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Livelihood Vulnerability Analysis to Climate Variability and Change Risks of Livestock Farming in Karnataka

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ABSTRACT

Vulnerability is reflected in the condition of an economic system as well as socioeconomic characteristics of the population in the system. Assessment of vulnerability can be done using a variety of socioeconomic indicators that capture exposure of the population concerned. Many factors contribute to social and economic vulnerability including rapid population growth, poverty and hunger, poor health, lower education level, gender inequality, social exclusion, marginal and hazardous location, resource degradation, and lack of access to infrastructure, resources and services, including knowledge and technological resources. Exposed population has a limited capacity to protect themselves from natural hazards and bear the brunt of the consequences of large-scale environmental change, including land degradation, biodiversity loss, and climate change, which affect the welfare of the most vulnerable populations. Over the long periods, vulnerable populations have to learn to cope with the effects of climate change on their production systems. Assessing Livelihood vulnerability of a population due to changing climate variables and events and its impact on social and economic eco system is of paramount importance. The Livelihood Vulnerability Index (LVI) was developed to estimate climate vulnerability of livestock farming in Karnataka, India. Two hundred and forty households were surveyed to collect data on socio-demographics, livelihoods, social networks, health, food and water security, natural disasters and climate variability. Data were aggregated using a composite index and differential vulnerabilities were compared.

Keywords: Climate variability, Livelihood, Livestock farming, Vulnerability

INTRODUCTION

Fallout of climate change on environment, social ecology and livelihood threatens to deepen varied vulnerabilities across regions, sectors, and social groups, which erode hard earned gains and undermine prospects of sustainable development. Deciphering regional and local dimensions of vulnerability is essential to develop appropriate and targeted adaptation efforts. Many of the developing countries tend to be especially vulnerable to extreme climatic events and adverse impacts of a gradual climate change as they largely depend on climate sensitive sectors like agriculture and forestry (IPCC, 2007). India has a geographic disadvantage as it is already in the warmer part of the world. Climate change is also likely to impact negatively on livestock production and health. Increase in physiological reactions at high temperatures elevates heat loads of animals resulting into a declined productivity of meat, wool, milk and draught power (Upadhyay *et al.*, 2008). Economic and environmental factors impacted fisheries sector and impacted the livelihoods of fishermen in Tamil Nadu

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(Johnson *et al.*, 2016). A well managed integrated crop livestock system has the potential to create a win-win situation for both farmers and environment as eighty percent of milk in India is produced in integrated mixed crop-livestock farming systems. Methane emission and degradation of common lands are two areas where Indian livestock has likely negative contributions on environment and need to be addressed through technical and policy interventions. The marginal livestock keepers depend heavily on common property resources for their survival. There are a few organized efforts for common land development and its sustainable management. This is likely to have a negative impact on land. Any change in status and productivity of common property resources directly influences rural poor and their returns. Jodha (1992) suggested introduction of technological investments and creation of economic incentives to conserve common property resources while raising their productivity. He also suggested for regulation of common resource use with the involvement of user groups and a community strategy that complements state interventions with the essential participation of people. Climate change is an emerging environmental and developmental challenge faced by humanity today, and Karnataka is likely to be one of the much vulnerable states (Radhika, 2017). Further, in terms of areas prone to drought, Karnataka is next only to Rajasthan. There is adequate scientific evidence to prove that climate change is already impacting crop productivity, forest biodiversity, hydrological processes and human health. It is imperative to develop an understanding of the potential climate change impacts and vulnerabilities and develop coping strategies to deal with current climate variability and build resilience towards long-term climate change. An effort was made to analyze the impact of climate change on livestock farming, in Karnataka state, through a combination of quantitative and qualitative methods, and to assess and map the vulnerability of Indian livestock farming to climate variability.

METHODOLOGY

The micro level study was conducted in Adilaur, Bharamapura, Kumbarakatte villages of Chitradurga District and Shahpur, Nanadanahalli, Yaranghatta villages of Kolar District in Karnataka. The study covered 240 farmer respondents from all the six villages together. Apart, vulnerability assessment was conducted for all the districts of Karnataka, largely based on secondary data. The vulnerable areas and social groups were identified, and nature of vulnerability was assessed using geo spatial data, with special emphasis on women headed families. Data was gathered at two levels. A macro-scale analysis at district level to map vulnerability profile for identified districts in Karnataka; and at micro level, attempts were done to map the vulnerability of dairy farming at village level. Five case studies were carried out in regions identified as exposed; focus on socio-economic implications of climate vulnerability for different dairy production systems in different regions.

To quantify the vulnerability, a vulnerability index was developed and tested by combining data on factors such as social vulnerability, infrastructure development, biophysical conditions, climate, agriculture, livestock and, transportation at appropriate scale (village/district) etc. The validity of vulnerability index and mapping methodology was done in non sampling areas to understand its applicability. Research tools such as survey, semi-structured in-depth interviews, focus group discussions etc., were used to generate information from various stakeholders. Secondary data sources were contacted for data on geo-spatial and climatic parameters Vulnerability mapping of farm women in dairy farming was done using geo spatial data. For mapping Bhuvan GIS tool was used.

RESULT AND DISCUSSION

The study generated knowledge regarding the vulnerable areas in Karnataka, India, an exploration of how some villages have coped with these issues, and a discussion of the impacts that public policy has had on the vulnerability in the villages studied. It was observed that there is a shift in cropping pattern and farmers themselves evolve their strategies to minimize the economic losses due to changes in climate and market changes.

