

Smallholders' role in achieving food security and ecological management in Kohima, Nagaland

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ABSTRACT

Diversified farming and forest management through indigenous knowledge have played an integral part in maintaining cultural unity and social cohesion in Nagaland. The study encompasses four villages (*viz.*, Khonoma, Mima, Viswema, and Jotsoma) in Kohima, where unique and traditional food production systems are widely practiced by smallholders in various agroecological settings. Smallholders are integral in producing quality crops and vegetation for sustenance, over large-scale commercial production as the quality is intact and organic, with minimal fertilizer application. However, the changing climate anomalies such as excessive heat, increasing temperature, pests and diseases, flood, and drought-like conditions harm crops, land use, and vegetation production, and have a negative impact, especially on the smallholders being less equipped with modern farming technologies and lesser awareness. The household surveyed among the smallholders in the four villages highlights that 52.2% perceived the intensity of rainfall decreased and 35.5% perceived the number of rainy days has highly decreased; 76.2% agreed on seasonal changes such as the increasing temperature; 52.2% responded that intensity of hot months has increased; conversely, 28.4% responded that cold months has highly decreased. Documenting and analyzing the best practices and adaptive capacities aids towards the goal of 'Zero Hunger' and underlines smallholders' crucial role in achieving global food security as per SDG's target, 2030. The ecological management practices comprised reservoir construction for water storage and rainwater harvesting by around 68% in Khonoma, 77.36% in Jotsoma, 79.23% in Viswema, and 42.5% in Mima village. Simultaneously, the adaptive measures of soil management in these villages were reusing the waste logs; planting bamboo and bananas on the farmlands; mixed farming; crop diversification, and growing plants such as legumes for soil fertility. In addition, diversification beyond farming activities such as livestock rearing in Viswema village had the highest practice and benefits via poultry rearing. Cleaning and sanitation of livestock shelters with timely livestock vaccination practice has been a challenge to adapt, in all the villages because it diversified the income source through milk, meat, and other by-products.

In conclusion, their farming systems revoked over generations, producing food, fodder, fiber, timber, and manures, thus enabling adaptive mechanisms in times of climate extremes, by maintaining their native crop types and productivity through practices such as natural and careful selection procedures, seed saving after harvest, and sharing among their local vicinity.

Keywords: Smallholders, SDG's, Food Security, Ecological Management, Climate Change

INTRODUCTION

Smallholder farmers make up a significant portion of the agricultural sector in Nagaland. Approximately 70% of farmers in the state are considered smallholders, typically cultivating small plots of land less than half a hectare. This high percentage highlights the agrarian economy of the state (Nagaland - STINER CSIR-NEIST; accessed on 15-10-2024) and the importance of smallholder agriculture in local food production and economic stability. Their contributions are vital for ensuring food security and sustaining rural livelihoods in Nagaland (Tsopoe *et al.*, 2023). They are integral in producing quality crops and vegetation for sustenance, over commercial productions and their diverse farming systems have played an integral part in maintaining cultural unity and social cohesion in Nagaland.

By leveraging their unique strengths and fostering sustainable practices, they significantly contribute to achieving the 'zero hunger' target set for 2030 as per the Sustainable Development Goals (SDGs). Empowering these farmers through access to resources, training, and supportive policies is key to creating resilient food systems and improving food security worldwide (Goal 2: Zero Hunger UN SDGs; accessed on 15-10-2024).

Achieving Sustainable Development Goal No. 2, "Zero Hunger," through the contributions of smallholder farming communities is essential, as these farmers play a crucial role in global food security. There are several ways smallholder farming communities can contribute *viz.* diversified cropping systems; local food systems (direct connections between farmers and consumers strengthen local food systems and provide fresh produce while reducing transportation emissions); sustainable farming practices; and also assisting them for larger reach by making its products accessible to resources and markets; through effective training and capacity building; technology and innovation; and encouraging nutrition-sensitive agriculture systems (such as crop diversification and mixed farming for nutrient-rich crops eg. fruits, green vegetables, and legumes) can improve local diets and combat malnutrition.

