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Farmers' Acuity on Climate Change in the Central Dry Zone of Karnataka

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ABSTRACT

To counteract the vulnerability results from climate change, it is critical to understand farmers' viewpoints. In Karnataka, farmers' perspectives, implications, adaptive measures, and barriers were investigated during 2021 by collecting the data from farmers using multi-stage random sample technique. Farmers witnessed significant changes in temperature, rainfall distribution, emergence of new plant pests and infirmity over time as a result of the introduction of new cultivars/crops, and the occurrence of drought/flood, according to the data. Crop harvests were inconsistent, depleted common property resources, and costs had risen as a result. Cultivation of stress-tolerant cultivars, drilling bore wells, novel plant protection molecules, changing sowing/harvesting dates, and water-saving techniques were among the adaptation strategies. Climate adaptation challenges in the region included high-cost farm inputs for climate-smart agriculture, labour scarcity, lack of shared water resources, and knowledge gaps. For the best results, adaptation strategies should be implemented "collectively" rather than "individually". Weather based Crop insurance must be marketed with assured indemnity.

INTRODUCTION

Climate change is impacting India's agricultural economy. Temperatures would rise by 1.7 to 4.78 degrees Celsius by 2030-2080, with precipitation increasing by 1.2 to 11.3 per cent, affecting the agricultural and water sectors (Vijayabhinandana et al., 2022). Since the twentieth century, climate change has been a major concern that threatens the livelihoods of humans and other living organisms (Kowshika et al., 2021). Future climate change projections for India indicate distinct rise in temperature and increased variability in rainfall (Sandeep et al., 2018). Climate change has a variety of effects on agriculture, including decreased crop productivity, incidence of pest and diseases and change in cropping pattern. When production decreases, availability of goods also decreases and hits the poor most. Climate change has about 4-9 per cent impact on agriculture each year. As agriculture contributes 15 per cent to Indian Gross Domestic Product (GDP), climate change presumably cause about 1.5 per cent loss in GDP (Subhojit, 2017). Numerous studies on climate change and variability have been conducted at the international, national, and state levels (Anonymous, 2017; Chand et al., 2011).

Farmers are facing a new challenge in the form of climate change. Apart from the losses incurred as a result of changing weather conditions, it also has an impact on farmers' decision-making abilities due to a lack of awareness and expertise. Farmers' readiness to adapt is influenced by their perceptions and attitudes about climate change. Adaptation to climate change requires long-term planning of alternative agricultural management strategies in response to changing weather conditions (Rachit et al., 2021). The impact of climate change is particularly visible in India's semi-arid

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region, where geo-ecological fragility is reflected by low and erratic rainfall patterns, poor soil fertility, and inherent socio-economic instabilities (Bantilan et al., 2006; Singh et al., 2012). Because of agro-climatic conditions, land pattern, cropping systems, cropping pattern, and resource availability differs by region, key findings from macro-level research may not be applicable to the micro level, such as individual districts (Kumar et al., 2011; Jangra & Singh, 2011). The regional study of climate parameters and their impact on agriculture is urgently needed. Normal agricultural and allied sector activities rely heavily on rainfall and the number of rainy days per year. Any deviation from the normal mean in climatic parameters puts a strain on rural livelihoods and economies. As a result of rural agriculture's distress, the state's agrarian crisis has worsened over time (Sagar et al., 2018). Between 2030 and 2050, climate change is expected to cause approximately 2,50,000 additional death per year from malnutrition, malaria, diarrhea and hear stress. The cardiopulmonary and digestive systems of humans are particularly vulnerable to the negative effects of global warming. Furthermore, climate change has an impact on some infectious human diseases and their animal vectors (Massimo & Pier, 2015).

Farmers' perceptions of climate change and the risks associated with it, on the other hand, are a necessary prerequisite for developing appropriate adaptations strategies. As a result, the purpose of this study is to elicit grassroot perspectives on climate change impacts, adaptation measures implemented to cope with climate change, and barriers to effective adaptation in Karnataka's Chitradurga district.

