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Original article

Impact of drought, farmers' adaptation strategies and administrative mitigation measure in the Marathwada region, India

Sagar Khetwani[1]*, Ram Babu Singh[1], Khusro Moin[2]

[1]Department of Geography, Delhi School of Economics, University of Delhi, Delhi 110007, Delhi, India
[2]Department of Geography, Kirori Mal College, University of Delhi, Delhi 110007, Delhi, India
*E–mail address (*corresponding author): sagardse96@gmail.com*
ORCID iD: Sagar Khetwani: https://orcid.org/0000-0002-3575-9557; Khusro Moin: https://orcid.org/0000-0001-9654-4579

ABSTRACT

The number of serious and extreme drought events is increasing, causing a serious threat to ecosystems, food security, livelihood security, social stability, and sustainable development. The Marathwada region of India is highly vulnerable to the impacts of drought and has been severely affected because of consecutive drought events from 2012 to 2016. This article aims to understand the rural farming household's perceptions of the impacts of drought, their adaptation and mitigation measures, and also attempts to assess the level of satisfaction of rural households with government mitigation measures. This study is based on primary and secondary sources of data collected from 192 farming households following a structured questionnaire survey. The survey reveals that crop failure, livelihood insecurity, declines in livestock production, livestock loss, water conflicts, and problems in meeting agricultural expenses, increased school dropout rates of children, and both psychological and health problems, were the most immediate socio-economic impacts of drought. The various environmental impacts of drought perceived by farmers included depleted groundwater levels, poor groundwater quality, land degradation, a decrease in seasonal river flows, degradation of pastures and declines in soil fertility. It was found that small and medium sized farmers were highly affected by drought compared with marginal and large scale farmers because of their high dependency on agriculture and poor adaptation strategies.

KEY WORDS: drought, agriculture, drought impacts, adaptation strategies, administrative mitigation measures, Marathwanda region

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1. Introduction

Drought is often referred to as an acute water scarcity caused by excessive water demand and limited availability. Various definitions of drought exist in the available literature, which classify drought into meteorological, agricultural, socio-economic, and hydrological drought (NIDM, 2009; NDMA, 2016). Drought has widespread detrimental impacts on crop production, surface and groundwater resources and human life (CRED, 2015). The increasing toll on an affected population due to drought makes it one of the most critical and costly natural disasters (ACTION AID, 2016; CRED, 2015). The recent scientific literature confirms the increase in the frequencies, durations and spatial extent of major drought events over the past decade (CRED, 2015). An assessment of the impacts of drought in arid and semi-arid regions from the Inter-governmental Panel on Climate Change (IPCC) revealed that the increase in land aridification around the world is expected to continue through the next three to five decades and lead to further negative effects on human society and sustainable development (IPCC, 2013).

The increasing drought risk of agrarian regions of developing nations is an outcome of

environmental change, largely anthropogenic modifications in global natural conditions (ZARGAR ET AL., 2011; MOHAMMED ET AL., 2018). Uneven distribution of rainfall and rising water needs can have severe regional impacts and contribute to worldwide effects (NAIR ET AL., 2013; SINGH & KUMAR, 2015; KHETWANI & SINGH, 2018). Global climate change has become more observable over the past ten decades marked by global warming and further triggered by critical human activities (IPCC, 2013). The hydrological cycle has altered to varying intensities which could be manifested in the rising risk of hydro-meteorological disasters represented by extreme flood and drought events (SINGH & KUMAR, 2014; NIDM, 2009; NDMA, 2016). The events of drought are worsening over the years, with complex frequencies, higher severity, and wider spatio-temporal coverage (NAIR ET AL., 2013; GUPTA ET AL., 2014).

The Marathwada region is one of the most industrially backward regions of Maharashtra state in India (PDGOM, 2013; KATALAKUTE ET AL., 2016). The population of the Marathwada region is highly dependent on the agriculture sector, i.e., 73.83% because of the unpromising industrial sector (PDGOM, 2013; MAHAENVIS, 2005). The economy of the Marathwada region is mainly agrarian in nature which makes the impacts of drought more critical (PURANDARE, 2013; DANDEKAR & NARAVADE, 2013; DANDEKAR & THAKKAR, 2013; DANDEKAR, 2015, 2016). The Marathwada region has witnessed critical drought years, i.e., 2012, 2014 and 2015. The post-drought scientific research works have revealed that the deficit of rainfall from normal are not new for the Marathwada region but gives scope to study the intensifying impacts of drought and to explore the associated factors (KULKARNI ET AL., 2016). The region has remained a pivotal point of concern for the global scientific community due to the multiple adverse effects of drought in the form of dry wells, crop failure and water conflicts in society (BISWAS, 2015; DEULGAONKAR, 2015; KHAIRNAR ET AL., 2015; DESHPANDE, 2016; KALE & GOND, 2016). The majority of farmers in the study area are poor and are highly reliant on monsoons due to the lack of irrigation support (PDGOM, 2013; DANDEKAR, 2015; KHAIRNAR ET AL., 2015; KALE & GOND, 2016; DANDEKAR, 2016).

