

## **Agri-Horti-livestock based Integrated Farming System for higher farm profitability of tribal Mizo farmers.**

The traditional rainfed slash and burn (*jhum*) farming systems are predominantly practiced in subsistence with limited profitability for household consumption of the tribal Mizo farming communities. The mixed cropping practiced in *jhum* agriculture during mid-April - October is often constrained by limited crop intensification with high value crops and income diversification. Small and fragmented land holding, poor investment capacity, lack of adequate knowledge and adaptation of modern improved agricultural practices further concentrate the problems of reduced crop productivity and low farm profitability in Mizoram. Vital livestock component (mostly, pig farming) significantly contributes to daily rural Mizo livelihood, due to high productivity and local demand for pork and pig manure. Establishment fruit orchards (dragon fruit, banana) are profitable alternatives for secondary *jhum* fallow management. Protected flower cultivation like anthurium (*Anthurium andraeanum*) also ensured high profitability to the farmers having good market linkages, irrespective of their regular exposure of climate change driven seasonal weather anomalies. The compatible integration of horticultural crops (fruit and floricultural crops) and livestock (pig farming) component is highly preferred for their high economic value and export potential towards boosting farmers' incomes in Mizoram. Such combinations also allow efficient resource optimization, as livestock waste can be used as organic manure for nutrient supplementation, improve soil fertility and enhance crop productivity. Conversely, horticultural residues can serve as pig feed and reduce net farm waste disposal. Such synergy enhances crop productivity, diversifies farm income, and promotes environmental sustainability; while ensure food security and income resilience to Mizo farm families. Moreover, Integrated Farming Systems enhance employment generation and support sustainable agricultural practices against the traditional shifting cultivation practice in Mizoram.

In 2018-19, Mrs. F. Lalhuanawmi from Hmarveng, Kolasib district undertook flower cultivation in five poly-house structure constructed over 150 m<sup>2</sup> area (24°14'11.1"N, 92°40'24.8"E & 725 m. a.m.s.l.) and water harvesting pond lined with LDPE (6 m × 5.5 m × 1.5 m) constructed under the technology demonstration component of Tribal Sub Plan, implemented by ICAR NEH Mizoram Centre. The poly-house roof frame was covered with a 200-micron UV-protected LDPE sheet, and the sides boundaries were fitted with 75% shade net. In addition, supportive technology demonstration on other Integrated Farming System

components viz. scientific dragon fruit cultivation (260 no. of poles; 4 seedlings/ pole, 200 banana suckers and 400 arecanut seedlings over 0.88 ha area), piglet rearing (3 sows and 2 boars) along with regular monitoring of animal health and daily feed-schedule was carried out. Collected pig dung from the pig sheds were well decomposed (aerobic composting, followed by vermicomposting) and applied as manure to grow subsequent crops. Intercropping of maize (sweet corn) + pumpkin, maize (sweet corn) + cucumber and maize (sweet corn) + cowpea, seasonal vegetables and pulses was cultivated over total 0.75 ha area, with necessary nutrient management and plant protection measures over past five years.

**Table 1:** Component details and production economics of IFS (Farmer: Mrs. F. Lalchhuanawmi at Hmarveng, Kolasib district)

Particulars	Before	After
Crops (agriculture and horticulture):	<p><b>Mix crops:</b>  <i>Pre-kharif</i> and <i>kharif</i> (Local land races): maize, pumpkin, ricebean, cucumber, snake gourd, brinjal and chilli.</p> <p>Post <i>Kharif</i> and <i>rabi</i>: frenchbean, cabbage, broccoli, pumpkin and chilli</p> <p>Anthurium cultivation in 1 unit (10 m x5 m) in poly house</p> <p>20 dragon fruit pole</p>	<p><i>Pre-kharif</i> and <i>kharif</i>:  <b>Intercropping:</b>            Maize (sweet corn)+pumpkin            Maize (sweet corn )+cucumber            Maize (sweet corn)+cowpea</p> <p><b>Vertical cropping:</b>            Bitter gourd, snake gourd and chow chow</p> <p><b>Normal cultivation:</b> Chilli, brinjal, ricebean and mustard</p> <p>Post <i>Kharif</i> and <i>rabi</i>:            Maize (Sweet corn)+pumpkin  <b>Normal cultivation:</b> frenchbean, cabbage, broccoli, pumpkin and chilli</p> <p>Anthurium cultivation in 3 unit (10m x8 m) with 75% shade net</p> <p>260 dragon fruit pole            200 banana plant            Arecanut 400 plants            2 sow + 1 boar</p>
Cash crop		
Livestock		
Area (ha)	0.5 ha.	1.8 ha
Productivity (t ha <sup>-1</sup> )	<p><b>Mix crops:</b>  <i>Pre-kharif</i> and <i>kharif</i>:            Maize- 2.7,            pumpkin- 4.8,            ricebean- 1.9,</p>	<p><i>Pre-kharif</i> and <i>kharif</i>:  <b>Intercropping:</b>            Maize (Sweet corn)- 6.5, Pumpkin: 5.8, Cucumber: 4.7 and Cowpea (green pod): 4.3</p>

