CHAPTER V

FARMING SYSTEMS ANALYSIS

5.1 Characteristic features of integrated farming systems in study area

The choice of agricultural activities within the farm households particularly under the subsistence production systems, heavily depend on land use type and location, capitals farming experience and knowledge. Therefore, the characteristic features of the individual farm were found basically determined by farm activities. The characteristic features of four farm types are summarized in Table 15.

Table 15. Characteristics of four types of integrated farming systems in study area

Characteristics	Farm type			
	IFS-I	IFS-II	IFS-III	IFS-IV
Objectives	Food and cash sufficiency	Food and cash sufficiency	Food security	Food security
Average farm size	2.43 ha	2.20 ha	2.09 ha	1.70 ha
Cropping intensity	High	High	Low	Medium
Farming diversity	High	High	Low	Low
Crop production systems	Rice dominated More diverse species of vegetables and fruit crops	Rice dominated More diverse species of vegetables and fruit crops	Rice dominated Low diverse species of vegetables and fruit crops	Rice dominated Both more and low diverse species of vegetables and fruit crops
Livestock production systems	Mixed herd Large animal dominated	Mixed herd Large animal dominated	Mixed herd Both large and small animal	Mixed herd Small animal dominated
Fish production	Fish management & natural fish	Natural fish	Natural fish	Natural fish
Resource utilization	Local resources relatively higher External inputs	Local resources relatively higher External inputs	Local resources relatively lower External inputs	Local resources relatively lower External inputs
Productivity	Higher	Higher	Low	Low
Linkage among the system components	High	High	Low	Low
Labor use	More on-farm	More on-farm	Less on-farm more at off-farm	Less on-farm more at off-farm
Knowledge of farming experience	Relatively high	Relatively high	Relatively low	Relatively low

Farm households in the study area were engage with range of activities to secure household food and incomes. As a result, the farm households' objectives varied from type to type from food security to food and cash when farm production sufficed their household food consumption requirement. These activities included rice

production, other field crops and garden production, livestock production, fishing, waged labor and small business.

Rice is the staple food for these households and the most important crop in relation to the food security. Garden and other field crops, and wild plants also contribute to the diet. The major source of protein is fish supplemented by smaller quantities of poultry, pork and beef.

In case of fishery farmers, IFS-I consisted of both pond reared and natural fish while farmers in other farm types had only natural fish. Natural fish means that farmers did not raise fish but they had ponds dug, in which fish brought with floodwater during rainy season were trap and harvested.

The farms of IFS-I and IFS-II were the semi-commercial farms, the products of households in these farm types contributed to cash than consumption. However, rice contributed more to consumption than cash but farmers still had rice surplus for market. The group of farmers in IFS-I and IFS-II were supported by project of CWS organization, including agricultural tools, source of water for their productions in dry season and capacity building.

The IFS-III and IFS-IV were the subsistence farms, the products of households in these farm types mainly contributed to consumption except livestock for IFS-III and vegetables for IFS-IV, farmers had some surplus of these products for market. Farmers in these both types were outside the CWS project, it means that their agricultural practices were traditional, but farmers in this group also learnt some technical knowledge of agriculture from group of farmers in IFS-I and IFS-II.

The households in all farm types of the study area were involved in rice, vegetable, fruit and poultry productions except IFS-III where 67 percent of households raised pigs and 44 percent of households raised ducks in IFS-IV. As for fishpond 67 percent, 50 percent and 44 percent of households in IFS-II, IFS-III and IFS-IV, respectively, had pond at the homestead for trap fish in rainy season (Table 16). Actually, farmers in this area were not interested in fish culture because

when they would like to consume fish they could harvest from their homesteads (in these farm types fish was available in both seasons).

