



## Comparative study on conventional and improved integrated farming systems for sustainable production, income generation and employment opportunity among the tribal farmers in hilly Regions of Manipur

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### ABSTRACT

Farming system integrates livestock farming and agriculture. It has revolutionized conventional farming of livestock, the practice of cultivating the land and raising stock and the aquaculture, horticulture, agro-industry and allied production activities. It is playing a pivotal role in maintaining the sustainability and increases the productivity as well as provides employment for better livelihood. The present survey was carried out in Chandel, Churachandpur and Ukhrul hill districts of Manipur during 2012-13. A total of 70 farmers/district, with a cluster of thirty five farmers for improved integrated farming systems (IIFS) and thirty five for conventional farming system (CFS) were surveyed for this study. The average holding of each farmer was 0.64 ha in Chandel, 0.65 ha in Churachandpur and 0.87 ha in Ukhrul. Seven components, i.e. paddy, vegetables, fruits, piggery, backyard poultry, fishery and water management were studied. Among hill districts, Ukhrul had higher production of all enterprises. The results revealed that the performance of all components is better in IIFS than CFS. The average productivity of different enterprises was significantly higher in IIFS as compared to the CFS. The IIFS also gave higher net returns and benefit cost ratio to the farmers as compared to traditional farming. In farming system most of the activities were done by women, therefore they were employed more than men. The overall result revealed that the improved practice with different crop and animal components is an excellent approach for sustainable production, income generation and employment opportunity of the small and marginal rural households of Manipur.

**Key words:** Conventional farming system, Economics, Employment generation, Farm productivity, Improved integrated farming system.

The size of the cultivated area is about 7.41% of the total geographical area of the Manipur. The agricultural operations are carried out up to an elevation of 3000 m above MSL on slopes up to 60% gradient. The agricultural production system in the region is mostly rainfed, monocropped and at subsistence type. Problems of high rainfall (12.1 % of country's total precipitation), soil acidity, aluminium toxicity in upland and iron toxicity in valley land have added to the problem of low agricultural productivity in the region. The soils of the region are usually

rich in organic matter and acidic to strongly acidic (pH 4.5-5.0) in reaction. Most of the hill soils are shallow in depth except in valleys and plateaus.

Farming system approach requires involvement of agriculture, horticulture, soil conservation, forestry, fisheries, animal husbandry (piggery and poultry), apiculture, etc. Integrated farming system takes into account the concepts of minimizing risk, increasing production and profits whilst improving the utilization of organic wastes and crop residues (Radhamani *et al.* 2003). It is clear from the above that IFS is characterized by synergy and between crop and animal components that form the basis of the concept (Jitsanguan 2001 and Radhamani *et al.* 2003). The agricultural production of the state has not been able to keep pace with population growth which is 14.75% per decade. The shortage in agricultural production is due to conventional farming and non-adoption of recommended technologies in improved farming systems. Therefore, we have conducted a comparative study of conventional and improved farming practices among

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the tribal farmers in hilly Regions of Chandel (Chandel Khulen), Churachandpur (Vazing village) and Ukhrul (Ramva village) districts of Manipur. These are the tribal districts of the state.

### MATERIALS AND METHODS

Manipur lies between 92°58'E to 94°45'E longitude and 23°50'N to 25°42'N latitude. Altitude varies from 750 to 3114 m above mean sea level draining from North to South. Out of total geographical area of 22, 327 sq km, 90% area is under hill tract and rest is valley. Manipur falls under the monsoon belt of India. Period from June to September is the monsoon season with an average annual rainfall of 1450-2000 mm. Due to varied level of altitude and slopes the climate of Manipur varies from subtropical to semi-temperate (prevailing at higher altitudes). The winter season (November to February) is characterized by low temperature, heavy dew fall and occurrence of frost. The temperature varies from 0 °C in winter to 36 °C in summer months. The soil type ranges from heavy (valley region) to light (hill slopes) in texture. The study was conducted in the Chandel (Chandel Khulen and nearby village), Churachandpur (Vazing village nearby village) and Ukhrul (Ramva village nearby village) hill districts of Manipur during 2012–13. A total of 70 farmers/districts, with a cluster of thirty five farmers for improved farming systems (IIFS) and thirty five for conventional farming system (CFS) were surveyed for this study. The average holding of each farmer was 0.64 ha in Chandel (Chandel Khulen), 0.65 ha in Churachandpur (Vazing village) and 0.87 ha in Ukhrul (Ramva village) (Fig 1). Seven components, i.e. paddy, vegetables, fruits, piggery, backyard poultry, fishery and water management were studied for comparisons based on the criteria as mentioned in Table 1. During the study period, the multi disciplinary scientific personnel from ICAR Manipur Centre have visited the farmers' household on pre-scheduled time and collected necessary information from interviews using structured questionnaires. The interviews were conducted individually as well as in groups. However, while interviewing in the groups, participant observation method was also employed to observe the farmers' perceptions and recording knowledge on profitability of different farming systems. Several visits in the rural areas were conducted to collect the information and verification of these practices. The data on cost of different inputs and return from outputs for different systems (CFS and IIFS) were also recorded for each farmer. The data collected were analyzed through the use of descriptive statistics using means and standard error for explaining the outcomes of findings.