METHODOLOGY

Chitradurga district was selected purposively as it is one of the most historically drought-prone districts in Karnataka. The district is experiencing insufficient water availability, owing to the depletion of the groundwater table. Such risk will be exacerbated by climatic variations, posing an imminent threat to the region's food and livelihood sustainability. Furthermore, the majority of studies assessing the vulnerability of Indian agriculture to climate change have designated Chitradurga as a highly vulnerable district (Anonymous, 2018).

Information from both primary and secondary sources were used. To select sample households, a multistage sampling technique was used, with the first stage focusing on three taluks: *Holalkere*, *Hiriyuru*, and *Challakere*. In the second stage, two villages from each taluk i.e., Chikkajajuru and Raamagiri from Holalkere taluk, Aadivaala and Maarikanive from Hiriyuru taluk, Kurudihalli and Saanikere from Challakere taluk were chosen. Finally, a total of 150 households i.e., 25 respondents from each village was chosen randomly to investigate grass-roots perceptions and adaptation measures to climate change during 2021. Furthermore, individual primary surveys and Focus Group Discussions (FGDs) with farmers were conducted, during which they were asked open-ended questions about their perceptions of climate change, socio-economic hardships experienced, and obstacles encountered in dealing with climatic uncertainty. Moreover, concerns were raised about the steps that farmers were taking in response to changing climatic conditions. Farmers' perceptions of climate change were validated further by observing variation in rainfall and temperature from their long-term averages using data on climate variables from 1951 to 2020.

RESULTS AND DISCUSSION

Farmers' perceptions on climate change

According to surveys and focus group discussions conducted in selected villages of Chitradurga district, the vast majority of farmers (97.33%) reported an increase in maximum temperature (Figure 1). A sizable proportion of respondents (94.67%) stated that pest and disease incidence had increased. Similarly, many farmers (93.33%) believe that unpredictable rainfall distribution has increased, with 92.67 per cent citing changes in monsoon arrival and the recurrence of extreme occurrences. Every year, the nakshatra-based rainfall is unpredictable, as perceived by majority of farmers. This result is supported by study conducted by Chinchorkar et al., (2019) and Swamy (2018). The study area

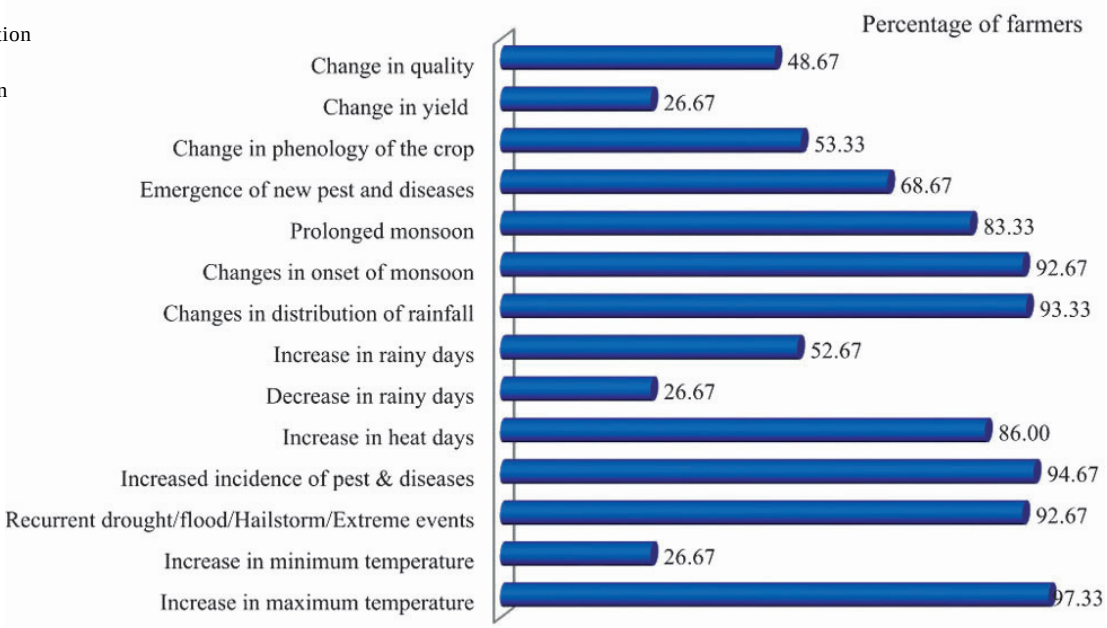

Figure 1. Farmers' perception on climate change
Source: Author's estimation based on Field Survey data, 2021