DANDEKAR AND NARAVADE (2013) argued that water scarcity remained a perennial situation in the Deccan plateau. Their study raised concern about the increasing geographic spread of the drought-prone area with every passing decade. The increasing area in the perpetual water-scarce region raises questions regarding the issue of irrigation and water policy with the fundamental one being about the rights-based approach in policy planning.

PURANDARE (2013) attempted to review the 2012 drought in the Marathwada region of Maharashtra based on various issues as reported in the Aurangabad edition of the state's newspapers. He attributed a lack of good water governance and poor operation of watershed development and irrigation projects as the major reasons behind the 2012 drought in Maharashtra's Marathwada region. He raised the need for developing policies to restrain sugar cane cultivation and modernize all types of water resource development works, in order to ensure that a situation as in 2012-13 was not repeated.

The impacts of drought can vary significantly from one community to another community and from one region to another region (UDMALE ET AL., 2014; UDMALE ET AL., 2015; VEDELD ET AL., 2014; FADINA & BARJOLLE, 2018). Still, few research works have attempted to examine the intricacy of drought events and their impacts at the local and regional level (UDMALE ET AL., 2014; VEDELD ET AL., 2014; UDMALE ET AL., 2015). Hence, the main aims of this article are to investigate through the empirical analysis in the study area, the farmers' perceptions of drought impacts, adaptation strategies and factors making them more complex and to assess the varied intensity of various impacts of drought. It is quite significant to study the impacts of drought and adaptation strategies because they vary from farmer to farmer. In this study the perceptions of different farmers were taken into consideration on the basis of their landholding size, i.e., marginal farmers, small farmers, medium farmers and large scale farmers. To formulate precise and community centric drought policies it is crucial to study the impacts of drought at a micro level on different categories of farmers.

2. Materials and methods

2.1. Description of the study area

The study focuses on the Marathwada region of Maharashtra state in India, with a total area of 64 813 sq. km, representing about 21% area of the geographical area of Maharashtra state (PDGOM, 2013). The latitudinal extent of the region is located between 17°37' and 20°39' north while longitudinal extent is 74°33' and 78°22' east longitudes (GSDA, 2017). The region consists of 8 districts and 76 sub-districts (*talukas/tahsils*) within 8 districts (Fig. 1).