### RESULTS AND DISCUSSION

#### *Paddy production*

Rice is the staple food for more than 90% population of Manipur and is the major component of all the farming

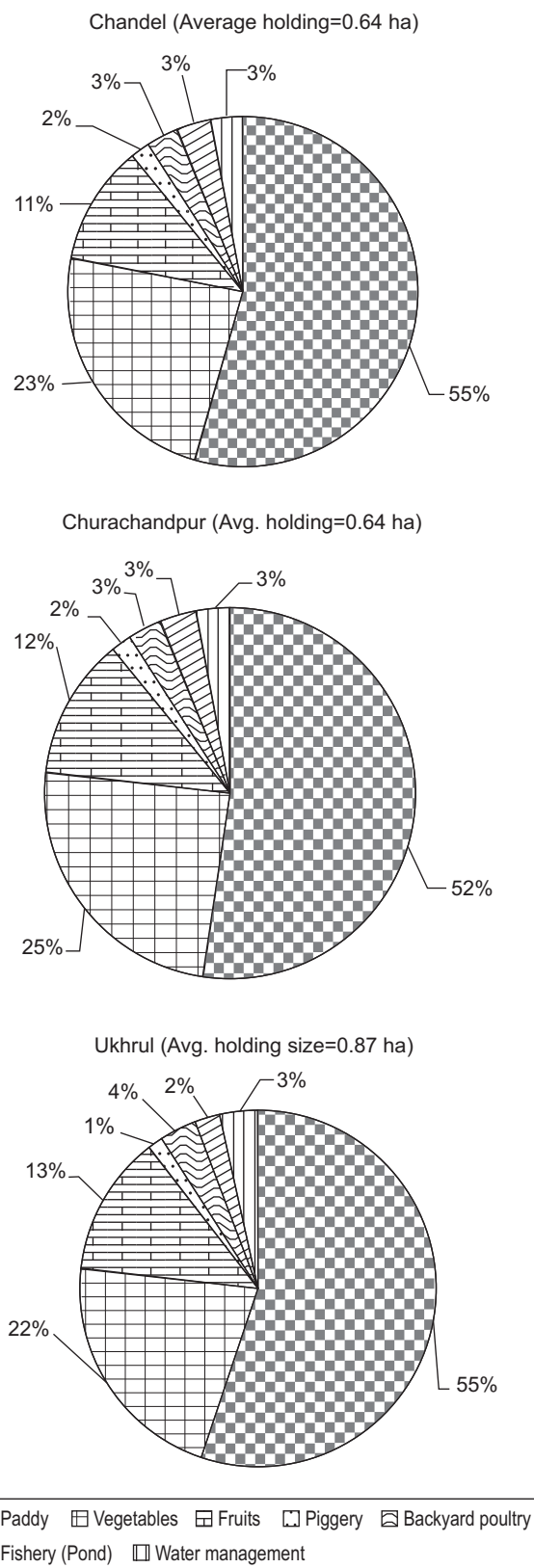


Fig 1 Area under different components in integrated farming system in Chandel, Churachandpur and Ukhrul (The average holding size of farm was 0.64, 0.65 and 0.87 ha)