Table 16. Percentage of households involved in each enterprise

Farm type	Rice	Vegetables	Fruits	Chicken	Ducks	Pigs	Fishery
IFS-I	100	100	100	100	100	100	100
IFS-II	100	100	100	100	100	100	67
IFS-III	100	100	100	100	100	67	50
IFS-IV	100	100	100	100	44	0	44

(Source: survey data, 2002)

5.2 Productivity evaluation

Productivity is the first evaluation criteria of the system performance of all types of integrated farming systems in the study area. It measures outputs per unit of land, labor, capital (e.g. livestock, money), time or other inputs (e.g. cash, energy, water, nutrients). All farm types were evaluated for the productivity of rice and vegetables. This productivity was calculated as average of households in every farm type. The yields of rice and vegetable shown were based on estimation by the farmer respondents.

5.2.1 Productivity of rice

Table 17 indicated that the highest average productivity of rice production was found in IFS-II (1,645.2 kg ha^{-1}) while IFS-I and IFS-III were 1,533 kg ha^{-1} and 1,060.1 kg ha^{-1}, respectively, with the lowest productivity reported in IFS-IV (927 kg ha^{-1}). Farmers in IFS-II also used inputs averaging US$ 90.2 ha^{-1}, which was higher than other farm types while the total input cost of farmers in IFS-I, IFS-III and IFS-IV were US$ 76.4 ha^{-1}, US$ 67.6 ha^{-1}, and US$ 65.1 ha^{-1}, respectively. But the highest gross margin of rice production (ha^{-1}) was found in IFS-I at about US$ 79 while IFS-II and IFS-III were US$ 76.4, US$ 40, respectively, and the lowest (US$ 28.7) was reported in case of IFS-IV.

Table 17. Productivity of rice production (ha^{-1}) of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=6)	IFS-IV (n=9)
Yield (kg)	1,533.0	1,645.2	1,060.1	927.0
Gross return (US$)	155.3	166.6	107.4	94.0
Input uses (ha^{-1}):				
Seed (kg)	67.5	66.2	67.7	71.2
Manure (kg)	4,732.0	6357.5	1,794.4	2,345.0
Urea (kg)	24.6	12.6	20.7	16.0
DAP (kg)	11.6	16.5	2.2	4.7
Insecticide (US$)	0.1	0.1	0.5	0
Hired labor (md)	3.5	7.6	12.1	4.2
Family labor (md)	61.0	72.0	54.3	58.0
Total variable cost (US$)	76.4	90.2	67.6	65.1
Gross margin (US$ ha^{-1})	79.0	76.4	40.0	28.7
Return to family labor (US$ md^{-1})	1.3	1.1	0.7	0.5

n: number of households, md: man-day

5.2.2 Productivity of vegetables

The productivity of vegetable was calculated as the output per 1,000 m^2. Table 18 indicated that farmers in IFS-I and IFS-II received average vegetable productivity of 1,434 kg/1,000 m^2 and 1,491 kg/1,000 m^2, respectively, significantly higher than farmers in IFS-III and IFS-IV (957 kg/1,000 m^2 and 852 kg/1,000 m^2, respectively). Because farmers in IFS-I and IFS-II used higher inputs on vegetable productions than farmers in IFS-III and IFS-IV, especially, to improve soil fertility. Farmers in IFS-I and IFS-II applied manure 4969.4 kg/1,000 m^2 and 7,562.2 kg/ 1,000 m^2, respectively, higher than IFS-III and IFS-IV (4,113.3 kg/1,000 m^2 and 1,584 kg/1,000 m^2, respectively). In addition, farmers in IFS-I and IFS-II applied 48.6 kg and 30 kg/1,000 m^2 of urea, respectively, while farmers in IFS-III and IFS-IV applied only 11.7 kg and 28.4 kg Urea per 1,000 m^2, respectively. Most farmers in

IFS-III and IFS-IV grew vegetables only one time a year while all farmers in IFS-I and IFS-II grew two times a year.