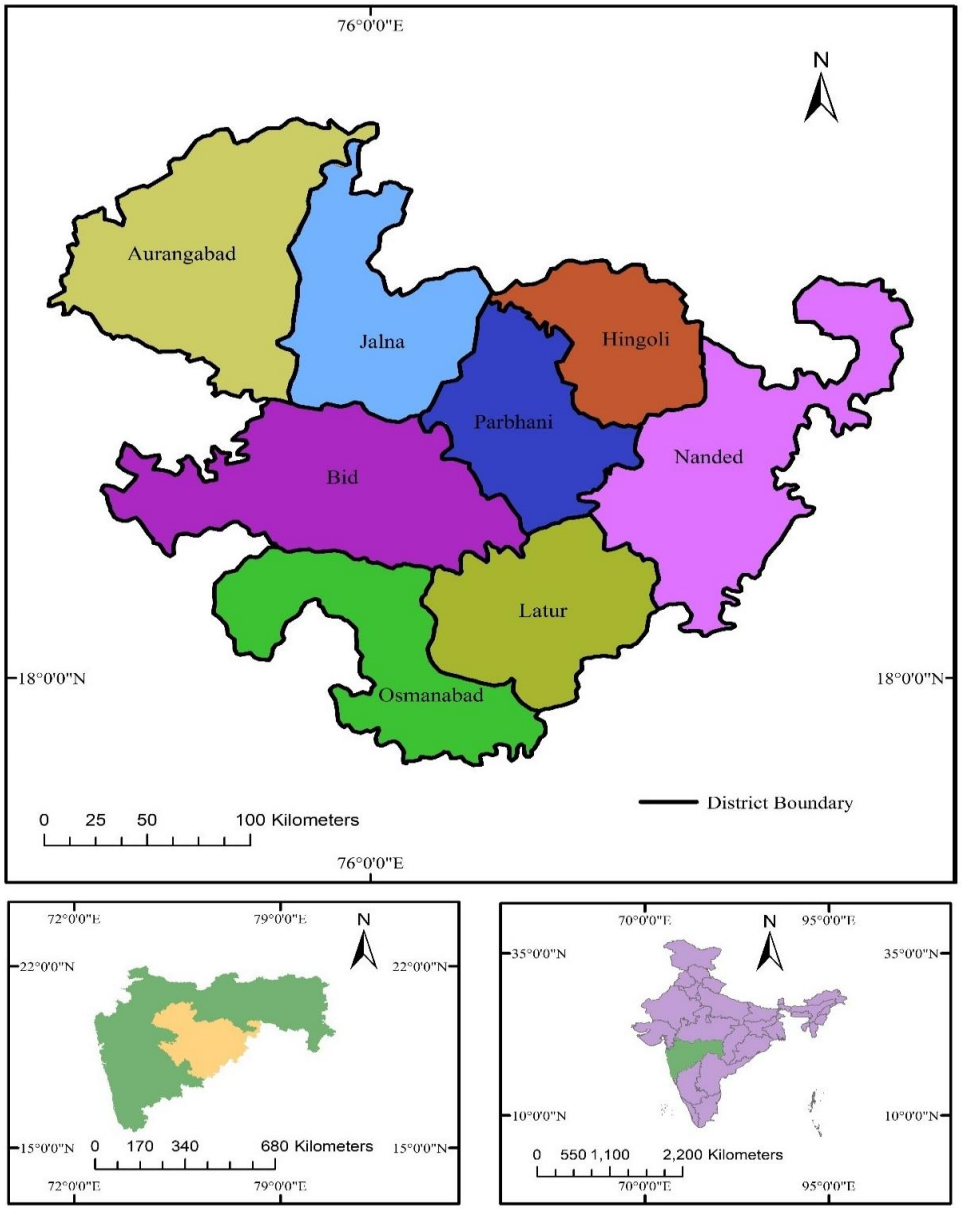

Fig. 1. The Marathwada Region

The location of the study area in the rain shadow belt of the Sahyadri mountain range of Maharashtra state makes it more vulnerable to drought. The climate of Marathwada is generally hot and dry characterised by an average daily temperature of 27.7 to 38.0°C and an average night temperature of 20.0 to 26.9°C (MAHAENVIS, 2005). The average rainfall in Marathwada is about 825 mm and is erratic in nature. The River Godavari acts as the lifeline for the study area supporting various small and large projects constructed on its tributaries. The total population of the region is 18,731,872, out of which 72.9% is rural while 27.1% is urban. The large rural population with their high dependency on the agricultural sector makes the impacts of drought more severe.

The local community-centric understanding of the varied socio-economic impacts of drought plays a vital role in developing the science-policy interface for effective drought risk reduction measures. Droughts have serious socio-economic impacts on developing nations in particular as they affect the livelihood security of the people. Drought in rain-fed agrarian economies results in consequences such as water scarcity, water conflicts, crop failure, a decline in crop yield and livestock production, which further weakens the financial conditions of the farming community (Fig. 2A to 2D). The district wise impact of drought on agricultural production of the Marathwada region for the year 2015-16 has been depicted in Fig. 3.

A B C D

Fig. 2. Decline in water availability in surface water streams (A); water scarcity (B), crop stress (C) and livestock production at risk during non-monsoon months (D)

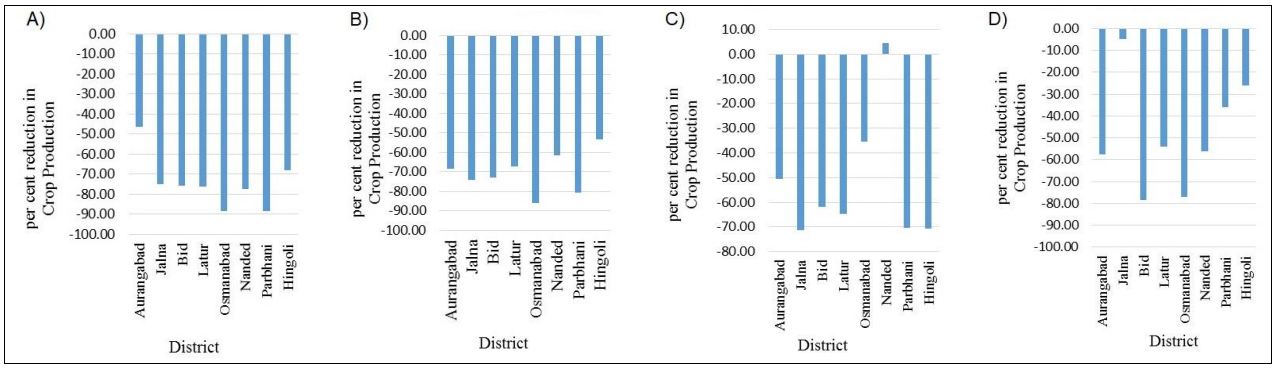

Fig. 3. District wise reduction (in per cent) in crop production of the Marathwada region for the year 2015–2016 compared to the average of 2005–2006 to 2010–2011: (A) Cereal production, (B) Pulses production, (C) Cotton production and (D) Sugracane production (Source: Based on data obtained from Department of Agriculture, Government of Maharashtra)

2.2. Data collection and analysis

For the attainment of the specific aims of this study, a structured questionnaire survey was conducted in the Marathwada region in the month of January of the year 2019. A multi-stage purposeful random sampling technique was used to select the samples by taking a village as the penultimate entity and a household as the final entity. The survey was conducted in the Aurangabad, Osmanabad, Latur and Bid districts of the Marathwada region. The rationale behind the selection of these districts was to represent the drought characteristics of the entire region. The analysis of the Rainfall Anomaly Index (1968-2016) revealed that during the year 2015 the Aurangabad district experienced a mild meteorological drought, the Osmanabad and Latur districts witnessed a moderate drought while the Bid district went through a severe meteorological drought (KHETWANI & SINGH, 2019). A further, two sub-districts from each district were selected. These particular sub-districts were selected purposefully because of their identification as a frequently drought affected region in the available scientific literature and the State disaster management plan. Also these districts remained recurrently in the news due to water conflicts because of drought in the years 2014 and 2015 (IGIDR, 2009; VAISHAMPAYAN & PATIL, 2016; SDMA, 2016) (Fig. 4). The villages from the identified sub-districts were selected on the basis of factors such as the dominance of the agriculture sector and the easy availability of translators for bridging the communication gap during the survey and ensuring the active participation of the local farming community (Table 1). The response rate of farmers was almost 100% during the face-to-face interviews because of the respondents' curiosity to discuss aspects related to drought in the area.