On the contrary, since they are less equipped with modern and resilient farming technologies the changing climate anomalies could impact their farm production and management. Excessive heat,

increasing temperature, heat stress and resulting increase in pests and diseases, flood, and drought-like conditions, etc. damage the crops, and reduce their crop and vegetation production (Zagre *et al.*, 2024). Therefore, in addition to the technical data available, it is also important to understand the various issues that arise due to the changing climate and weather conditions faced by these farmers at ground level. By recognising the localised adaptive strategies or practices at the farm level and analysing their effectiveness coupled with scientific research and guidance; coupled with creating awareness, could help them be better equipped for future CC impacts.

OBJECTIVES

- Documenting diversified farming practices; annual farm production and consumption estimation among smallholders' in Viswema, Jotsoma, Khonoma, and Mima respectively.
- Taping perceptions of the Changing Climate among smallholders and their impact;
- Recognising localized adaptive strategies (agricultural farm/water management, diversification activities), among the smallholders in Nagaland

METHODOLOGY

10% of households were randomly surveyed from each village, covering participation from various khel/groups, and their responses were recorded in a semi-structured questionnaire covering their socio-economic status, their perceptions on the changing climate through various CC indicators/parameters, their existing localised and cost-effective farm and agricultural management practices were also recorded for further analysis. Pre-informed consent was obtained from all participants and flexibility of participation was given to every household. A total of n=295, households practicing diverse farming systems were surveyed in the four villages in Kohima, Nagaland in India. The four villages along with major crops and vegetations are listed in Table 1.

RESULTS AND DISCUSSION

According to the study the smallholders in Nagaland earned approx. 13,644 per household from major crops and vegetables yield on annual basis

Table 1. Annual production, consumption, and sale estimation of major crops and vegetation

Village name	Major crops, vegetables, and fruits	Farming systems practiced by smallholders'	Production (kg's)	Consumption (kg's)	Sale (kg's)	Income (in rupee)
Viswema	Rice, maize, ginger, potatoes, sweet potatoes, lettuce, cabbages, spring onions, garlic etc. Guavas, bananas, plums, jackfruits, pomelo	Alder-based jhum farming, terrace farming, livestock rearing	85,430	61,721.5	23,543	14,16,779
Khonoma	Rice, jobs tear Maize, garlic, ginger, potatoes, taro Pumpkins, edule, gourds, peas, beans, tree tomatoes, green leafy vegetables melons, guavas, passion fruit,	Alder-based agroforestry, traditional jhum, terracing, livestock rearing, kitchen gardens	95,258	58,855.5	34,427.5	22,11,975
Jotsoma	Rice maize, ginger, potatoes Cabbage, beans, broccoli, chili, and squash guava, banana, jackfruit	Terracing, kitchen gardens, livestock rearing	29,561.48	27,670.98	1,596.5	88,460
Mima	Rice Potato, maize, ginger Garlic, jobs tear Peas, common bean, chayote, perilla, mustard, eggplant, chili, taro Guava, wild cherry, jamun, banana	Oak-based agroforestry, traditional jhum, terracing, bee-keeping	35,921	25,204	10,716.2	3,07,808.5
Total			2,46,170.5	1,73,452	70,283.2	40,25,023

(Table 1), which is quite less in comparison to the amount of labor it demands. However, this figure may be influenced with seasonal variations, crop yields, and economic conditions yearly. Additionally, majority of the farmers supplement their income through other activities, such as livestock rearing or engaging in non-farm work, diversifying beyond farm activities to sustain and enhance their livelihood income (Fig. 4). The lesser yield and income generated could also be attributed to their organic way of farming, using minimal fertilizers or synthetic supplements to increase the yield. Hence, addressing income disparities and enhancing agricultural productivity remains crucial for improving the livelihoods of farmers in Nagaland.

