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Enhancing livelihood and income of smallholder farmers through Integrated Farming Systems in Mima, Nagaland

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ABSTRACT

Mima village is located between 25°59′12″ N and 94°11′02″ E in the Southern part of Kohima, Nagaland, and is divided into three major khels *viz*., Tsophima khel (Tm-khel), Rusoma khel (R-khel), and Tama khel (T-khel). From their indigenous knowledge and survival instincts, the local farmers here have adopted various Integrated Farming Systems (IFS) to enhance their livelihood and sustainably generate financial assistance. The various IFS components in Mima are Oak-based agroforestry, Terrace cultivation integrated with trees, beekeeping, livestock rearing, paddy and fish culture, etc. The IFS approach of land use through the integration of Agri-horticultural crops, fishery, livestock, and bee-keeping proved to be most suitable for livelihood security of the smallholder farmers in Mima, Nagaland through improved resource recycling on farms, creating job opportunities, generating revenue, and restoring the ecology by maintaining soil health. Some major fruit trees intercropped along terrace fields were *Psidium guajava, Prunus avium, Syzygium cumini, Musa,* and *Psidium guajava.* Various horticulture crops intercropped in oak-based agroforestry were *Colocasia esculenta*, *Cucurbita*, and *Lagenaria siceraria*, used as livestock feed. The combined estimated annual income from various IFS components was better than that generated from traditional Jhum farming alone. The study also indicated bee-keeping as an integral IFS component because of its labor efficiency and enhanced financial assistance compared to conventional agriculture. Out of 295 L of honey produced from 40 households, 267 L were sold, which generated 2,67,000 rupees approximately, whereas vegetables (potatoes, chilies, and chayote) in jhum fields were sold for 58,370 rupees for 258 kg. By integrating various agricultural enterprises (such as cropping systems, livestock, agroforestry, agri-horticulture, and apiary) and promoting ecological sustainability through increased economic viability, improved productivity, and decreased environmental footprint, adopting various IFS could prove to be beneficial for the impoverished, small, and marginal farmers.

Keywords: Integrated Farming Systems (IFS), Smallholder farmers, Indigenous farming, Mima village

INTRODUCTION

In Nagaland, jhum cultivation is one of the major occupations of a majority of the rural population; however, a shorter jhum cycle has put tremendous pressure on resources, affecting the productivity of land caused by land degradation, increased level of soil erosion, and forest degradation, leading to low yield and food insecurity. It has intrinsic restrictions on soil loss, which ranges from 30 to 170 t/ha/year and causes significant nutrient and biodiversity loss (Saha *et al*. 2012). There is a need for positive interventions where natural resources can be protected from over-exploitation, and creating food security has become a major concern in feeding the ever-expanding population (Malik *et al*., 2022). In such a scenario,

an equilibrium between effectual and productive agricultural enterprise and environmental sustainability is in demand to make the agriculture sector more productive and economically viable (Yadav *et al.*, 2013; Bhardwaj *et al.*, 2023). Sustainable farming alternatives such as the Integrated Farming System (IFS) must be considered for prudent management of natural resources.

Integrated farming is a method of farming that involves the mixed farming approach. It incorporates crops, vegetables, and fruit trees along with the integration of pond dykes with fish, dairy cattle, livestock rearing, poultries like hens and ducks. The integrated farming method promotes judicious land utilization, thus promoting sustainable farming over monoculture farming systems. When adopted, the integration of crops and vegetation along with livestock components (dairy, poultry, duckery, and fishery) could help in the sustainable production of jhum fields and enhance the economic condition of the local farmers. By strengthening and sustaining conventional shifting cultivation, IFS could effectively reduce the risk of soil and environmental deterioration (Das *et al.*, 2008).

About 85% of farmers in India's North Eastern Region (NER) are smallholder farmers. The IFS, therefore, could be an asset for the poor, small, and marginal farmers by sustaining their production system through the integration of various agricultural enterprises such as cropping systems, livestock, aquaculture, agroforestry, agri-horticulture, and apiary in an optimum combination (Nayak *et al.*, 2020). IFS plays a pivotal role in ecological sustainability by enhancing economic viability, improving productivity, and reducing the environmental footprint (Das *et al.*, 2008). In addition, besides improving productivity and the financial aspects, these systems also have the potential for climate change resilience and mitigation potentials and thus enable the farmer's participation in climate risk management for building a climate-resilient production system (Nayak *et al.*, 2020). The IFS approach to land use by integrating agri-horticultural crops, fishery, and livestock could be most suitable for livelihood security among smallholder farmers in rural areas. Therefore, establishing integrated practices could improve farm resource recycling, create jobs and revenue, and maintain ecological aspects such as soil health (Das *et al.*, 2019).