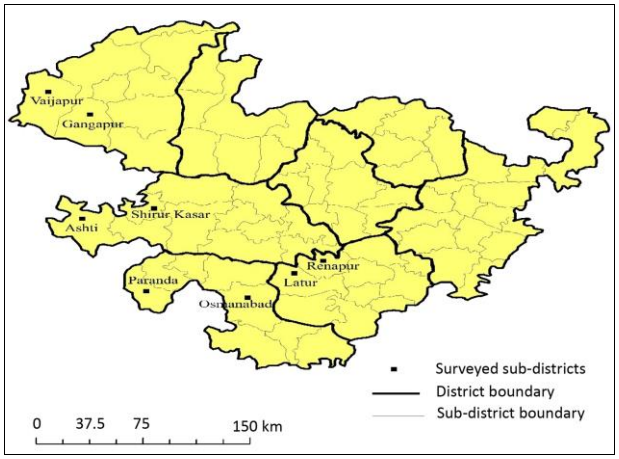

Fig. 4. Location of surveyed sites

The important questions incorporated in the questionnaire related to the impacts of drought were broadly classified into socio-economic and environmental impacts of drought. The various socio-economic impacts of drought included crop failure, livelihood insecurity, decline in livestock

production, livestock loss, health problems, psychological problems, water conflicts, increased school drop out rate of children and problems in meeting agricultural expenses. While the various environmental impacts of drought include depleted groundwater levels, poor groundwater quality, decrease in seasonal river flows, land and pasture degradation, decline in soil fertility and various other ecological damages. The farmers belonging to different categories were asked to rate the impacts of drought in the questionnaire. The important questions related to drought adaptation and mitigation measures were also included in the questionnaire. The various drought adaptation strategies adopted by farmers included off-farm employment, migration for a livelihood, storing the crop harvest, selling of livestock, sowing drought-tolerant crops and early crop sowing. On the other hand, different drought mitigation measures included changing the crop calendar, usage of common property resources (CPRs), adoption of sprinkler and drip irrigation, water harvesting, avoiding water consuming crops and using community fodder services. Further, category wise per cent response of farmers towards adaptation and mitigation measures have been depicted through multiple bar diagrams.

Table 1. List of surveyed sites (Source: Primary survey)

District	Sub-district	Village
Aurangabad	Vaijapur	Shioor
	Gangapur	Maliwadgaon
Osmanabad	Osmanabad	Upla
	Paranda	Sonari
Latur	Latur	Chincholi Rao
	Renapur	Kamkheda
Bid	Ashti	Kada
	Shirur Kasar	Raimoha

To analyze the difference in perception of respondents, the population is grouped based on their landholding size, i.e., marginal farmers (less than 1 hectare), small farmers (1-2 hectares), medium farmers (2-4 hectares) and large farmers (more than 4 hectares). Six households were selected randomly from each category, i.e., marginal, small, medium and large, in this way 24 households were covered from every village, and a total of 192 households (48 marginal, 48 small, 48 medium and 48 large farmers) were included in the entire survey. The average age of the respondents was 45 years (range was 18–78 years). The data of the education profile of respondents revealed that 11.46% had no education, 33.33% had completed their primary education, 44.8% had completed their secondary education and 10.41% were graduates or post-graduates.

The primary data was arranged, tabulated and analyzed with the help of software such as Microsoft Excel and Statistical Package for the Social Sciences (SPSS). The comparative impact analysis of drought on farmers and crop production was represented by radar and bar diagrams.

3. Results and discussion

3.1. Socio-economic impacts of drought

The impacts of drought such as crop failure and livelihood insecurity were rated by marginal farmers as below-high and between moderate to high (3.79 and 3.5 on the scale of 1 to 5), small farmers as between high to very high (4.5 and 4.6), medium farmers as above high to very high (4.29 and 4.58) and large farmers as moderate and below-moderate (3 and 2.79). The impacts of drought such as decline in livestock production and livestock loss were rated by marginal farmers as below moderate and between very low to low (2.92 and 1.6), small farmers as below high and just above high (3.71 and 4.19), medium farmers as just above high and between high to very high (4.1 and 4.5) and large farmers as between low and moderate and above very low (2.5 and 1.31).

Health problems and psychological problems were rated by marginal farmers as just above moderate and just below moderate (3.1 and 2.79), small farmers as above moderate and high (3.29 and 4.1), medium farmers as above moderate and just above high (3.39 and 4.19), and large farmers as between very low and low and just above very low (1.5 and 1.21). While water conflicts and increased school drop out rates of children as the impacts of drought were rated by marginal farmers as high and near to high (4 and 3.79), small farmers as just above high and near moderate (4.06 and 2.75), medium farmers as just below high and closer to moderate (3.79 and 2.71), large farmers as just above moderate and above very low (3.1 and 1.25).