	cucumber- 4.2, snake gourd- 3.8, brinjal- 2.5 chilli- 2.2	<b>Vertical cropping:</b> Bitter gourd- 6.4, snake gourd-5.1 and chow chow- 6.8
		<b>Normal cultivation:</b> Chilli-5.7, brinjal-6.8, ricebean-2.4 and mustard-5.6
	Post <i>Kharif</i> and <i>rabi</i> : Frenchbean- 6.8, cabbage- 6.1, broccoli- 5.8, pumpkin- 6.8 and chilli- 3.5.	Post <i>Kharif</i> and <i>rabi</i> : Maize (Sweet corn)-5.8 and Pumpkin-6.4
		<b>Normal cultivation:</b> frenchbean- 6.2, cabbage-7.8, broccoli-5.9, pumpkin- 5.8 and chilli-5.1
	6.8 flower per plant per year	10-11 flower per plant per year with large spathe.
Fruits yield(t ha <sup>-1</sup> ):		
• Dragon fruit	5.8	8.9
• Banana		9.5
Cash crop		6.9
Livestock		43 piglet and 5 pigs (After 4 years)
Maize Equivalent Yield (MEY) t ha <sup>-1</sup>	15.261	62.825
Productivity enhancement (%)		411.66
Cropping intensity%,	14.28	51.42
CLUI%	47.2%	89.5%
Crop diversification index	4.2	10.4
Cost of production (Rs.)	Rs. 80,415	Rs. 1,84,118
Gross income (Rs.)	Rs. 1,90,750	Rs. 7,22,750
Net income (Rs.)	Rs. 1,10,335	Rs. 5,38,632
B: C ratio	1.37	2.92
Income enhancement %	-	488.17%
Employment enhancement %	-	388.17

**Impact:** The Agri-horticulture-livestock (piggery) based Integrated Farming System (IFS) became one of the most profitable options to adapt among the tested IFS models in Mizoram. The established Integrated farming System (IFS) of Mrs. F. Lalchhuanawmi was an alternative of traditional slash and burn cultivation that relies on feed cost reduction through utilization of horticultural waste product and utilizing well-decomposed pig manure as alternative of external inorganic fertilizer application with accounted resource saving of ~56.01%. The floricultural component like Anthurium cultivation venture generated gross income of Rs. 1,72,380, involving Rs. 45,180 as cost of cultivation with net income of Rs. 1,27,200. The investment and outcome ratio of Anthurium cultivation was 1:2.82, with 53.14% reduction in external input like fertilizer application. Mrs. F. Lalchhuanawmi

successfully developed supportive market linkages with Aizawl vendors for selling *Anthurium* stem cuttings on regular basis. Fruit crops secured gross income of Rs. 2,24,000 from Rs. 44,278 initial investment that lead to net income of Rs. 1,79,722. The reduction in external input (pig manure) by 57.47% assured an impressive investment and outcome ratio of 1:4.06. The net income from seasonal agricultural crop cultivation was comparatively lower (Rs. 48,200) with investment and outcome ratio of 1:1.87 from ~65.19% reduction in external resource usage (aerobic composting and vermicomposting of pig manure). Animal husbandry i.e. pig farming secured the net profit of Rs. 1,83,510 from the augmented highest component wise gross income of Rs. 2,52,370, with investment and outcome ratio ~1:2.66.

Before 2018-19, the system yield was expressed in terms of Maize Equivalent Yield (MEY) ~15.261 t/ha, gained from her 0.5 ha cultivation area with initial net cropping intensity of 14.28%, CLUI of 47.2%, and crop diversification index ~ 4.2. Her gross income of Rs. 1,90,750 affixed B:C ratio of 1.37 with annual net income of Rs. 1,10,335. Over past 5 years, her net cultivation area was gradually expanded to 1.8 ha (~3 times). The MEY increases dramatically to 62.825 t/ha with enhanced cropping intensity 51.42%, CLUI ~89.5%, and crop diversification index ~10.4. Her net annual income rose to Rs. 5,38,632 with B:C ratio of 2.92. The net return from the Agri-horti-livestock (piggery)- based Integrated Farming System (IFS) models was remarkably higher against the traditional slash-burn culture. The TSP demonstrated IFS minimized soil loss, enhanced farm waste recycling, reduced farm input use, improved soil health and ensured year-round food availability for her family; thus generated sustainable farm income through entrepreneurship development. She engaged rural youth from her neighbouring region and generated employment for ~1417 man days/ year. In 2023, she is leading Kolasib Agro Marketing Co-Operative (KAMCO); 30 members) to engage more rural women in post-harvest processing of her excess dragon fruit produce under the Fostering Climate Resilient Upland Farming System in the North East (FOCUS) project. At present, she successfully introduced commercial scale dragon fruit juice making and wine preparation in Kolasib market and developed supportive market linkages at Aizawl.