The changing climate anomalies such as excessive heat, increasing temperature, pests and diseases, erratic rainfall and floods or no rainfall, and drought-like conditions harm crops, land use, and vegetation production, and have a negative impact, especially on the smallholders being less equipped with modern farming technologies. The household surveyed among the smallholders in the four villages highlights that 52.2% perceived the intensity of rainfall decreased and 35.5% perceived

the number of rainy days has highly decreased; 76.2% agreed on seasonal changes such as the increasing temperature; 52.2% responded that intensity of hot months has increased; conversely, 28.4% responded that cold months has highly decreased (Fig. 1 and 2). Among the changing weather conditions, temperature increase has been one of the most important indicators for the smallholders, which led to the occurrence of new pests and diseases in their farmlands affecting the crops and vegetation production. In addition, the erratic rainfall patterns also make the already prone hilly terrain exposed to higher landslide conditions (Fig. 2).

Therefore, management practices that are suitable for the localized region must be recognized and encouraged for their cost and time effectiveness. The indigenous and local ecological management practices modified over generations, comprised reservoir construction for water storage and rainwater harvesting. Rainwater harvesting in tanks and the creation of water channels in farmlands have been adopted by around 68% in Khonoma; whereas 77.36% in Jotsoma, 79.23% in Viswema, and 42.5% in Mima also practiced water harvesting