The impacts of drought such as problems in meeting agricultural expenses and risky farming were rated by marginal farmers as between moderate and high (3.31 and 3.54), small farmers as between high to very high (4.6 and 4.5), medium farmers as between high to very high (4.29 and 4.4) and large farmers as just below

moderate and just above moderate (2.92 and 3.19). Farmer suicides as an impact of the drought was rated by marginal farmers as medium-moderate (3.52), small farmers as just above high (4.21), medium farmers as just below high (3.81) and large farmers as just above medium-low (2.71) (Fig. 5).

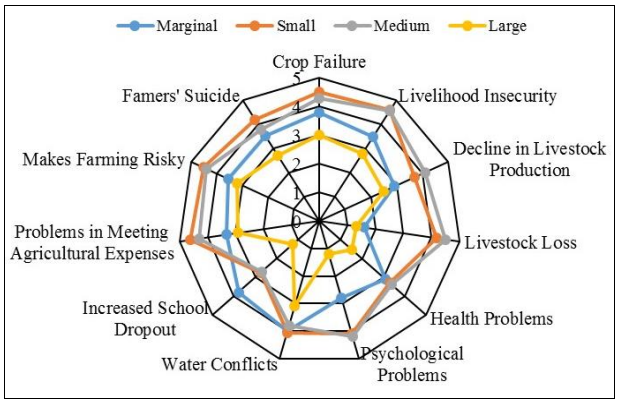

Fig. 5. Socio-economic impacts of drought (mean ratings based on sample size of 48). Rating scale: 0 = no impact, 1 = very low, 2 = low, 3 = moderate, 4 = high, 5 = very high (Source: Primary survey)

3.2. Environmental impacts of drought

Directly, or indirectly, drought affects various components of the environment in many different ways. Drought can result in depleted groundwater levels, poor groundwater quality, decrease in seasonal river flows, land and pasture degradation, decline in soil fertility and various other ecological damages, etc. (Fig. 6A to 6D). The environmental impacts of drought such as a decrease in seasonal river flows and depleted groundwater level were rated by marginal farmers as high to just above high (4 and 4.21 on scale of 1 to 5), small farmers as just above high and high (4.19 and 4), medium farmers as just below high and just above high (3.89 and 4.1), and large farmers as between moderate and high (3.71 and 3.81). The impact of poor groundwater quality was rated between high to very high by marginal farmers (4.17), small farmers (4.29), medium farmers (4.21) and large farmers (4).

A B C D

Fig. 6. Decline in soil moisture (A); deteriorated seeds during dry spell (B); fodder stress (C) and dried shallow well (D) (Source: Primary survey)

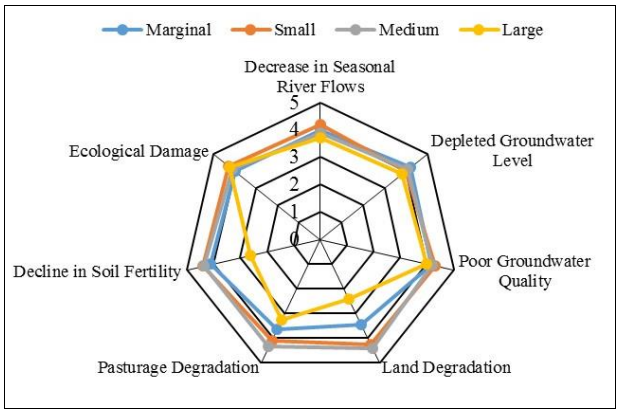

Fig. 7. Environmental impacts of drought (mean ratings based on sample size of 48). Rating scale: 0 = no impact, 1 = very low, 2 = low, 3 = moderate, 4 = high, 5 = very high (Source: Primary survey)

Land degradation and pasture degradation were rated by marginal farmers as between moderate and high (3.44 and 3.64), small farmers as just above high (4.25 and 4.1), medium farmers as between high to very high (4.42 and 4.35) and large farmers as between low and moderate and just above moderate (2.42 and 3.25). Decline in soil fertility and ecological damage were rated by marginal farmers as just above high and high (4.1 and 4), small farmers as between high to very high (4.4 and 4.29), medium farmers as just between high to very high (4.35 and 4.1) and large farmers as between low to moderate and just above high (2.64 and 4.25) (Fig. 7).

3.3. Comparative impact analysis of drought

The comparative impact analysis of drought impacts like crop failure, livelihood insecurity, declines in livestock production, livestock loss, problems in meeting agricultural expenses and psychological problems among the marginal, small, medium and large farmers revealed that small and medium farmers rated these impacts of drought higher than the marginal and large farmers. Further discussion with the farmers revealed that the small and medium farmers were highly dependent on farming for meeting their day to day needs as compared to the marginal

and large farmers. While the marginal farmers have alternate sources of income such as various off-farm employment options (including the wage worker at construction sites, auto-rickshaw drivers operating in nearby villages, domestic jobs, etc.). The large farmers also had alternative sources of income, 72.92% of large farmers had confirmed their involvement in various off-farm occupations such as small shopkeepers, traders, local transport operators of small vehicles like vans and auto-rickshaws, etc. The impact of drought such as increased school dropout rate of children was rated by marginal farmers as comparatively higher than the small, medium and large farmers particularly because of the migration of marginal farmers often during the period of drought in search of livelihood options. The discussion also revealed that the impacts of drought such as land degradation and decline in soil fertility were rated between low and moderate by large farmers, comparatively lower than the marginal, small and medium farmers because of their active adoption of drought adaptation and mitigation measures such as a shift to drought-tolerant crops, changing the crop calendar, adoption of micro-irrigation facilities like drip and sprinkler and their inclination towards a soil-health card scheme.