Table 18. Productivity of vegetable productions (per 1,000 m^2) of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=6)	IFS-IV (n=9)
Outputs (kg)	1,434.0	1,491.0	957.0	852.0
Gross return (US$)	118.5	192.3	130.2	69.0
Input used (1,000 m^2):				
Seed (US$)	7.0	8.7	15.0	9.7
Manure (kg)	4969.4	7,562.2	4,113.3	1,584.0
Urea (kg)	48.6	30.0	11.7	28.4
DAP (kg)	10.0	34.4	6.3	3.3
Insecticide (US$)	2.6	2.2	1.3	0.4
Family labor (md)	48.0	76.0	60.0	37.2
Total variable cost (US$)	72.1	103.2	76.4	49.6
Gross margin (US$)	46.4	89.1	54.0	19.3
Return to family labor (US$ md^{-1})	1.0	1.2	1.0	0.5

n: number of households, md: man-day

The results of the productivity evaluation showed that farmers of both farm types (IFS-I and IFS-II) under CWS project received rice and vegetable productivity higher than farmers of non-CWS project (IFS-III and IFS-IV). Farmers in IFS-I and IFS-II had attended the training courses on integrated pest management (IPM) and integrated nutrient management (INM) practices in the past. In the mean time, farmers in these farm types always had easy access to the inputs for the vegetable production while farmers in IFS-III and IFS-IV always had limited labor and cash to invest on their farm production and management.

5.3 Economic benefits of households in each farm type

Economic benefit or profitability can be measured by gross margin for each enterprise of farm households. Profitability is one of eight criterions that can be

applied in the evaluation of integrated farming systems. Strictly speaking, the determination of profitability, or net farm income levels on these farms, would require that production cost be deducted from the gross farm incomes. These farm incomes or profitability measures will consist of cash from produce sales and value of consumed produce.

Gross margin was used as measures of farm performance when studying past farming activities. In this study, the gross margin analysis of rice, vegetables, poultry, pigs and fish productions were presented.

5.3.1 Gross margin analysis of wet season rice production

The higher average gross margin per household of rice production was found in IFS-I at about US$ 146.1 while IFS-II, IFS-III and IFS-IV were US$ 136, US$ 67, US$ 33, respectively. The average return to variable cost of IFS-I and IFS-II were similar, its were calculated as 1.0 and 0.9, respectively, higher than IFS-III and IFS-IV (0.6 and 0.4, respectively) (Table 19).

The result revealed that the average rate of return to family labor per household of IFS-I, IFS-II, IFS-III and IFS-IV were 1.3, 1.1, 0.7 and 0.5, respectively, (Table 19). Therefore, almost all farmers in this farm type decided to work on their farm, getting higher economic return compare to the risk to look for employment in town or off-farm employment.

Table 19. Gross margin (US$ HH^{-1}) of rice of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=6)	IFS-IV (n=9)
Average land area (ha)	1.9	1.8	1.8	1.1
Outputs (kg)	2,819.7	2,885.3	1,802.4	1,067.8
Gross return (US$)	285.5	292.2	182.5	108.1
Total variable cost (US$)	139.5	156.2	115.6	75.4
Gross margin (US$)	146.1	136.0	67.0	33.0
Return to variable cost (US$)	1.0	0.9	0.6	0.4
Return to family labor (US$ md^{-1})	1.3	1.1	0.7	0.5

n: number of households, md: man-day

5.3.2 Gross margin analysis of vegetable productions

There were several types of vegetables (See Table 12) grown in a small piece of homestead and all farmers in IFS-I and IFS-II grew it during both seasons but some farmers in IFS-III and IFS-IV grew its one time a year. The yields of several types of vegetables were integrated as one component for economic analysis. So gross margin of these combined vegetables was calculated.

Table 20 indicated that the average gross margin of vegetables for farmers in IFS-I, IFS-II, IFS-III and IFS-IV were US$ 68, US$ 42, US$ 6.2 and US$ 14.1, respectively, and the average return to variable cost was calculated as 1.1, 0.8, 0.7 and 0.5, respectively.

The average return to family labor was 1.7, 0.9, 0.8 and 0.6 for IFS-I, IFS-II, IFS-III and IFS-IV, respectively. Therefore based on these results, farmers in IFS-I received high profit from vegetable enterprise than other farm types.