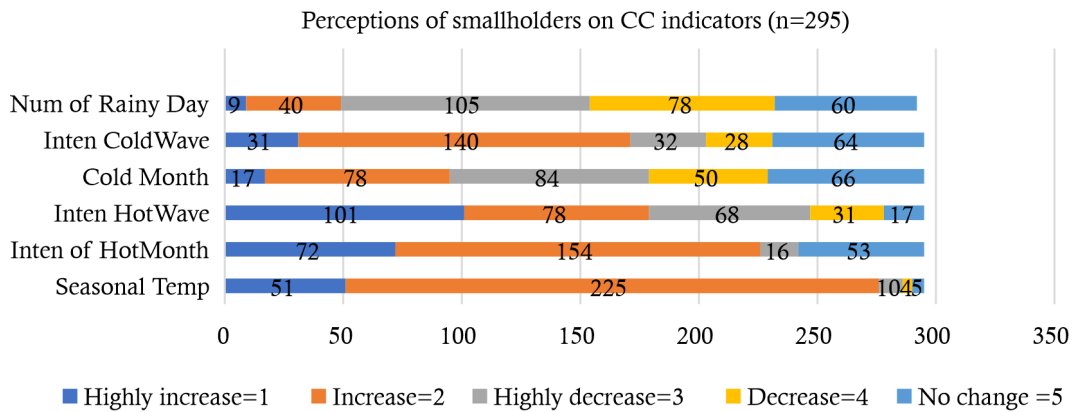


Fig. 1. Perceptions of smallholders on CC indicators

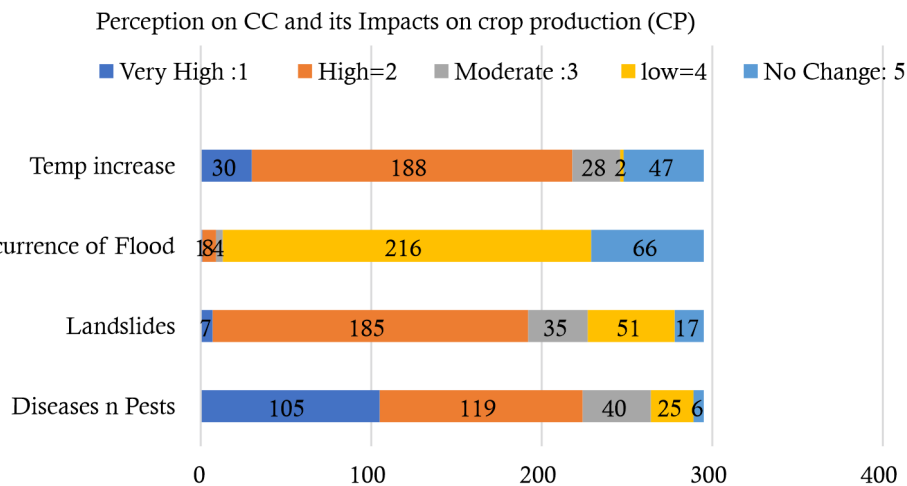


Fig. 2. Perception of CC and impact on Crop Production

in various storage structures (Fig. 3). The common soil management practices were reusing the waste logs from vegetation and crop harvest for making boundaries in terracing, filling up lands; planting bamboo, bananas on the farmlands and fruit trees such as guava on the boundaries; mixed farming; crop diversification, and growing plants such as legumes (peas, beans) for soil fertility (Fig. 4 and 5). In addition, diversification beyond farming activities such as livestock rearing were common in Viswema village such as poultry rearing and eggs. Cleaning and sanitation of livestock shelters with timely livestock vaccination practice has been a challenge to adapt, in all the villages because it diversified the income source through milk, meat, and other by-products. Other diversified income sources included carpentry, small businesses, private employment, and the senior citizens were also receiving old age pension schemes via DBT (direct bank transfer) govt. schemes (Fig. 6).

The smallholder farmers in Nagaland are known for their indigenous and unique knowledge tank, capable of providing vital input related to changing weather conditions and associated socio-economic vulnerability being actively engaged at ground level and associated farming systems. Therefore, understanding their farming mechanism and utilization patterns becomes indispensable for generating effective adaptation measures at the localised farm level (Jamir and Khan, 2019). Farmlands are an asset for smallholder farmers, they practice farming systems to extend the source of their survival, and in the process learn unique techniques of farm management (Maikhuri *et al.*, 2019). However, to achieve long-term sustainability under climate change and achieve the 'zero hunger' targets of the SDG's goal, government-supported adaptation measures should be modified or customized in light of various factors such as pressure, resources, and livelihood options of the