3.4. Household level drought adaptation strategies

Farmers have adopted different drought adaptation strategies to reduce the impacts of drought. The household survey data revealed that 84.9% of households had observed an increase in the frequency and intensity of drought. Various different types of drought adaptation strategies at different scales were adopted by marginal, small, medium and large farmers (Fig. 8).

Various drought adaptation strategies were adopted by marginal farmers, i.e., off-farm employment (70.83% of response), followed by strategies like migration for livelihood (64.58%), storing crop harvest (62.5%), selling of livestock (31.25%), reduction in day to day spending (29.16%), further followed by sowing drought-tolerant crops (14.58%) and early crop sowing (6.25%). The adaptation strategies of small farmers included storing the crop harvest (68.75% of responses), followed by selling of livestock (58.33%), reduction in day to day spending (43.75%), sowing drought-tolerant crops (31.25%), further followed by migration for livelihood (27.08%), off-farm employment (22.91%) and early crop sowing (10.41%). While the widely adopted strategies of medium farmers included, storing the crop harvest (72.91% of response), followed by selling of livestock (54.16%), reduction in day to day spending (47.91%), sowing drought-tolerant crops (27.08%), further followed by migration for livelihood (25%), off-farm employment (18.75%) and early crop sowing (14.58%). Different drought adaptation strategies adopted by large farmers were a shift to drought-tolerant crops (70.83% of response), followed by early crop sowing (62.5%), storing crop harvest (60.41%), off-farm employment (47.91%), further followed by a reduction in day to day spending (22.91%), selling of livestock (16.66%) and migration for livelihood (8.33%) shown in Fig. 8.

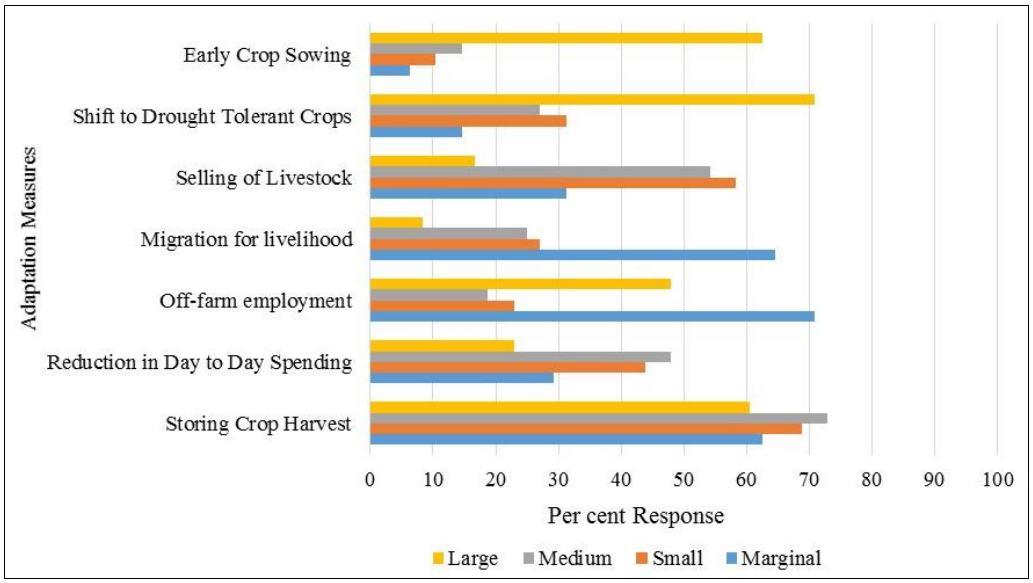

Fig. 8. Various drought adaptation strategies used by farmers (Source: Primary survey)
Note that a farmer can adopt more than one adaptation strategy

3.5. Drought risk reduction measures

For reducing the current and future risks associated with the impacts of drought, different drought mitigation measures have been adopted by marginal, small, medium and large farmers at a varied rate. Fig. 9 depicts various drought mitigation measures such as changing the crop calendar, usage of common property resources (CPRs), adoption of sprinkler and drip irrigation, water harvesting, avoiding water consuming crops and using community fodder services.

The drought mitigation measures adopted by marginal farmers included usage of CPRs (22.91% of response), followed by using community fodder services (18.75%), avoiding water consuming crops (16.66%), water harvesting (14.58%), which were further followed by changing the crop calendar (12.5%) and adoption of sprinkler and drip irrigation (4.16%). The mitigation measures of small farmers included water harvesting (37.5%), followed by avoiding water consuming crops (33.33%), using community fodder services (27.08%), changing the crop calendar (20.83%), which were further followed by usage of CPRs (16.66%) and adoption of sprinkler and drip irrigation (12.5%). The widely adopted drought mitigation measures by medium farmers included water harvesting (47.91% of response), followed by changing the crop calendar (31.25%), avoiding water consuming crops (29.16%), adoption of sprinkler and drip irrigation (27.08%), which were further followed by usage of CPRs (25%) and using community fodder services (22.91%). Various drought mitigation measures adopted by large farmers included water harvesting measures (72.91% of response), followed by adoption of sprinkler and drip irrigation (68.75%), avoiding water consuming crops (66.66%), usage of CPRs (62.5%), which were further followed by changing the crop calendar (56.25%) and using community fodder services (47.91%).