Table 1 Price of different enterprises and average labour requirement

Particulars	Price (₹)	Enterprises	Labour engaged (days)	
			CFS	IIFS
<i>Main Product</i>				
Paddy	10/kg	Paddy	20	30
Vegetables	10/kg	Vegetables	18	25
Fruits	20/kg	Fruits	15	23
Pork	200/kg	Piggery	50	70
Piglets	2000/piglets	Poultry	70	90
Chicken	100/kg	Fishery	30	39
Egg	8/egg	Water management	8	22
Fish	100/kg	Total	211	299
Water	10 paise/liter			
<i>By product</i>				
Paddy straw	1/kg			
Poultry manure	6/kg			
Pig manure	6/kg			

system of Manipur. Among the hill districts surveyed, Ukhru has recorded highest paddy production. The production of paddy in CFS was recorded much less in the present study as compared to rice grown under IIFS. On an average, 5 087.1 kg per hectare rice yield was observed under IIFS as compared to 3 000.15 kg in conventional farming system (Fig 1A). Rice grown under IIFS produced 69.5% more yield as compared to CFS. The lower yield of rice under CFS was mainly due to use of poor quality seeds, that they are procuring from neighbouring farmers and use of conventional methods in rice cultivation with very poor nutrient and weed management. Farmers who practice improved farming with certified seeds of improved varieties and scientific practices like system of rice intensification (SRI) with proper nutrient and weed management recorded higher rice yield. Our results are close agreement with Yadav *et al.* (2013), they also studied at Tripura on CFS and IIFS and they found that SRI is the one of the best techniques for paddy cultivation, which significantly increased the paddy yield as compared to conventional system.

#### Vegetable production

Vegetables are mostly grown for household consumption

Table 2 Criteria followed for the selection of the farming systems

Components	Criteria	CFS	IIFS
Paddy cultivation	a. Variety	a. Local or improved cultivars	a. Improved varieties
	b. Seed quality	b. Old cultivars	b. Good in quality
	c. Techniques	c. Conventional package and practices	c. Improved package and practices (Some SRI and ICM)
	d. Weed management	d. Hand weeding	d. Cono/rotatory weeder
Vegetable cultivation	a. Cultivars	a. Local cultivars	a. Improved cultivars
	b. Seed	b. Uncertified seed	b. Certified seed
	c. Method of cultivation	c. Conventional methods	c. Improved methods
	d. Manure & fertilizers	d. Less than recommended dose	d. Balance nutrition
Fruits cultivation	a. Parental stock	a. Old and less production	a. Improved and more production
	b. Training and pruning	b. Not timely and regularly	b. Timely and regularly
	c. Fertilization	c. Below recommended dose	c. Optimum dose
	d. Irrigation	d. Not properly	d. Proper at certain interval
Piggery	a. Breed	a. Local	a. Cross breed and improved
	b. Feed	b. Based on house hold wastage	b. Quality feed
	c. Health management	c. Rarely	c. Proper deworming and vaccination
Backyard poultry	a. Breed	a. Local	a. Improved birds
	b. Feed	b. Scavenging	b. Quality and concentrated feed
	c. Health management	c. Rarely	c. Proper vaccination
Fishery	a. Fingerlings	a. Local	a. Improved
	b. Pond liming	b. Rarely	b. Proper at certain interval
	c. Stocking density	c. Below stocking density	c. Optimum stocking density
	d. Feed	d. Natural feed	d. Natural + Concentrated
	e. Fertilization	e. Raw cow dung	e. Fertilization with well rotted organic and inorganic fertilizers
Water management	a. Water harvesting unit	a. Lacking	a. Jalkund/Farm pond