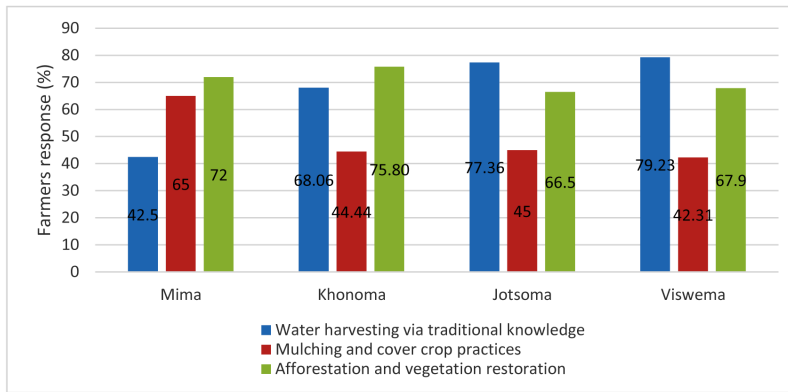


Fig. 3. Agricultural water management

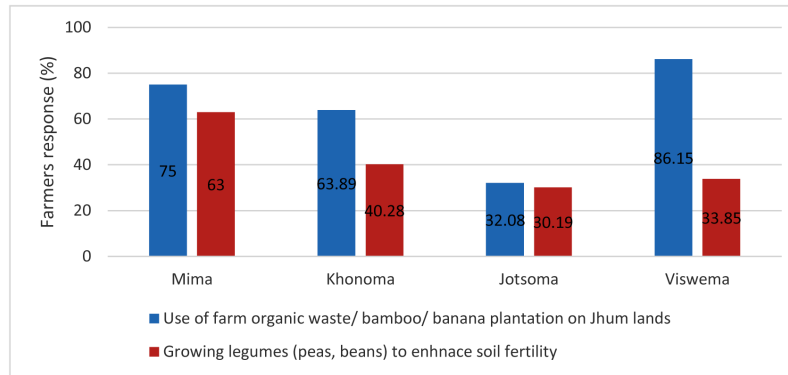


Fig. 4. Agricultural soil management

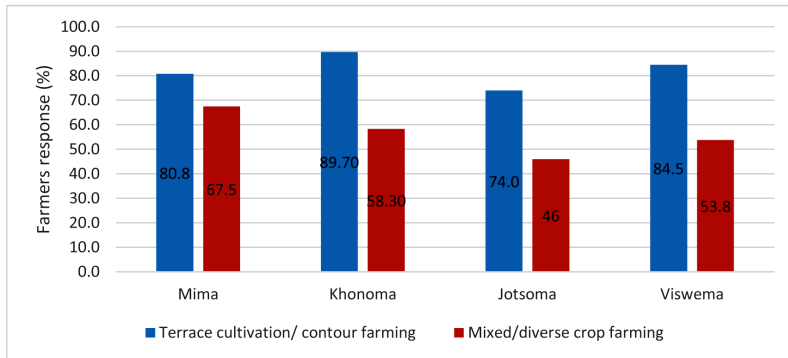


Fig. 5. Agricultural farm management

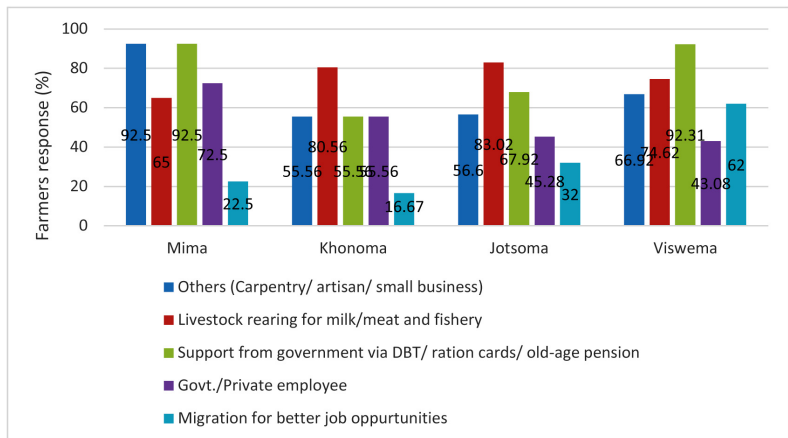


Fig. 6. Diversification activities beyond farm

Fig. 3-6 highlights the local adaptive strategies of ecological management system in the villages

smallholders' (Pandey *et al.*, 2015).

In addition to the adaptation measures at the farm level, Vermeulen *et al.* (2018), suggests that organisations like governments, policymakers, and development partners play crucial roles and could increase the efficacy of favorable results by offering more thorough and long-term approaches to adaptation planning. Alongside financial and technical assistance, all within a framework that rewards farms as multi-functional systems besides crop and vegetation produce. IPBES's Global Assessment Report (2019) highlights the importance of identifying indigenous and local communities' inherent knowledge, innovations, practices, institutions, and values. Their participation in environmental governance and the preservation, restoration, and sustainable use of nature to improve the quality of life and enhance their adaptive capacity to cope with CC anomalies (Bongaarts, 2019). Because indigenous communities have a close and traditional dependence on nature, their livelihood and lifestyles often depend on the availability of bio-materials allowing ecological adaptation and food security in various situations effectively (Munzara, 2007).

CONCLUSION

In addition to the technical reports on Climate Change, the smallholders' perceptions and observations cement the impacts of CC on farmlands in Nagaland. Infused with their Indigenous practices, they are integral in producing quality food and maintaining the nutrition dynamics; enabling the smallholders' equipped with food, fodder, fiber, timber, and manures, and allowing adaptive mechanisms in times of climate extremes, by practices such as maintaining their native crop and productivity, seed saving after harvest, and sharing among their local vicinity; by making the local chain self-sufficient to produce food in the following years too. The localised ecological adaptive strategies to manage agricultural water, soil, farm, and livestock must also be recognized, supported with scientific research, and encouraged for their availability and cost-effectiveness for effective management; coupled with creating effective awareness channels, which

could help them be better equipped for future CC impacts.

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