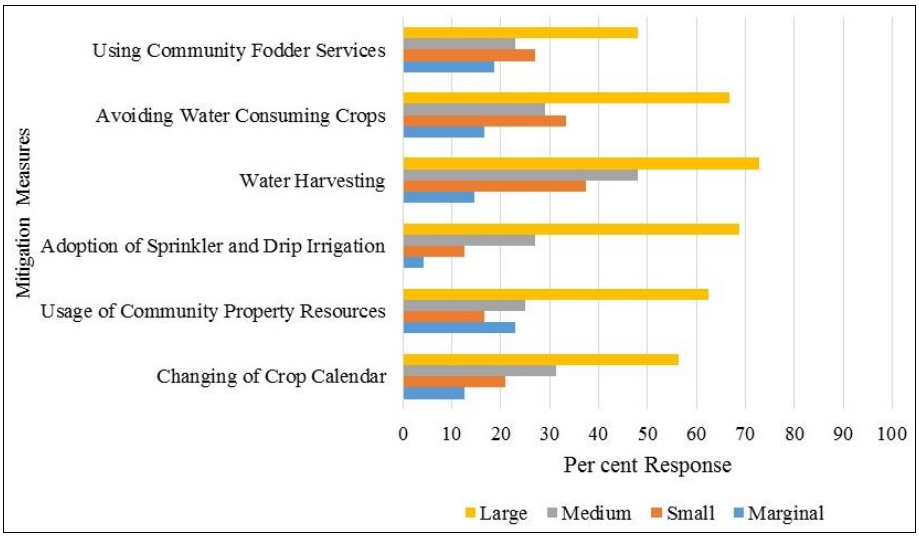

Fig. 9. Various drought mitigation measures adopted by farmers (Source: Primary survey)
Note that a farmer can adopt more than one mitigation measure

3.6. Comparative analysis of drought adaptation and mitigation measures

A significant difference was observed in the adoption of drought adaptation strategies and mitigation measures by marginal, small, medium and large scale farmers. The drought adaptation strategies significantly adopted by marginal farmers included off-farm employment, followed by migration for livelihood and storing the crop harvest while small and medium farmers largely adopted strategies such as storing the crop harvest, selling of livestock and reduction in day to day spending. The large farmers were highly dependent on drought adaptation strategies like a shift to drought-tolerant crops, early crop sowing, storing the crop harvest and off-farm employment. It was also found that small farmers (77.08%) and medium farmers (79.16%) were highly dependent on farming alone and their adopted strategies were also not resilient towards drought risk reduction. The discussion revealed that large farmers largely adopted drought mitigation measures like water harvesting, adoption of sprinkler and drip irrigation, avoiding water consuming crops, usage of CPRs, changing the crop calendar and using community fodder services compared with the marginal, small and medium farmers which resulted in the comparatively lower impacts of drought as compared with the marginal, small and medium farmers. The marginal farmers frequently

preferred off-farm employment and migration for livelihood during the period of drought in order to reduce the impacts of drought on their livelihood which resulted in an increased school dropout rate of their children as a consequence of their migration.

3.7. Administrative drought risk reduction measures

Administrative mitigation measures played a key role in reducing the impacts of drought on the local community. The Maharashtra government undertook various drought relief measures such as providing a drinking water supply through tankers, cattle camps and providing employment through the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). Apart from this, the government also provided compensation for agricultural losses, a crop insurance scheme, provided credit facilities to farmers and introduced a soil health card scheme. This section attempts to assess the level of satisfaction amongst the local community with various administrative drought mitigation measures in the Marathwada region (Fig. 10).

The MGNREGA scheme was notified on September 7, 2005. The scheme aims at enhancing livelihood security by providing a minimum of 100 days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work at a minimum daily wage rate (MIRD, 2012; DESAI ET AL., 2015). Particularly, in the drought-prone areas (DPAs) of India, this scheme serves the multiple needs of providing employment opportunities, enhancing livelihood security and makes the community more resilient to the severe impacts of drought (DESAI ET AL., 2015). The results of this study revealed that the level of satisfaction associated with the MGNREGA scheme was rated by marginal farmers as moderate (3 on scale of 1 to 5), small farmers as just above low (2.25), medium farmers as between low and moderate (2.5) and large farmers as low (2).

The consecutive drought year resulted in meager surface and groundwater recharge which further resulted in an increased dependency on groundwater resources. During the 2015-16 drought the immediate need for drinking water was fulfilled through the deployment of 3032 tankers in the Marathwada region (CWC, 2016). The level of satisfaction with the tanker water supply service was rated by marginal farmers as below very low (0.5), small farmers as just above very low (1.15), medium farmers as near to very low (0.96) and large farmers as just above very low (1.25). The crop insurance scheme was rated by marginal farmers as below very low (0.77), small farmers as just above very low (1.29) while medium farmers rated this scheme between very low and low (1.4) and large farmers rated it between moderate to high (3.42). The compensation for crop losses was rated by marginal farmers as near to very low (1.04), small farmers as just below very low (0.81), medium farmers as below very low (0.71) while large farmers rated the scheme as just above very low (1.23). The consecutive drought years in Marathwada not only impacted human lives but also adversely impacted the livestock. Due to crop failure, the availability of fodder for livestock decreased which further resulted in decreased livestock productivity. The cattle camps organized by government were rated by marginal farmers as near to very low (0.9), small farmers rated them as between very low and low (1.54) while the medium farmers rated them just below moderate (2.75) and large farmers rated them between low and moderate (2.48).