farmers reported an 86 per cent increase in the number of hot days and 83.33 per cent increase in the length of the monsoon. Almost 69 per cent of respondents predicted the emergence of new pests and sickness over the years. Surprisingly, roughly 54 and 53 per cent of farmers reported that changes in crop Phenology (growth stages) and increased rainy days in the region have made agriculture unpredictable over time. Concerns about changes in the quality of their produce were expressed by approximately 49 per cent of farmers. Farmers also reported a change in crop yield by 26.67 per cent, fewer rainy days, and a higher minimum temperature. Farmers' education, use of the media, and source of meteorological information all played a role in their impression of climate change (Bharat et al., 2022).

Temperature and rainfall patterns of Chitradurga district

From 1951 to 2020, the long-term variation and trends in climate variables were studied. Figures 2 and 3 indicate rainfall and temperature anomalies calculated by subtracting the current value from the long-term average. Maximum temperatures, according to farmers' perceptions, have been rising at a rate of 0.019°C per year. Singh et al., (2021) reported similar increase in maximum temperature in Rajasthan and Ganesh (2020) also found out similar outcome in Gujarat. However, the increase in minimum temperature was insignificant when compared to the increase in maximum temperature in the district. Significant changes in the amount of annual rainfall was observed in the study area, indicating that farmers perceive rising oscillations in precipitation.

Impact of Climate Change in Chitradurga district

Climate-related risks have a negative impact on the socio-economic stability of rural households. Figure 4 shows that 98.67 per cent of farmers believe that changing climatic conditions have increased the cost of farming in recent years due to crop loss, while, 93.33 per cent believe that common property resources (wells, ponds, lakes, and so on) in their village have declined due to unpredictable rainfall. Farmers they all agreed that climate change has reduced the cultivation of conventional varieties, which has increased crop yield uncertainty. A large majority of respondents (82.67%) agreed that soil fertility has declined over time, and 85.33 per cent said pest and disease infestation has increased on a regular

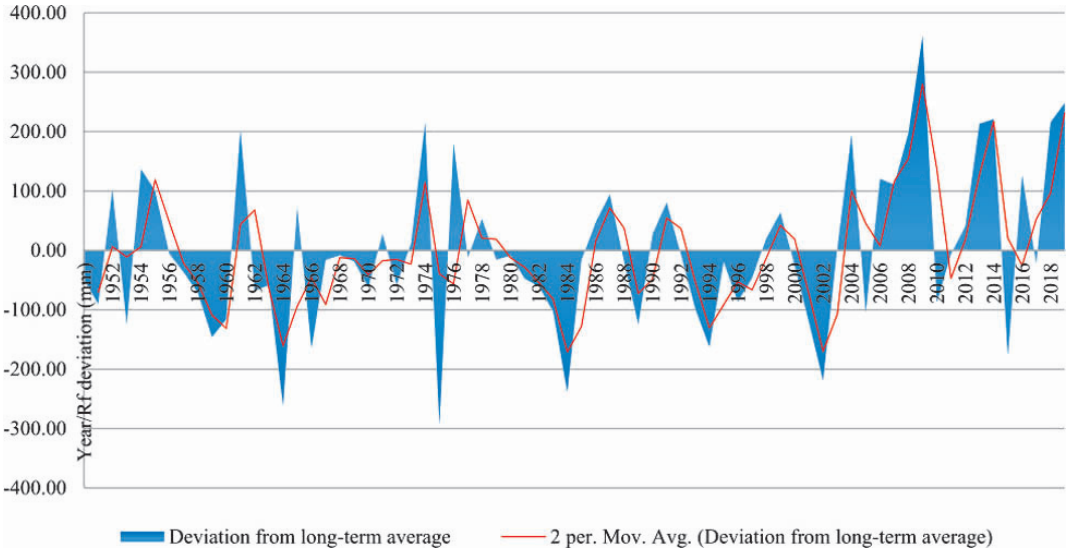

Figure 2. Rainfall deviation in Chitradurga district, Karnataka during 1951-2020
Source: Author's estimation based on secondary data obtained from ICAR-CRIDA, Hyderabad