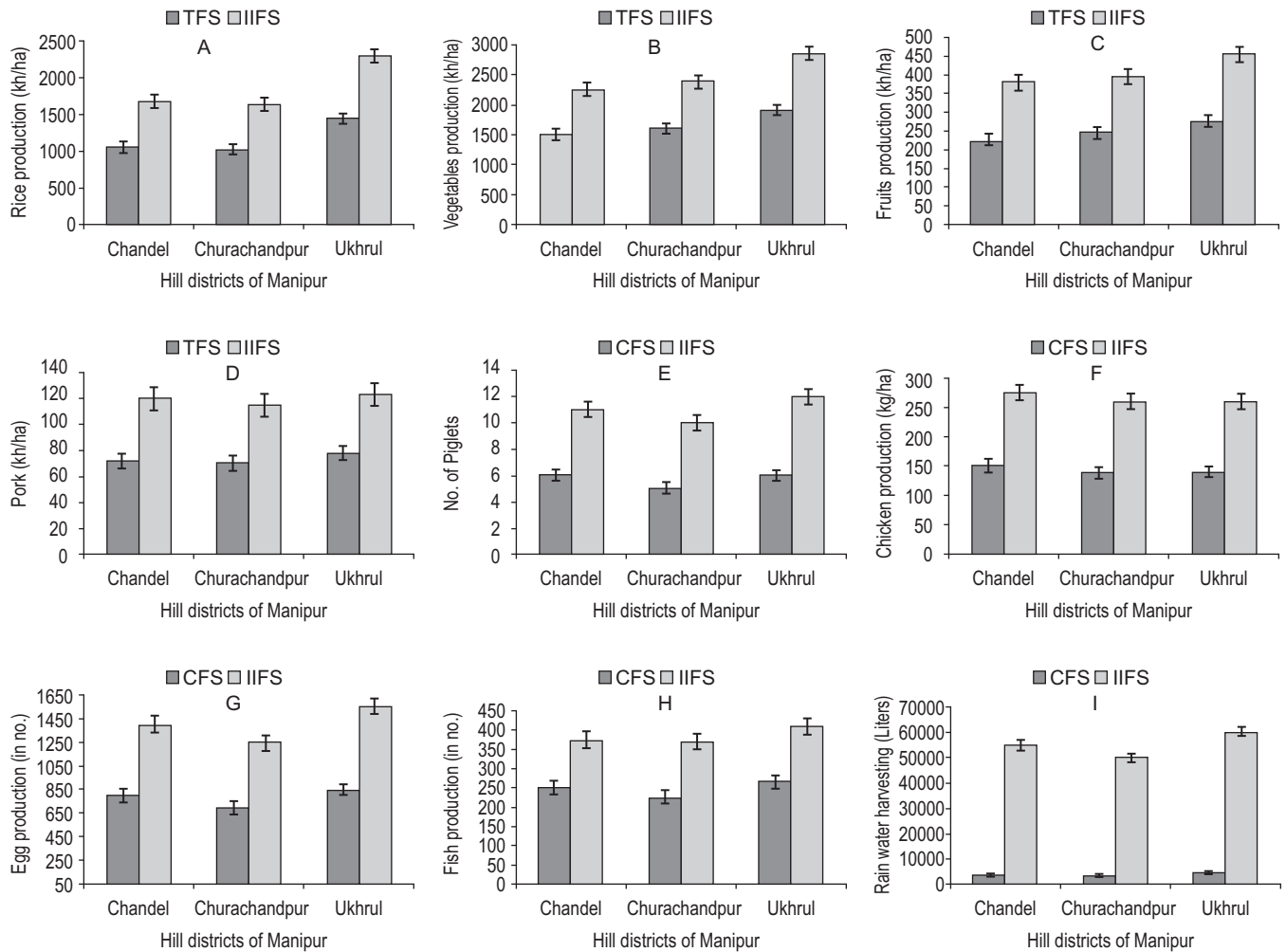


Fig 2 Production of paddy (A), vegetables (B) fruit (C) pork (D), piglets (E), chicken (F), Egg (G) fish (H) and rain water harvesting (I) in Chandel, Churachandpur and Ukhrul under CFS and IIFS. Standard error bars represent the standard error value and significant level at  $P=0.05$ .

Table 3 Crop varieties and animal breeds under different enterprises

Components	CFS	IIFS
Paddy cultivation	Drumphou, Priya, Jatra, Ayangleima	RCM 5, RCM 9, RCM 10 and other improved cultivars
Vegetable cultivation	Local varieties	Cabbage: Rareball, Wonderball, Green hero Cauliflower: Early Hemlata, White flush, Shweta Broccoli: Green magic, Aishwarya, Puspa Tomato: Nidhi, Swaraksha, Avinash-2 etc. Okra: Arka anamika, Prabhani Kranti, Pusa Sawni
Fruits cultivation	Local cultivars	Banana: Grand nine, Jaint Cavendis, Robusta Orange: Khasi mandarin Kachai lemon Passion fruit: Kaveri Pineapple: Kew, Queen Papaya: Taiwan, Ranchi, Coorg Honey Dew
Piggery	Local Breed	Cross breeds
Backyard poultry	Local birds	Gramapriya, Vanraja, Improved
Fishery	Catla, rohu	Catla, rohu, mrigal, grass carp, common carp etc
Water management	Lacking	Construction of Jalkund/Farm pond