The level of satisfaction of credit facilities provided by the government was very low among the marginal, small and medium farmers. The marginal farmers rated the credit facilities provided by government as near to very low (0.83), small farmers rated these facilities as below very low (0.54) while medium farmers rated these facilities just above very low (1.08) and large farmers rated them between low and moderate (2.46). The Maharashtra government started an initiative of *Jalyukt Shivar Abhiyan* (peoples campaign for water conservation) for water conservation in the last few years with the collaborative efforts of various stakeholders of society including government at different levels, Non-Governmental Organizations (NGOs) and the local community of drought-affected villages. It undertakes the construction of various drought proofing infrastructures such as: soak pits for improving the groundwater recharge, renovation of existing water bodies including the desiltation of surface water bodies, construction of dug out farm ponds (MAHARASHTRA AHEAD, 2015). The farmers were highly satisfied with the *Jalyukt Shivar Abhiyan* scheme, marginal farmers rated the scheme as near to high (3.94) while small farmers (4.06), medium farmers (4.16) and large farmers (4.08) rated the scheme as above high. The discussion revealed that people were highly satisfied with *Jalyukt Shivar Abhiyan* because it enabled the local community in the participation of water conservation measures and enabled them to realize their common responsibility towards the judicious management of water.

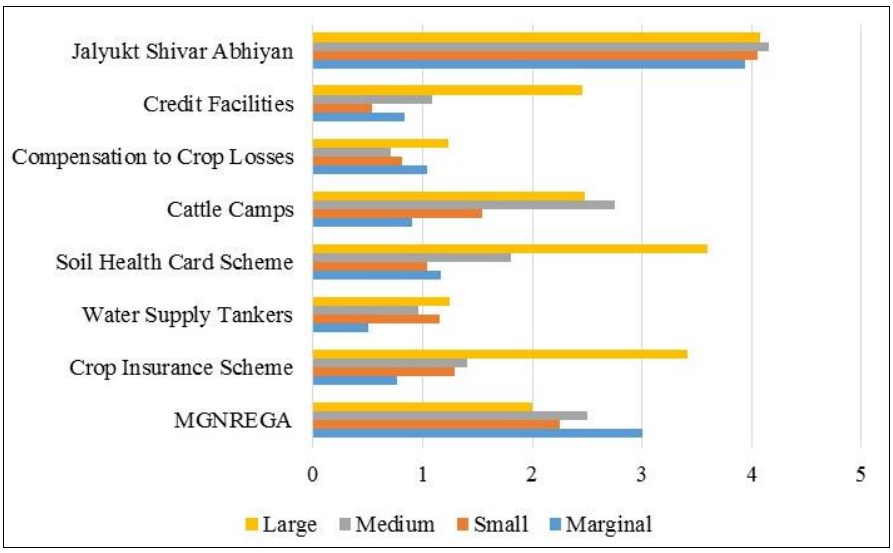

Fig. 10. Administrative drought mitigation measures and level of satisfaction of different category of farmers (mean ratings based on sample size of 48). Rating scale: 0 = no impact, 1 = very low, 2 = low, 3 = moderate, 4 = high, 5 = very high (Source: Primary survey)

4. Conclusions

Anthropogenic factors like increasing water requirements and haphazard water management can further aggravate the impacts of drought. The respondents witnessed a number of impacts of drought such as livelihood insecurity, crop failure, water conflicts, declines in livestock production, livestock loss, health problems, problems in meeting agricultural expenses, difficulties in continuing farming operations and increased school dropout rates of children, which were perceived at various scales by the marginal, small, medium and large scale farmers. However, the interaction between natural drought events and human responses lead to varied impact intensities of the same drought events. The small and medium farmers were highly affected by the drought compared with the marginal and large farmers because of their comparatively high dependency on agriculture and their poor adaptation strategies.

Compared with the small and medium farmers, marginal farmers frequently preferred off-farm employment and migration for a new livelihood during the period of drought in order to reduce the impacts of drought on their livelihood but it resulted in an increased school dropout rate of their children. The large scale farmers also had an alternative source of income, 72.92%, and confirmed their occupancy in various off-farm occupations as small shopkeepers, traders, local transport operators of small vehicles like vans and auto-rickshaws, etc. The large farmers had comparatively good access to mitigation measures like water harvesting, adoption of sprinkler and drip irrigation, avoided water consuming crops, usage of CPRs, changing the crop calendar and using community fodder services as compared with the marginal, small and medium farmers which resulted in the comparatively lower impacts of drought compared with the marginal, small and medium farmers. Also, the short-term drought relief measures may not prove fruitful for addressing the complex drought impacts in a chronic drought-prone region like Marathwada in a developing nation like India.

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