16.67
Changes in the use of fertilizers	66	55.00
Use of organic manure	112	97.50
Changes in marketing behaviour	19	15.83
Soil and water management practices		
Summer ploughing	73	49.17
Off season tillage	90	75.00
Broad beds and furrows	8	6.67
Compartmental bunding	17	14.17
Mulching	12	10.00
Farm pond construction	3	2.50
Animal husbandry		
Changes in cattle breed	27	22.50
Changes in number of cattle possession	73	68.33
Adjustment in livestock management practices	26	21.67

Adaptation to thermal stress	37	30.83
Income Diversification		
Adapt to alternate livelihoods like dairy, poultry, etc.	25	20.83
Undertake non-farm economic activities	38	31.67
Salaried employment	7	5.83
Temporal migration to other places for livelihood	0	0

(Multiple responses obtained)

A glance at Table 1 with respect to crop diversification shows that all the respondents started cultivating climate resilient crops like sorghum, maize, etc., due to the shorter duration and less water requirement of crops. Farmers have diversified to cultivate less water-consuming crops based on the water availability. Ten years ago, the farmers in the study area were cultivating cotton, tobacco, and flower crops like crossandra, banana, vegetables, etc. Only 10.83 per cent of respondents were cultivating drought tolerant varieties to help crops withstand adverse climatic conditions and 43.33 per cent of the respondents followed genetic diversity in monoculture i.e. using different varieties of a single crop. As the majority of the respondents were cultivating sorghum, they stored the seed grains of the previous crop, which could be used for the next sowing. Only those respondents who had better contact with extension agencies like input dealers cultivate different crop varieties. This might be the probable reason for lesser adoption of genetic diversity in monoculture.

It could be seen from Table 27 that the strategies like inter-cropping (31.67 %), integrated farming system (44.17 %), and crop rotation (71.67 %) were followed by the farmers as an adaptation to climate variability. Sorghum is intercropped with Cow pea and Horse Gram. The chances of reducing the risk in the event of one crop failure might be the reason for intercropping. As a majority of the farmers had diversified their enterprise for additional incomes, an integrated farming system became one of the major adaptation strategies.

With respect to changes in cropping intensity, the majority (85.83 %) of the respondents followed mid-season correction i.e. using of crops as livestock fodder in case of failure followed by changes in the cropping system (76.67 %) and leaving the land fallow (65.00 %). As most of the respondents had livestock, crops were used as fodder if there were prolonged dry spells. Ten years back, multiple cropping systems was prevalent in the study area. But the failure of monsoon rains and depletion of the ground water table due to climate variability limited the water availability, resulting in single and double-cropping systems. Sometimes the farmers leave the land fallow due to a dearth of water.

Regarding the changes in farm operations, a majority (90.00 %) of the respondents changed the timing of activities (sowing, planting, spraying, harvesting) depending upon the time of occurrence of rainfall. Nowadays, the timing of rainfall for crop season varied, resulting in the adjustment of sowing to harvesting dates. The delayed onset of monsoon and rainfall at the time of harvesting damages the crops as well as leads to the storage problem. This might be the probable reason for changing the time of farm activities. Only 16.67 per cent of the respondents adopted seed hardening techniques to make crops resistant to moisture stress. The reason for nonadoption of seed hardening techniques by the majority (83.33 %) of the respondents was due to the lack of awareness about seed hardening and the financial constraints experienced by them. More than half (55.00 %) of the respondents changed the use of fertilizers. For last ten years, some of the respondents were practicing only rainfed farming due to nonavailability of water for irrigation and this might be the reason for the reduced use of fertilizers. It was also seen that the overwhelming majority (97.50 %) of the respondents were using organic manures to retain the soil moisture content. This is because adding organic manure increases the number of micro pores and macro pores in the soil. As most of the respondents had livestock rearing and poultry farm as a livelihood option, the dung and litter materials obtained from these enterprises were composted and used as organic manure. It was also found that only 15.83 per cent of the respondents changed their marketing behavior.

Concerning soil and water management practices, three-fourth (75.00 %) of the respondents adopted

off-season tillage followed by summer ploughing (49.17 %), compartmental bunding (14.17 %), mulching (10.00 %), broad beds and furrows (6.67 %) and farm pond construction (2.50 %) respectively. Only big farmers can afford the construction of a farm pond. The lack of knowledge and high cost involved in these practices made farmers hesitant to initiate soil and water management practices even though it proves beneficial. Hence this might be the major reason for the non adaptation of soil and water management practices successfully by the farmers.