Table 4 Variable costs of different component of farming systems at Chandel, Churachandpur and Ukhrul under CFS and IIFS

Components	Variable cost (₹)					
	Chandel		Churachandpur		Ukhrul	
	CFS	IIFS	CFS	IIFS	CFS	IIFS
Paddy cultivation	4 442.5±86.9	6 152.5±81.8	4 310.3±124.2	6 052.2±105.6	6 020.7±172.2	8 454.0±141.7
Vegetable cultivation	2 642.5±57.8	3 520.8±61.4	2 811.3±118.5	3 608.3±108.3	3 331.2±127.5	4 500.8±112.7
Fruits cultivation	1 501.7±30.3	2 241.7±79.5	1 543.5±57.0	2 315.0±98.3	1 543.3±106.5	2 315.0±114.3
Piggery	11 233.3±274.4	15 251.5±143.0	11 383.3±563.0	14 981.7±561.5	11 483.3±563.0	15 666.7±726.5
Backyard poultry	3 393.3±109.7	6 366.7±88.2	3 323.3±110.5	6 283.3±101.4	3 451.7±133.3	6 450.0±144.3
Fishery	3 983.3±274.4	7 016.7±274.4	3 643.3±127.1	6 420.0±75.7	4 116.7±116.7	7 146.7±163.3
Water management	150.0±5.8	2 000. ±80.9	150.0±5.8	2 000.3±1000.3	199.3±13.9	2 100.3±118.0

Table 5 Gross returns of different component of farming systems at Chandel, Churachandpur and Ukhrul under CFS and IIFS

Components	Gross returns (₹)					
	Chandel		Churachandpur		Ukhrul	
	CFS	IIFS	CFS	IIFS	CFS	IIFS
Paddy cultivation	10,466.7±260.3	16,666.7±296.3	10,233.3±202.8	16,213.3±225.8	14,400.0±577.4	23,070.0±915.2
Vegetable cultivation	15,200.0±544.0	22,533.7±606.9	16,033.7±289.3	23,883.1±709.3	19,033.3±448.1	28,516.3±591.7
Fruits cultivation	4,550.0±217.9	7,533.3±233.3	4,900.0±144.3	7,933.3±260.3	5,500.0±230.9	9,076.7±159.2
Piggery	26,366.7±721.9	46,033.3±1,414.6	24,133.3±638.6	43,080.0±1,109.2	27,466.7±868.6	48,393.3±1,130.6
Backyard poultry	18,966.7±837.3	38,400.0±1,078.6	19,650.0±361.7	36,100.0±1,126.9	20,733.3±520.7	38,306.7±1,190.2
Fishery	24,900.0±838.7	37,433.3±1,097.5	22,400.0±608.3	37,033.3±1,183.7	26,366.7±696.0	41,133.3±638.6
Water management	350.0±6.90	5,500.7±155.2	320.0±5.01	5,000.0±181.5	450.0±8.3	6,000.3±274.4

in kitchen gardening and also for commercial cultivation for selling in local market at remunerative price. In Manipur, farmers are growing mainly leafy, root, cruciferous, cucurbits and egg plants at commercial scale. High value vegetables like broccoli, brussels, carrot are also being grown by some farmers. Among the surveyed districts, Ukhrul had higher vegetables productivity followed by Chandel and Ukhrul. In the present study, on an average the production of vegetables in IIFS was 50% higher over CFS (Fig 1B). The higher vegetable production in improved farming system might be due to use of quality seeds and better management practices followed by the farmers. The increase in yield of vegetables with improved practices could be attributed to improved vegetative growth, better availability of nutrients at vital growth period and greater synthesis of carbohydrates and their translocation to the storage organs (Yadav *et al.* 2013). The observations of the present study are in line with the findings of Brahma *et al.* 2010 and Patel and Rajput 2003.