Table 20. Gross margin (US$ HH^{-1}) of vegetables of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=6)	IFS-IV (n=9)
Average land area (m^2)	1,388.0	1,125.0	126.0	1,045.0
Outputs (kg)	1,491.0	836.0	113.0	636.0
Gross return (US$)	132.2	98.0	15.4	45.0
Total variable cost (US$)	64.1	56.0	9.2	31.0
Gross margin (US$)	68.0	42.0	6.2	14.1
Return to variable cost (US$)	1.1	0.8	0.7	0.5
Return to family labor (US$ md^{-1})	1.7	0.9	0.8	0.6

n: number of households, md: man-day

5.3.3 Gross margin analysis of poultry production

The result indicated that the average gross margin of poultry production per household of farmers in IFS-I, IFS-II, IFS-III and IFS-IV at about US$ 36.3, US$ 27, US$ 17.6 and US$ 7.9, respectively, the average return to variable cost was 2.6, 2.1, 2 and 1.5, respectively and the average return to family labor was 7.8, 5.4, 5.5 and 5.1, respectively (Table 21). Based on this result, it can be expressed that chicken production was highly profitable as farmers could earn more income of his or her chicken enterprise. And the highest gross margin, return to variable cost and return to family labor were found in IFS-I and the lowest were in IFS-IV.

Table 21. Gross margin (US$ HH^{-1}) of chicken of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=6)	IFS-IV (n=9)
Average frequency (heads)	29.0	33.0	21.7	11.0
Weight (kg)	40.0	43.7	27.5	14.0
Gross return (US$)	50.1	39.7	26.4	13.1
Total variable cost (US$)	13.8	12.7	8.8	5.2
Gross margin (US$)	36.3	27.0	17.6	7.9
Return to variable cost (US$)	2.6	2.1	2.0	1.5
Return to family labor (US$ md^{-1})	7.8	5.4	5.5	5.1

n: number of households, md: man-day

5.3.4 Gross margin analysis of duck productions

Table 22 indicated that farmers in IFS-II received higher profit from duck productions than other farming enterprises. The average gross margin of ducks in FS-II was US$ 13.5 while IFS-I, IFS-III and IFS-IV was US$ 10.6, US$ 11.1 and US$ 8.3 HH^{-1}, respectively, and the higher average return to variable cost and return to family labor also found in IFS-II, 1.3 and 1.5, respectively, while the lower was found in IFS-IV, 0.9 and 1.0, respectively.

Table 22. Gross margin (US$ HH^{-1}) of ducks of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=6)	IFS-IV (n=4)
Average frequency (heads)	9.7	11.7	12.2	9.3
Weight (kg)	20.0	23.5	21.3	17.4
Gross return (US$)	20.2	23.8	21.6	17.6
Total variable cost (US$)	9.5	10.3	10.5	9.3
Gross margin (US$)	10.6	13.5	11.1	8.3
Return to variable cost (US$)	1.1	1.3	1.1	0.9
Return to family labor (US$ md^{-1})	1.2	1.5	1.1	1.0

n: number of households, md: man-day

5.3.5 Gross margin analysis of pig productions

Pig production was also found as the major source household income in the study area. Every household of each farm type could earn income from pig productions except IFS-IV because farmers in this farm type did not raise pig. The average gross margin of pig productions of farmers in IFS-I and IFS-II was US$ 24.7 and US$ 25, respectively, higher than IFS-III (US$ 10). The average return to variable cost of farmers in IFS-I, IFS-II and IFS-III was 0.3, 0.4 and 0.1, respectively. And the average rate return to family labor was 0.9, 1.2 and 0.4, respectively, (Table 23).

Table 23. Gross margin (US$ HH^{-1}) of pigs of each farm type

Items	IFS-I (n=6)	IFS-II (n=9)	IFS-III (n=4)	IFS-IV
Average frequency (heads)	2.7	1.7	1.75	0
Weight (kg)	173.5	121.1	108.5	0
Gross return (US$)	123.0	86.0	77.0	0
Total variable cost (US$)	98.2	61.0	67.0	0
Gross margin (US$)	24.7	25.0	10.0	0
Return to variable cost (US$)	0.3	0.4	0.1	0
Return to family labor (US$ md^{-1})	0.9	1.2	0.4	0

n: number of households, md: man-day

5.3.6 Gross margin analysis of fish production

There are two types of fish production: raised or cultured and natural fish for households in IFS-I but for households in IFS-II, IFS-III and IFS-IV were only one natural fish. It was found that the average gross margin of cultured fish per household of farmers in IFS-I was US$ 20.4, the average return to variable cost and return to family labor at about 1.4 and 3.6 (Appendix F1), respectively.