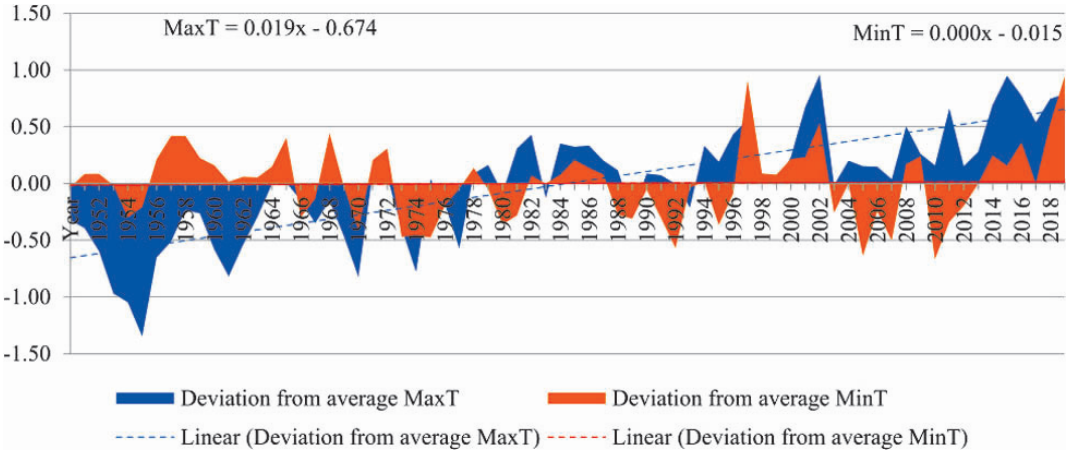

Figure 3. Maximum and minimum temperature anomalies and linear trend for Chitradurga district, Karnataka during 1951-2020.
Source: Author's estimation based on secondary data obtained from ICAR-CRIDA, Hyderabad

basis. As a result, crop yield and quality were both questioned (81.33%). The findings of Sreenivas et al., (2021) back up this conclusion. More than half (53.33%) of respondents were satisfied with the percentage of net revenue earned. Around 47 per cent of each group wish to stop farming and believes that climate change has hampered crop growth and affected the farm income. A significant proportion of the farming community (34.67%) has abandoned agriculture as a primary source of income. Surprisingly, 32.67 per cent of farmers have shifted to new crops (i.e., arecanut and pomegranate, which were not there in the district before two decades). Changes in soil health and mortgage/sale of precious metals for income generation are also expressed by 33.33 and 46.67 per cent of farmers, respectively. Furthermore, only 5.33 per cent of farmers have made investments in climate-smart technologies such as protected structures (poly and shade house). In Meghalaya, Singh & Feroze (2020) support a similar finding on asset sales due to climate change.

Adaptation strategies for climate change

Farmers' awareness, technical competence, and financial ability all play a role in climate change adaptation efforts in the district. It is crucial to note that adaptation strategy selections are not mutually exclusive, and farmers have reported using more than one technique at a given time. As shown in Figure 5, the majority of farmers (86.67%) in the selected villages chose to dig a borewell to ensure continued irrigation after the district experienced several years of drought and to provide adequate irrigation to new crops such as arecanut and pomegranate. Approximately, 86 percentage of respondents reported using new chemical compounds to combat persistent plant pests and illnesses in hybrids and high-yielding varieties, while 57.33 per cent reported using drip and sprinkler watering. Farmers were also found to be making proper modifications in terms of planting and harvesting stages (54.67%), which is critical because crop production is mainly influenced by climatic condition. To adapt to climate change, a sizable proportion of farmers (53.33%) were able to find new crops or change their cropping patterns. Furthermore, 34.67 per cent of respondents used adaptive techniques such as cultivar selection for biotic and abiotic stress tolerance (drought tolerant, pest and disease resistant varieties). Few farmers (25.33%) were able to use soil and water conservation methods to combat climate change, which were among the other possible strategies employed. Besides, only 8.67 per cent