#### Fruit production

The horticultural crops are grown as integral enterprise of farming system from kitchen gardening to commercial scale. In Manipur, mainly banana, orange (khasi mandarin),

kachaai lemon, passion fruits, pineapple and papaya as being grown. In kitchen gardening (farming system at small scale) fruits production is enough to supply the household requirements. In the present study, Ukhrul has been better performing district in terms of fruit production as compared to other hill districts. In the present study, Ukhrul was better performing district in terms of fruit production as compared to other hill districts. On an average, the production of fruit in IIFS was found to be 65% higher as compared to production recorded under CFS (Fig 1C). The higher fruit production in improved integrated farming system might be due to use of quality and disease free planting materials and better management practices followed by the farmers. The increase in fruit yield with improved practices could be attributed to improved vegetative growth, better availability of nutrients at vital growth period and greater synthesis of carbohydrates and their translocation to the storage organs (Yadav *et al.* 2013). Ghosh (2008) also recorded better fruit crops production under improved practices.

#### Pig rearing and pork production

Pig farming is one of the choicest enterprises in farming system, where pork is the most preferred meat among tribal farmers. Scientific piggery is a profitable venture because of

superior feed conversion ratio, faster growth rate, short generation interval and high proliferation in pigs (Yadav *et al.* 2013). The indigenous breed of pigs in Manipur is smaller in size with poor feed conversion abilities and average adult body weight is about 45 kg and litter size is 3.5 to 5. The up-gradation of local pigs through cross breeding with the exotic pigs (Hampshire) has given a new dimension to the piggery. The improved breeds are healthy and their body weight is more than the indigenous pigs. In the present study, approximately 63% more weight was found in cross breeds as compared to local breeds (Fig 1D & E). Lekule and Kyvsgaard (2003) also reported poor feed conversion, high mortality rates, low productive rates and poor final products in pigs in conventional method of farming.

#### Backyard poultry

Poultry is playing an important role for human nutrition, family income, employment and income generation in homestead. Breed, strain, reproductive efficiency, and proper management system with regard to housing, balanced feeding, proper nursing, vaccination etc are the major factors in the profitability of poultry farming (Yadav *et al.* 2013). Poultry farming is the second most important enterprise after piggery in Manipur under farming system. It is more popular in both

hills and valley areas. Almost all households have backyard poultry. Grampriya and Vanraja are being reared by the farmers in Manipur. In the present study, 85 and 79% more meat and egg production was recorded under IIFS as compared to CFS (Fig 1F & G). These findings are in line with those of Ershad (2005).

#### Fish production

Fisheries play an important role in the economy of North East, as fish constitutes one of the vital items in the diet of 95% of its population (Dey and Ghoshal 2011). They are fond of fishes, and cooked for consumption in raw as well as dry form. In the present study, after vegetable production, fishery is the second most profitable enterprise in terms of higher net returns and benefit cost ratio (Table 6 and 7). On an average, the fish production under IIFS was approximately 57% higher than CFS (Fig 1H). Our results are in accordance with Yadav *et al.* (2013). Additional production of fish in IIFS might be due to the adoption of scientific fish culture practices. Probably the cumulative effect of maintaining proper ratios of fingerlings with area and different layers of water bodies and uniform feed supply accelerated better fish growth, resulting in increased fish production.

Table 6 Net returns of different component of farming systems at Chandel, Churachandpur and Ukhrul under CFS and IIFS

Components	Net returns (₹)					
	Chandel		Churachandpur		Ukhrul	
	CFS	IIFS	CFS	IIFS	CFS	IIFS
Paddy cultivation	6 024.2±347.3	10 514.2±214.8	5 923.0±326.4	10 161.2±331.3	8 379.3±407.8	14 616.0±774.0
Vegetable cultivation	12 557.5±576.7	19 012.9±635.3	13 222.0±348.8	20 274.8±687.2	15 701.3±376.4	24 075.5±648.3
Fruits cultivation	3 048.3±187.8	5 291.7±154.3	3 356.5±200.8	5 618.3±162.1	3 956.7±335.7	6 761.7±46.9
Piggery	15 133.3±996.0	30 781.8±1,271.6	12 750.0±104.1	28 098.3±1,670.7	15 983.3±308.7	32 726.7±1,856.9
Backyard poultry	15 573.3±727.6	32 033.3±990.5	16 326.7±472.1	29 816.7±1,026.5	17 281.7±652.8	1 046.1
Fishery	20 916.7±1,112.2	30 416.7±1,371.8	18 756.7±481.5	30 613.3±1,258.6	22 250.0±579.5	33 986.7±797.9
Water management	200.0±15.8	3 500.0±216.7	170.0±15.8	3 000.3±181.9	250.7±116.3	3 900.0±250.0