The gross margin of natural fish of each farm type was calculated in Table 24. The average gross margin of natural fish per household of farmers in IFS-I was

US$ 37 higher than other farm types while IFS-II, IFS-III and IFS-IV was US$ 22.5, US$ 18.1 and US$ 16.3, respectively (Table 24).

Table 24. Gross margin (US$ HH^{-1}) of natural fish of each farm type

Items	IFS-I (n=4)	IFS-II (n=5)	IFS-III (n=3)	IFS-IV (n=4)
Output (kg)	45.8	29.0	24.0	21.5
Gross return (US$)	40.5	25.7	21.3	19.1
Total variable cost (US$)	3.6	3.2	3.2	2.8
Gross margin (US$)	37.0	22.5	18.1	16.3
Return to variable cost (US$)	10.1	7.1	5.7	5.9
Return to family labor (US$ md^{-1})	10.5	7.5	6.0	5.9

n: number of households, md: man-day

Table 24 and Appendix F1 indicated that the average output of natural and cultured fish for IFS-I were 45.8 kg HH^{-1}. But farmers in this farm type earn benefit from natural fish (US$ 37) higher than cultured fish (US$ 20.4) because the price of natural fish was US$ 0.90 kg^{-1} higher than price of cultured fish (US$ 0.75 kg^{-1}). The natural fish of this area was abundant and it was also good for market than cultured fish. Furthermore, during some years this area was flooded and the cultured fish farmers were more difficult to protect than natural fish, so that why farmers in this area were not so interested in cultured fish.

5.4 Time-dispersion of incomes of farming households

Time-dispersion of the household incomes in each farm type was important criteria in evaluating crop, livestock and fish compositions. The total annual income or output of the farm households was concentrated within a single month, or it could be perfectly dispersed uniformly of over 12 months.

5.4.1 Time-dispersion of incomes for every enterprise of each farm type

IFS-I, IFS-III and IFS-IV represented complete time-concentration from rice enterprise because its RTD index was zero and RTC was one while IFS-II had

complete time-concentration on fruit crops because the RTD index was zero and RTC was one (Table 25).

Table 25 also indicated that, in terms of rice, vegetable and livestock enterprises, IFS-II was more time disperse than other farm types because it's RTD index was the highest (0.2, 0.6 and 0.8, respectively) while IFS-I, IFS-III and IFS-IV had RTD index zero for rice; and 0.4, 0.4 and 0.5, respectively, for vegetables and 0.7, 0.5 and 0.5, respectively, for livestock. For fruit crops IFS-I and IFS-IV were more time disperse than IFS-II because the RTD index of both farm types was 0.2 while RTD index of IFS-II was zero. Whereas, fish enterprise, IFS-I was more time disperse than other farm types because it RTD index was 0.3 while RTD index of IFS-II, IFS-III and IFS-IV was 0.1.

Table 25. Relative time concentration and relative time dispersion of each farm type

Enterprise	IFS-I		IFS-II		IFS-III		IFS-IV	
	RTC	RTD	RTC	RTD	RTC	RTD	RTC	RTD
Rice	1.0	0	0.8	0.2	1.0	0	1.0	0
Vegetables	0.6	0.4	0.4	0.6	0.6	0.4	0.5	0.5
Fruits	0.8	0.2	1.0	0	-	-	0.8	0.2
Livestock	0.3	0.7	0.2	0.8	0.5	0.5	0.5	0.5
Fish	0.7	0.3	0.9	0.1	0.9	0.1	0.9	0.1

5.4.2 Whole farm related time-dispersion values of income of each farm type

Discussion above had related to separate enterprises or activities, which were the components of systems. The time-dispersion (RTD') of a whole farm system also can be obtained as the sum of the RTD values of the productive components, which comprise the farm system.