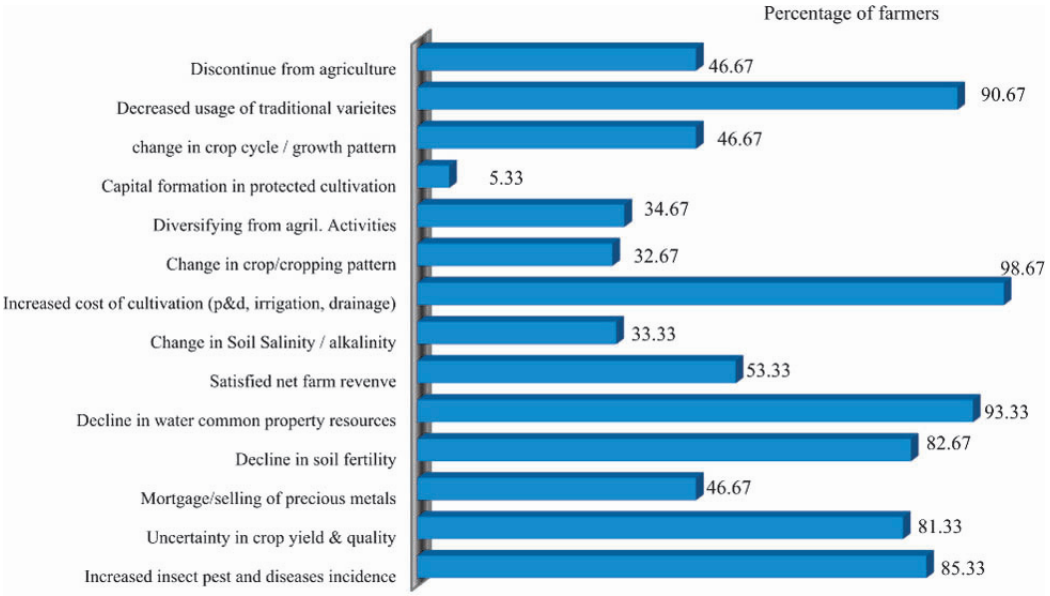

Figure 4. Perceived impact of climate change

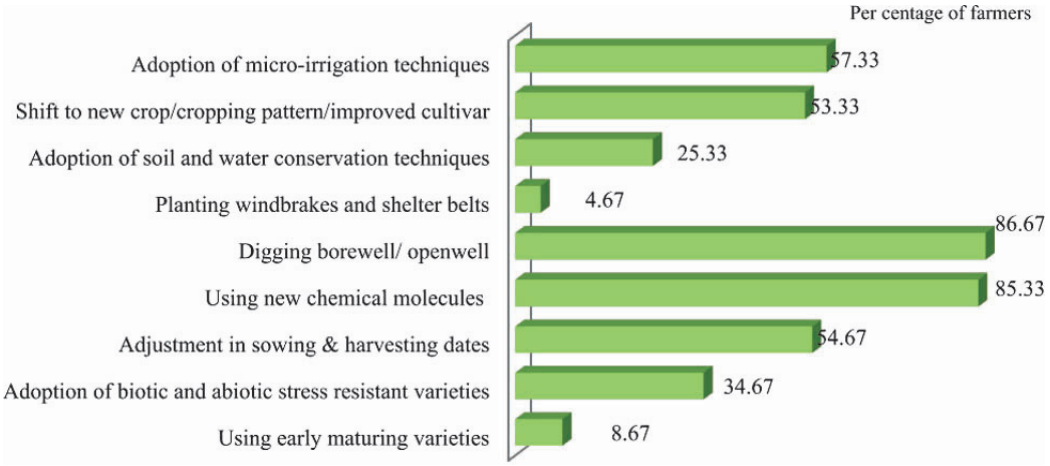

Figure 5. Adoption to climate change

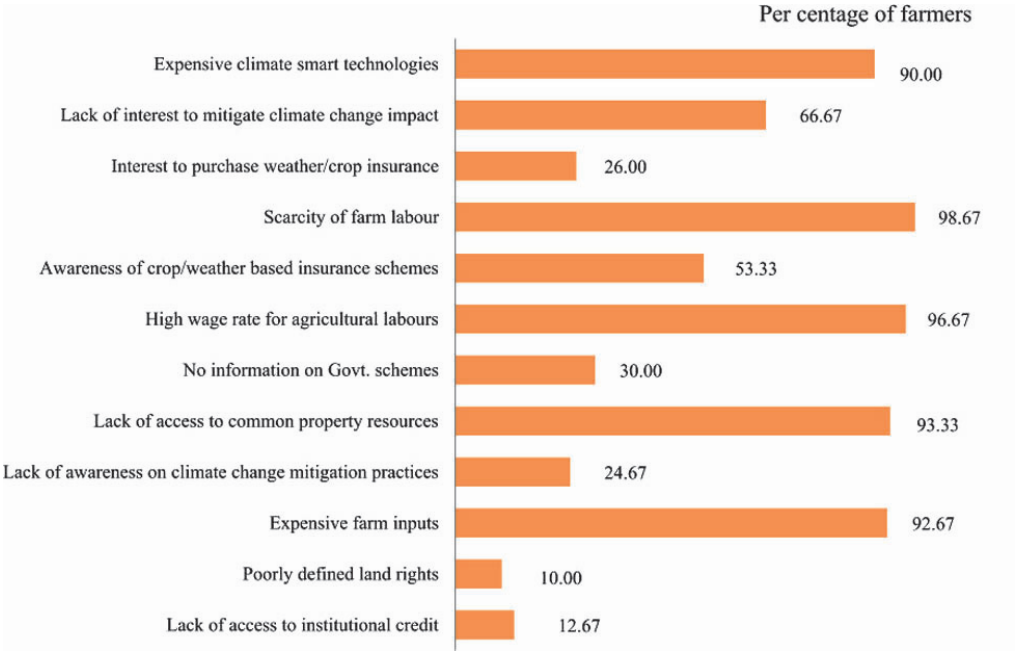

Figure 6. Barriers to climate change adaptation
Source: Author's estimation based on Field Survey data, 2021

of farmers used early maturing cultivars as an adaptation strategy. A negligible proportion of tree species were used for windbreaks and shelter belts (4.67%) as there is misconception of reduced yield due to shade. Sujit et al., (2022) reported similar adaptation strategies in climate smart village in West Bengal.

Climate adaptation roadblocks

Farmers' ability to adapt to climate change is hampered by a variety of issues. These include institutional, economic, technological, social, and informational factors, all of which contribute to a lack of coping capacity. Farmers' perceptions of barriers must be evaluated to determine the relative importance of the factors influencing their adaptation decisions. The majority of farmers in the research areas stated that the biggest deterrents to adaptation were lack of farm labour availability (98.67%) and high wage rates of agricultural labourers (96.67%) (Figure 6). Farmers also cited a lack of access to common property resources (93.33%), expensive farm inputs (92.67%), and expensive climate smart technologies (90%) as major barriers to adaptation. Despite the fact that it is a task that requires people's participation, 66.67 per cent of farmers in our grass-roots survey reported a lack of interest in mitigating climate change. About 53 per cent of respondents were unaware of crop/weather-based insurance programmes, and only 26 per cent were interested, because respondents believe that prompt indemnity is not guaranteed every year. Furthermore, 30.00, 24.67, and 12.67 per cent of farmers saw a lack of information about government programmes, lack of awareness about climate change mitigation methods, and lack of access to institutional loans as significant impediments, respectively. Surprisingly, 10 per cent of those polled believe that lack of clearly defined land rights prevents them from implementing climate change mitigation measures.

CONCLUSION

As a result of the introduction of new cultivars/crops owing to climate change, farmers in the Chitradurga area of Karnataka are witnessing major differences in temperature, rainfall distribution, the advent of new plant pests and diseases, and the occurrence of drought/flood over time. Crop yields are uneven, resulting in fewer common property resources and higher costs. Stress-tolerant cultivars, borehole drilling, innovative plant protection molecules, shifting sowing/harvesting time, and water-saving techniques were among the adaptation options. High-cost farm inputs for climate-smart agriculture, labour scarcity, a lack of shared water resources, and knowledge gaps are among the region's climate adaption issues. To achieve the optimum results, "collective" adaption strategies should be used rather than "individual." Crop insurance dependent on weather must contain a regular indemnity guarantee.

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