Table 7 Benefit cost ratio (BCR) of different component of farming systems at Chandel, Churachandpur and Ukhrul under CFS and IIFS

Components	B : C ratio (₹)					
	Chandel		Churachandpur		Ukhrul	
	CFS	IIFS	CFS	IIFS	CFS	IIFS
Paddy cultivation	2.4±0.1	2.7±0.1	2.4±0.1	2.7±0.1	2.4±0.1	2.7±0.1
Vegetable cultivation	5.75±0.3	6.40±0.3	5.70±0.3	6.62±0.2	5.73±0.1	6.33±0.3
Fruits cultivation	3.0±0.1	3.4±0.1	3.2±0.2	3.4±0.1	3.6±0.4	3.9±0.1
Piggery	2.3±0.1	3.0±0.1	2.1±0.1	2.9±0.2	2.4±0.1	3.1±0.2
Backyard poultry	5.6±0.1	6.0±0.1	5.9±0.3	5.7±0.1	6.0±0.4	5.9±0.1
Fishery	6.4±0.6	5.4±0.4	6.2±0.1	5.8±0.3	6.4±0.1	5.8±0.2
Water management	2.33±0.1	2.75±0.1	2.13±0.1	2.5±0.1	2.26±0.2	2.87±0.1

**Water management**

The major water source for cultivating agricultural crops in Manipur is rain water. The rainfall of Manipur varies from 1400 to 2000 mm. In *kharif* season, rainwater is sufficient for agricultural crops. But, in *rabi* season, rainfall is scanty. The farmers having farm pond, jalkund etc. on their farm can give life saving irrigation for various vegetables and pulses. Present study shows that approximately 3 000 to 5 000 liters of rainwater was conserved as compared to 55 000 liters in IIFS. There is 1200% more water conservation under IIFS than CFS in Jalkund, farm pond etc.

**Economics**

Profitability in terms of economic returns of any farming system is the integral component for its adoption by farmers. The current study indicates higher variable cost, gross returns,

net returns and benefit cost (B:C) ratio in all the components of IIFS as compared to CFS. Among the districts, Ukhru has better adoption of farming system either CFS or IIFS than other two hill districts of Manipur. The higher variable cost in all the components of IIFS was mainly due to use of quality seed material of improved varieties/breeds, optimum fertilization, proper weed management and pest management with better package and practices. The higher gross returns, net returns and B: C ratios were due to more production of economic products in respective components of IIFS as compared to CFS. The lower cost of production, gross returns, net returns and B:C ratios in CFS might be due to use of poor quality seed material of local varieties/breeds with very poor management practices just for subsistence farming for sustaining the family livelihood. Among the components, vegetable production showed higher variable cost and higher