The study documents the various IFS practiced by the indigenous people in the Mima village of Kohima, Nagaland. The possible benefits of incorporating multiple IFS components in the farming systems to the local communities in Mima are financial assistance, prudent and efficient land-use management, saving time and labour, and many other valuable attributes over conventional farming systems such as monocropping.

MATERIALS AND METHODS

Study area

Mima is a village located between 25°59′12″N and 94°11′02″E in the Southern part of Kohima, Nagaland, and is divided into three major khels *viz.*, Tsophima khel (Tm-khel), Rusoma khel (R-khel), and Tama khel (T-khel). The primary data was collected via household surveys and semi-structured questionnaires across the three khels in Mima village. The interrogation and discussion proceeded in native dialects with the help of local guides so that the respondents could better understand and respond to the questions. Respondents' prior informed consent (PIC) was obtained with assurance of confidentiality to their responses.

RESULTS AND DISCUSSION

i) Various Integrated Farming Components in Mima

The various IFS components recorded in Mima were integrated jhum cultivation, oak-based agroforestry system, terrace cultivation integrated with vegetable crops and fruit trees along the boundaries, poultry (hens and ducks), and Piggery, were commonly reared livestock at the household level, beekeeping (both traditional underground and modern aboveground), fish and paddy culture.

The estimated paddy yield was higher in terrace cultivation; it is cultivated and harvested mainly for consumption purposes, and only a few households reported engaging in paddy selling if the yield exceeds their requirements. They also depend on livestock feeds from their produce. Terrace cultivation is the major farming system for paddy production in hilly areas like Kohima, mainly cultivated for self-consumption (as rice is the stable food in Nagaland), and shifting cultivation is popular for intercropping various vegetables for sale and

Table 1. Annual production and income estimation from various IFS component in Mima

IFS component	Major composition	Production (kg)	Consumption (kg)	Sale (kg)	Annual income (Rs)
Shifting Cultivation(SC)	Potato, Chillies, Chayote, Perilla, Mustard, Banana etc.	8728	3260	5995.5	1,88,778.3
Oak based Agroforestry (AF)	Maize, Ginger, Peas, Common beans, Guava, Wild cherry, Jamun etc.	6053	2110	3943	1,16,147.6
Terrace Cultivation (TC)	Rice	19,210	19,210	-	-
Bee-keeping	Indian honey bee	295	28	267	2, 67,000

consumption. Shifting cultivation is an integral part of their cultural and traditional production system, and many local farmers still rely on this form of cultivation, where the intercropping of various vegetable crops, along with paddy, was practiced. Therefore, the annual income from vegetable crops was slightly higher than the agroforestry system (Table 1, 2). The harvested vegetation is then sent to the local markets in districts like Kohima and Dimapur for sale.

Trees, vegetables, and fruits were also maintained in the oak-based agroforestry. Oak trees were pollarded, and instead of being chopped, the trees permanently paved the way for a good source of fuelwood and timber for the rural communities in Mima. The local farmers suggested Oak to be an excellent source of firewood. Many rural households still depend on firewood to prepare livestock feeds, which requires much fuelwood. For example, pigs feed, and maintaining trees in the agroforestry system also helps meet the requirement through its pollarded branches which are collected and used for fuelwood.

The village is popular for practicing unique underground beekeeping ("traditional hives"), which has been practiced for generations. Given their affordability, beekeepers in Mima could build and maintain multiple traditional hives. Most households practice traditional beekeeping in their backyard, farming under trees. The practice of beekeeping fetched farmers an enhanced income over other farming systems. With positive interventions from state agriculture departments, traditional and modern bee hives co-exist. The traditional hives were environmentally and economically sustainable, making them a fantastic choice in several situations, especially in rural areas. Modern improvisation aims to obtain more hygienic honey. Local farmers also agreed that beekeeping, honey extraction, and honeycomb are more advantageous in labour and financial stability than conventional farming in the hills. 295 L of honey could fetch them a decent amount (Table 1) whereas, around the same figure, 258 kg of vegetables (potatoes, chilies, and squash) from jhum fields could fetch them 58,370 rupees only, which is comparatively less in terms of energy and labor invested. The IFS component, such as beekeeping in Mima village, has huge potential for expansion because the bees in these hives are healthy organic and may serve as the foundation for vast, robust, and genetically diverse bee populations; they are also incredibly profitable.