Therefore, in terms of whole farm related time-dispersion, IFS-II represented more time disperse than other farm types because the RTD' values were 0.42 while RTD' value of IFS-I and IFS-IV are 0.30 and 0.20, respectively, and the lowest of RTD' values were found in IFS-III (0.18) (Table 26).

Table 26. Time-dispersion of each farm type

Item	IFS-I	IFS-II	IFS-III	IFS-IV
RTD'	0.30	0.42	0.18	0.20

RTD' is the related time-dispersion values of whole farm systems

5.5 Income stability

5.5.1 Income stability from each enterprise of each farm type

There was variation in average annual monthly income distribution from each enterprise of households in each farm type.

In all farm types, rice provided highest average monthly income than other enterprise but it provided only two months a year while livestock provided ten months (IFS-I and IFS-II), five months (IFS-III) and four-months (IFS-IV) a year (Appendix G1, G2, G3 and G4). Therefore, for IFS-I, IFS-II and IFS-III, livestock provided stable income than other enterprises, because the CV was the lowest (59.2 percent, 62 percent and 155.4 percent, respectively) if compare to other enterprises but for IFS-IV, vegetables provided more stable incomes than other enterprises because CV (158.4 percent) was the lowest (Table 27).

Table 27. Relative average monthly income (US$ HH^{-1}) from each enterprise of each farm type

Enterprise	IFS-I		IFS-II		IFS-III		IFS-IV	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Rice	12.2	234.1	11.3	253.0	5.6	310.5	2.7	310.5
Vegetables	5.7	136.2	3.5	120.0	0.5	181.2	1.2	158.4
Fruits	0.5	191.4	0.3	310.5	-	-	0.2	255.0
Livestock	6.0	59.2	6.5	62.0	2.9	155.4	1.0	161.5
Fish	3.8	169.1	1.0	274.0	0.8	279.5	0.6	279.5

5.5.2 Whole farm income stability of each farm type

Whole farm annual monthly incomes of the households in each farm type were calculated by the total income of all enterprises in each month. Figure 5. (a), (b), (c) and (d) showed that, farmers in IFS-I and IFS-II received incomes from their farm activities 11 months year^{-1} (missing September) in year 2001 while farmers in IFS-III received seven months (missing April, May, August, September and October) and IFS-IV received eight months (missing May, August, September and October) in the same year.

Furthermore, it was found that IFS-I provided stable annual monthly income to households than other farm types because the CV the whole farm monthly incomes of IFS-I was calculated at 98.1 percent while CV of IFS-II, IFS-III and IFS-IV was 130 percent, 213.4 percent and 151.1 percent, respectively (Appendix G1, G2, G3 and G4).