Regarding animal husbandry, it could be seen from Table 27 that more than one-fifth (22.50 %) of the respondents changed their cattle type from indigenous breed to cross-breeds. More than two-thirds (68.33 %) of the respondents changed the number of cattle possessions. The scarcity of water and feed combined with non availability of labour to maintain the herd reduced the number of cattle possessions. Nearly 21.67 per cent of the respondents made adjustments in livestock management practices. It includes changes in the proportion of feed, feeding cattle with aloe vera, etc., About 30.83 per cent of the respondents adapt to thermal stress. As the temperature shows an increasing trend, cattle became more susceptible to heat stress. This ultimately leads to a reduction in milk yield. Farmers regularly wash the cattle in water to adapt to thermal stress, provide water sprinklers inside the cow shed, and keep the cattle in a shaded environment. Due to water scarcity and the high cost of adaptation, a majority (69.17 %) of the respondents did not adopt any practices to overcome thermal stress.

To income diversification, it is evident that nearly one-third (31.67 %) of the respondents were engaged in non-farm economic activities to adapt to climate variability. About one-fourth (20.83 %) of the respondents adapted to alternate livelihoods like dairy and poultry and the remaining 5.83 per cent of them undertook salaried employment as an adaptation measure. None of the respondents migrated to other places due to the availability of employment opportunities in the nearby towns.

Crop cultivation alone would not help the dryland farmers to sustain their livelihoods. Therefore many of them engage in several other income-generating activities.

The study complies with the findings of Nhemachena and Hassan (2007) who indicated that, common adaptation methods in agriculture include the use of new crop varieties and new livestock species that are better suited to hot climate conditions, change in frequency of irrigation, crop diversification, adaptation of mixed crop and livestock farming systems, and change in planting dates, follow different crop varieties, change in planting and harvesting dates and diversification of farm to non–farm activities to cope up with climate change.

The overall adaptive behavior of the dryland farmers is presented in Table 2.

Table 2. Distribution of respondents based on their overall adaptive behavior towards climate variability (n=120)

Category	Number	Percent
Low	16	13.33
Medium	80	66.67
High	24	20.00
Total	120	100.00

It could be seen from table 28 that two-thirds (66.67 %) of the respondents had a medium level of adaptive behavior followed by high (20.00 %) and low (13.33 %) levels. It could be observed that more than half of the farmers followed the adaptation strategies to manage the ill effects of climate change. This may be due to the active social participation and greater contact with the extension functionaries.

CONCLUSION

This study indicated that dryland farmers had practiced different adaptation strategies such as cultivating climate-resilient crops, changing the timing of farm operations, changes in cropping patterns, reducing the number of farm animals, etc. The study indicated a low level of adoption of soil and water management practices. Even though most of the respondents were aware of soil and water management practices, they were reluctant to adopt them due to the high cost of adaptation and lack of knowledge of the economic advantage of the practices. Hence training the farmers on different soil and moisture management techniques such as zero tillage, strip cropping, mulching, compartmental bunding, on-farm water harvesting, agro-horticulture, etc., and enhancing the subsidy level

for the construction of farm ponds may contribute to an increased level of adaptation. The study also indicated that most of the respondents were engaged in non-farm economic activities to augment their income. So, there is much scope for non-farm enterprise with additional off–farm opportunities in dryland ecosystems. Appropriate non and off-farm employment avenues such as vermicompost, biofertilizer, etc., could be motivated to provide additional income and employment to the dryland farmers. Therefore, this study provides supportive evidence for policy makers to take into account the changes in farming practices that farmers had adopted to minimize the adverse impacts of climate variability for designing suitable location-specific adaptation strategies. The study also suggests that incorporating farmers' knowledge of adaptation in policy decisions will realize the fullest benefits of the proposed action.

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Originality and plagiarism

I solely declare that this research article is originally written by the author. The article has not been submitted elsewhere for publication or consideration.

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Competing interests

There was no conflict of interest in the publication of this content.

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required. If anything is required from the MS, certainly, this will be extended by communicating with the corresponding author through corresponding official mail; adharanipriya@gmail.com.

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