Fodders were not cultivated separately but collected for feeding domesticated livestock such as Piggery, rabbits, and cattle (cows and buffaloes) from

Table 2. Major vegetations recorded from various IFS components in Mima village

List of crop varieties	Scientific names	Family
Potato	*Solanum tuberosum*	Solanaceae
Rice	*Oryza sativa*	Poaceae
Maize	*Zea mays*	Poaceae
Ginger	*Zingiber officinale*	Zingiberaceae
Garlic	*Allium sativum*	Amaryllidaceae
Job's tear	*Coix lacryma-jobi*	Poaceae
Peas	*Pisum sativum*	Leguminosae
Common bean	*Phaseolus vulgaris*	Leguminosae
Chayote	*Sechium edule*	Cucurbitaceae
Perilla	*Perilla frutescens*	Lamiaceae
Egg plant	*Solanum melongena*	Solanaceae
Mustard	*Brassica nigra*	Brassicaceae
Chilli	*Capsicum frutescens*	Solanaceae
Taro	*Colocasia esculenta*	Colocasia
Guava	*Psidium guajava*	Myrtaceae
Pumpkin	*Cucurbita*	Cucurbitaceae
Bottle gourds	*Lagenaria siceraria*	Cucurbitaceae
Wild cherry	*Prunus avium*	Rosaceae
Jamun	*Syzygium cumini*	Myrtaceae
Banana	*Musa*	Musaceae
Alder trees	*Alnus nepalensis*	Betulaceae
Oak trees	*Quercus serrata*	Fagaceae

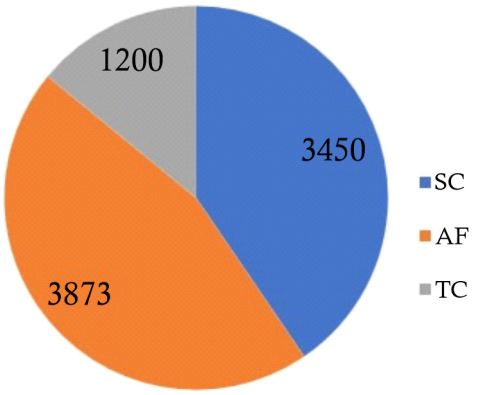

Fig. 1. Annual fodder production (kg) from SC-Shifting cultivation, AF-Agroforestry, Terrace Cultivation (TC)

various sources (Figure 1). The last feed was recorded from terrace cultivation (TC) because paddy crops are majorly cultivated in TC. Even though vegetables and fruit trees were intercropped, they were in lesser quantity because of space constraints. Some of the vegetation used as livestock feeds in Mima were taro leaves (*Colocasia esculenta*), pumpkins (*Cucurbita)*, maize (*Zea mays)*, chayote leaves (*Sechium edule)*, bottle gourds (*Lagenaria siceraria)* and some wild leaves, etc. Wet paddy integrated with fish cultures has also been recorded in Mima. No specific fish feeds were recorded, as they naturally feed on the available phytoplankton and zooplankton. However, wheat barns were occasionally introduced as fish feeds. Besides providing food, integrating paddy-and-fish culture could also increase nutrient and water management.

Implication and Recommendation

i) The current study highlights the importance of introducing IFS components for better yield and enhanced financial assistance. However, it has to be recognized at a mass scale for its implications to be well understood and adapted widely among rural farming communities.

ii) It is also observed that shifting cultivation is a cultural and traditional food production in Mima, and they still rely on this form of cultivation. Therefore, transformed cultivation practices incorporating IFS techniques could allow the local communities to stay connected to their roots, enhance their yield and efficiency by providing optimum financial assistance.

iii) Mima village is known for its unique bee-keeping practice. However, besides the raw organic produce, it could be channeled into various Value-Added Products (VAP), paving the way for additional on-farm employment opportunities.

CONCLUSION

The incorporation of localized IFS components could prove to be an asset for the poor, small, and marginal farmers of Mima, and similarly for other villages in Nagaland by enhancing the yield, encouraging crop diversification techniques, sustaining their production system through the integration of various agricultural enterprises (such as cropping systems, livestock, aquaculture, agroforestry, agri-horticulture, apiary) and enhancing economic viability, nutritional security, improving productivity and ecological sustainability by reducing the environmental footprint. IFS could also reduce the pressure of depending on a single land use system through judicious and efficient utilization of farmlands.

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