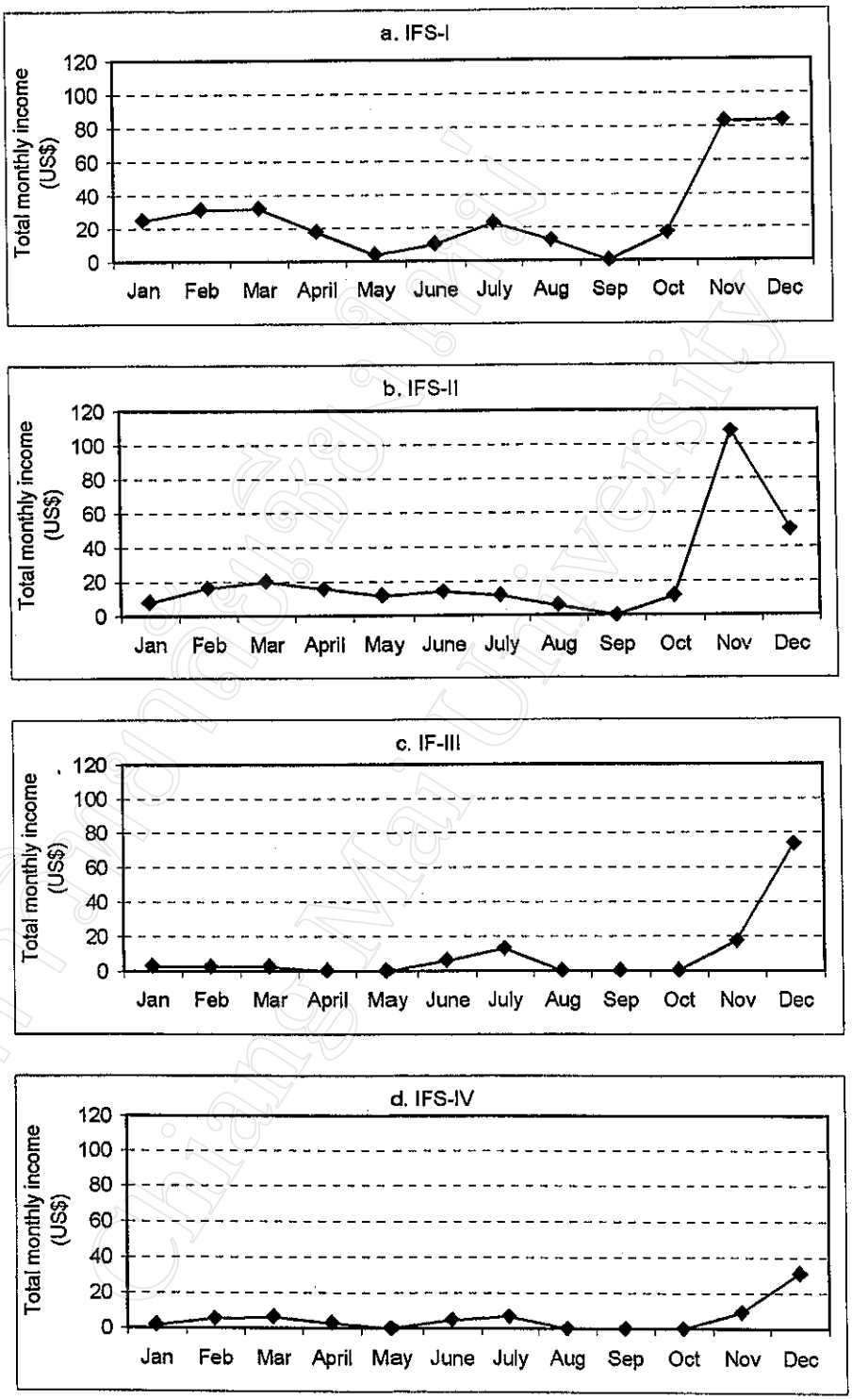

Figure 5. Total annual monthly income of households in each farm type

5.6 Diversity evaluation

Diversity refers to the number of species/activities and economic or value in a system. A high diversity level is conducive to system stability because it may help to reduce overall system risk (of income or finely subsistence failure), and increase overall production and profit through a more finely structured and closely integrated system. As noted in Chapter II, Simpson's diversity index (DI) and income diversity ratio (R) were used.

5.6.1 Species and activity diversity of each farm type

Simpson's Diversity Index (DI) values were calculated on the basis of species/activities, physical diversity and income. The income diversity ratio (R) was also calculated on the basis of income.

In its physical or structural dimension, all farm types were dominated by fruit crops (Appendix H1, H2, H3 and H4).

Table 28 indicated that the IFS-I, IFS-II and IFS-IV had DI values for economic higher than species; therefore this farm types were more diverse of economic terms than in terms of species but for IFS-III it was opposite. In terms of species diversity, the IFS-III was more diverse than other farm types because its DI values was 0.71 was the highest while the DI values of IFS-I, IFS-II and IFS-IV were 0.58, 0.66 and 0.56, respectively.

Noted that difficulties arose in the calculation of DI on species basis for those crops and on economic for some livestock activities for which the individuals could not be enumerated, e.g., with rice, vegetables, cattle and buffalo.