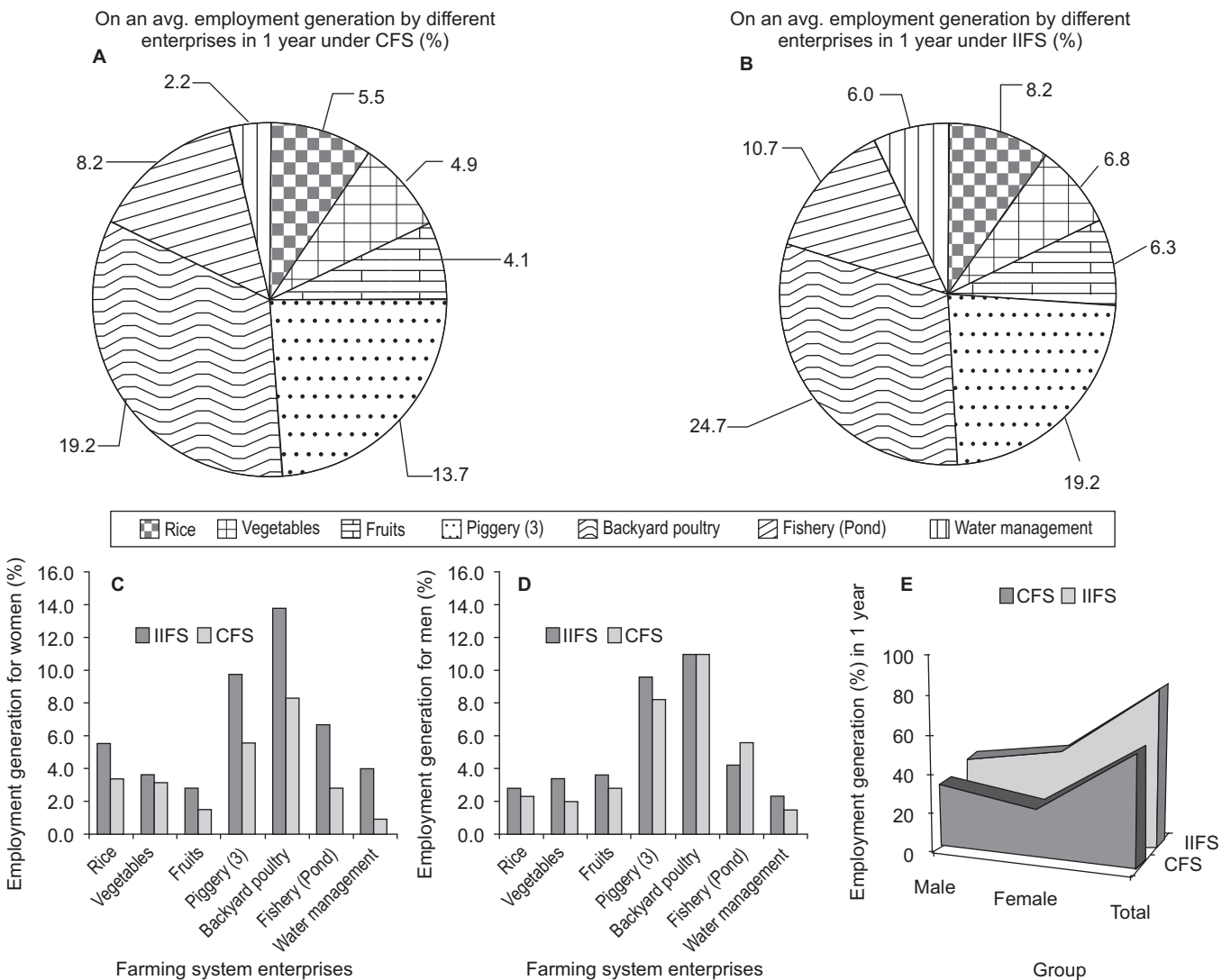


Fig 3 Employment generation under CFS (A), employment generation (B) employment generation for women (C), employment generation for men (D) and total employment generation based on group(E) under CFS and IIFS.

gross and net returns, followed by backyard poultry, fishery and piggery in both the farming systems (Table 4, 5, 6 and 7). Overall, the IIFS showed more expenditure towards variable cost and higher gross and net returns when compared to CFS. The net return is the main parameter for deciding the adoptability of a farming system. The present study showed that the IIFS is more profitable and sustainable as compared to farmer's conventional farming system. Similar results were also reported by Kumar *et al.* (2011), Alam *et al.* (2009) and Yadav *et al.* (2013).

#### Employment generation

A special feature of farming system is value addition due to employment of family members and non-farming families. One marginal farmer absorb 593 person days, out of which family labour absorption was 470 person days (MSSRF 2009). On an average 299 man days were utilised under IIFS as compared to 211 man days under CFS. Moreover, women participation was more (45.5% in IIFS, 24.9% in CFS) as compared to men (36% in IIFS, 33% in CFS). Backyard poultry followed by pig rearing were the top most enterprises for engaging the household men and women for longer duration. Thus integrated farming system is suitable for ensuring sustainable livelihood for North Eastern people.

#### CONCLUSION

There is a tremendous potential for developing farms to their optimum levels by integrating different enterprises in a farming system mode to make agriculture a profitable venture for farmers. It can be concluded that improved farming can play a significant role in increasing production, remunerative returns, and nutrition requirements as well as employment opportunities of tribal populations. The overall findings in terms of production, economic returns and employment generation with seven components of conventional and improved integrated farming system in the present study in

Chandel, Churachandpur and Ukhrul hill districts of Manipur revealed that improved farming is better over conventional farming.

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