The Climatic parameters like rainfall and temperature variability were recorded from the secondary sources over a period of 1986-2014 and studied for any variations. (Source: AICRP on Agro meteorology). Vulnerability to

climatic variability is often reflected in the condition of the economic system as well as the socioeconomic characteristics of the population living in that system. Assessment of current vulnerability was done using a variety of socioeconomic indicators that capture the exposure of the population in concern. The socioeconomic status of a group is closely linked to the adaptive capacity of that particular group. Many factors contribute to social and economic vulnerability including rapid population growth, poverty and hunger, poor health, low levels of educations, gender inequality, social exclusion, fragile, marginal and/or hazardous location, resource degradation, and lack of access to infrastructure, resources and services, including knowledge and technological means. The exposure to extreme events such as storms, droughts and floods limits the capacity of people to protect themselves from natural disasters. Often they end up with consequences of large-scale environmental change, such as land degradation, biodiversity loss, and climate change. Over the long term vulnerable populations have to learn to cope with the effects of climate change on their production systems (Table 1).

Vulnerability index was calculated for Crop farming system, Livestock farming system and Integrated farming system. The indices were compared across three systems. There was a significant difference among the vulnerability index in Namdanahalli and Yaranghatta villages of Kolar at 1 per cent level. A significant difference at 5 per cent level was found among the vulnerability index among respondents from Bharamapura and Kumbarakatte villages in Shivamogga. Crop farming system with mono cropping was found to be most vulnerable, whereas Integrated farming system with livestock component was found to be the least vulnerable.

Most of the households reported that they suffered crop loss and loss of animals due to extreme climatic conditions. The major loss was due to field crops and vegetables, which are much sensitive to climatic conditions. Cross bred cattle was most vulnerable as compared to sheep and goat. Animal Feeding and management were the worst affected in case of climate vagaries. In extreme climate affected situations, livestock was the first option to en-cash, followed by cash crops and trees. Shelter, food and basic sustenance were the most essential needs in case of climate vagaries, both for human and animal. 95 per cent of respondents reported that meeting out the water requirement of animals was challenge during drought periods. There was very little compensation received for the loss of livestock, due to natural disasters, as is the case of crops. 98 per cent were not able to repay the agricultural loans during climate disasters. 79 per cent of the total respondents changed their livelihood pattern, as coping strategy to climate changes (species of crops and livestock, management practices, housing of animals etc.).

The vulnerability indices were constructed for different districts of Karnataka mapped onto the district level maps of Karnataka using GIS software. Raichur was found the most vulnerable and Shivamogga was found the least vulnerable for climate variability (Table 2).

Further, it was found that groups with single livestock species (Cattle) were highly vulnerable to climate vagaries. Integrated farming system with a few cattle,

Table 1: Comparison of vulnerability index in selected villages (n=240)

Village	Vulnerability Index (Crop farming system)	Vulnerability Index (Livestock farming system)	Vulnerability Index (Integrated farming system)	F-value
Adilaur	58.10	57.50	56.74	0.57
Bharamapura	55.70	54.64	53.65	1.04*
Kumbarakatte	56.96	55.28	54.58	1.01*
Shahpur	56.12	54.98	54.73	0.81
Nanadanahalli	56.91	53.21	54.74	2.07**
Yaranghatta	57.12	55.58	54.64	1.99**

* Significant at 5 % level and ** Significant at 1 % level

Table 2: Climate Vulnerability of districts in Karnataka

District	Climate vulnerability index
Raichur	82.04
Yadgir	81.90
Bagalkot	79.43
Vijayapura	79.81
Ballari	76.62
Kalaburagi	75.91
Koppal	77.00
Chikkaballapur	75.17
Chamarajanagar	76.08
Dharwad	69.00
Gadag	67.84
Haveri	65.32
Tumakuru	68.47
Chikkamagaluru	61.06
Davanagere	64.92
Mandya	73.91
Mysuru	72.41
Belagavi	73.70
Chitradurga	74.83
Kolar	74.06
Bidar	74.90
Udupi	54.96
Kodagu	52.03
Shivamogga	52.01
Uttara Kannada	53.91
Bengaluru Urban	59.69
Dakshina Kannada	55.04
Bengaluru Rural	63.00
Hassan	69.05

sheep/goat and livestock was found to be the least vulnerable system. Significant difference was found among integrated farming system and livestock farming system. Loss of crops and livestock due to extreme climatic conditions were reported during extreme natural events. The field crops, was the most sensitive to climatic conditions, followed by vegetable crops. Similar studies conducted in Sunderbans Ecosystem (Sarkar *et al.*, 2010) reported that adequate training programmes in area of adaptation technology need to be organized besides launch of social protection measures to empower them for better preparedness and adaptation to the consequences of climate change. It is imperative to make proactive interventions in areas of importance like livelihood mechanism and resource utilization pattern.

CONCLUSION

Majority of households were affected by climate extremes and most of them carved out their own adaptation strategies, especially in case of livestock rearing. The trend in crop-livestock production shows that milk production was less susceptible to drought conditions, compared to crop production. Farmers have developed their own adaptation strategies to vagaries of nature by shifting from field crops to cash crops, adoption of scientific management practices for crops and livestock. It was observed that milk production can be sustained even under stress if population is optimized along with proper management of available feed-fodder resources. This is more important for feed-fodder deficit states like Karnataka. There is still lack of initiatives in the climate adaptation policies from the government agencies and most of the households believe that there has to be intervention from the government, especially in natural disasters, with respect to crops and livestock. Insurance sector also can play a vital role in this regard. It can be concluded that poor population find it challenging to cop up with impacts of climate vagaries.

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