5.6.2 Income diversity of each farm type

The calculated DI values in terms of economic diversity found that IFS-I was more diverse than other farm types with it's DI at 0.74 while DI of IFS-II, IFS-III and

IFS-IV were 0.70, 0.63 and 0.70, respectively. Furthermore, based on the income diversity ratio (R), it also indicated that IFS-I was more diverse than other farm types with the values of R ratio were 4, 3.24, 2.71 and 3.27, respectively (Table 28).

Table 28 Simpson's diversity index and income diversity ratio (R) of each farm type

Items	IFS-I	IFS-II	IFS-III	IFS-IV
Species diversity (DI)	0.58	0.66	0.71	0.56
Economic diversity (DI)	0.74	0.70	0.63	0.70
Income diversity ratio (R)	4.00	3.24	2.71	3.27

Therefore, even IFS-III had higher DI value than other farm types in terms of species diversity but it's economic diversity was lower, so economic return of the farm enterprises were not based on diversity of farm but it also relied upon management practices, investment, capital and land size.

5.7 Sustainability evaluation

The sustainability is also one of eight criteria of evaluation for evaluating the system performance. The purpose here was more modest to use the four criteria of sustainability as mentioned in Chapter II, to score the relative impact of farming practices on farm sustainability for 30 integrated farming system farms. This evaluation was based on the indicators as indicated in Table 29 and Table 30.

Due to the management practices of farmers in IFS-I and IFS-II, which were quite similar, the sustainability evaluation was done on 15 farms and also the same as for IFS-III and IFS-IV were 15 farms.

Sustainability indicators were established based on information from various sources/means (secondary data, participatory approaches). 30 farms of farmers in four farm types were score by using the method of scoring for each indicator on input uses.

Thus it could be seen in Table 29 and Table 30 that farmers of these farm types applied synthetic fertilizers to maintain soil fertility, that it had negative impact

on three criteria registered as –1 with respect to each of minimizing off-farm inputs, minimizing use of non-renewable input and maximizing natural biological process. It was classified as having no significant effect (positive or negative) with respect to local biodiversity and hence no point was scored under this category. Hence, the minimum number or the total of points that could be generated with respect to synthetic fertilizers was –3 (for use on all crops) and the maximum was zero (for use on none). The minimum total score of all indicators for all farm types was synthetic pesticides at –4, it affected all criteria that registered –1 at each criteria.

Based on farmers in IFS-I and IFS-II used cover crops to control weed so it affected on all criteria sustainability that registered +1 in each criteria and the total score of this indicator was +4 (Table 29), but for IFS-III and IFS-IV half of farmers in these farm types used it, thus the score would register +0.5 in each criteria and the total score of this indicator was +2 (Table 30).

Based on result of scoring the total score of all indicators at all criteria +27.5 and –7 for 15 farms of IFS-I and IFS-II, and +16.5 and –7 for 15 farms of IFS-III and IFS-IV mean that these farm systems were sustainable but farms of IFS-I and IFS-II were more sustainable than the farms of IFS-III and IFS-IV because it's total score of positive impact was higher than.

Table 29. Scoring practices with respect to sustainability for farms of IFS-I and IFS-II

Farm practice	Dimension of sustainability				Total
	Minimize off-farm inputs	Minimize non-renewable inputs	Maximize natural biological process	Promote local biodiversity	
Seed sourcing:					
Own farm seed	+1.0	+1.0			+2.0
Soil fertility:					
Synthetic fertilizers	-1.0	-1.0	-1.0		-3.0
Organic fertilizer	+1.0	+1.0	+1.0		+3.0
Composed fertilizer	+1.0	+1.0	+1.0		+3.0
Green manure	+1.0	+1.0	+1.0		+3.0
Pests/disease control:					
Natural pest control		+0.5	+1.0	+1	+2.5
Synthetic pesticides	-1.0	-1.0	-1.0	-1	-4.0
Weed control:					
Crop cover	+1.0	+1.0	+1.0	+1	+4.0
Crop rotation	+1.0	+0.5	+1.0	+0.5	+3.0
Crop management:					
Resistant varieties		+1.0	+1.0	+1	+3.0
Crop rotation	+1.0	+1.0	+1.0	+1	+4.0

Total scores: +27.5 & -7