Indian Journal of Agronomy **44** (3) : 431–439 (September 1999)

Income and employment generation for small and marginal farmers through integrated farming systems

U. K. BEHERA[1] AND I. C. MAHAPATRA

Orissa University of Agriculture and Technology, Bhubaneshwar 751 003

Received: May 1997

ABSTRACT

Pond-based farming system research studies comprising enterprises like field and horticultural crops, fishery, poultry, duckery, apiary, mushroom, dairy and agroforestry were undertaken at Bhubaneshwar during 1992-94, with a view to generate income and employment opportunities for small and marginal farmers. Among the above mentioned enterprises, apiculture produced the highest return of Rs 7.94/ rupee invested. Multilayer pisciculture stood next, fetching Rs 5.46/ rupee invested. Among the crops, the best returns were obtained with multistoried cropping involving pumpkin, ridge gourd and *poi* as ground storey; pineapple, colocasia, ginger and turmeric as first storey; and coconut as second storey. Poultry, duckery and mushroom enterprises fetched low returns. The highest level of employment (180 man days/year) was achieved in mushroom cultivation. Integrated farming system, comprising above enterprises generated net income of Rs 58,360 and employment for 573 man days, on a small piece of land (1.25 ha), ensuring high standard of living for small and marginal farmers.

Key words : Apiculture, Fishery, Crop husbandry, Poultry, Duckery, Mushroom, Integrated farming system

In India 76.2% of farming community belongs to marginal and small farmers. The income from seasonal field crops on small and marginal farms is hardly sufficient to sustain the farmers' family. With the gradual decline in farm size, it would be increasingly difficult to produce enough food for the farm family in coming years. Under such circumstances, it will be required to undertake some land-based enterprises which will complement their existing farming activity to get more income and employment, leading to a better standard of living. Such enterprises include livestock, fishery, poultry, duckery, apiary, mushroom production and tree farming etc. A judicious combination of any one or more of such enterprises with cropping and effective recycling of residues/

Present address : Scientist (Agronomy), IARI, Regional Wheat Research Station, Indore, Madhya Pradesh 452 001

wastes would ensure better utilization of available resources and employment to the family labour during off season. An effort has been made for a holistic integration of different land-based enterprises with the objectives of sufficiency in food, increased income and employment opportunity for the farm family and recycling of farm wastes and by-products.

MATERIALS AND METHODS

A pond-based farming system research study was undertaken at the University research farm during 1992-94, with pisciculture, field and horticultural crops, duckery, mushroom, apiculture and bio-gas enterprises. An area of 1.25 ha consisting of pond area of 0.28 ha, upland area (including dikes of pond) of 0.33 ha and low land area 0.32 ha was demarcated for undertaking the study. A small farm house was located within this land area. Bio-gas plant was installed in one side of the farm house and multistoried cropping programme in 0.21 ha was taken in back of it. The bunds of the pond were utilized for banana, papaya, plantation and also used for cowshed, poultry and duckery houses.

Pisciculture

Pisciculture was taken up in a pond area of 0.28 ha and depth of 3.0 m. Three Indian major carps, viz. catla (*Catla catla),* rohu (*Labeo rohita),* mrigal (*Cirrhinus mrigala*) and 1 exotic carp commonly known as grass carp (*Ctenopharyngodon idella)* were released into the pond. Catla, rohu and mrigal feed on surface, column and bottom layers respectively of the pond ecosystem. The stocking density of 5,536 fish seeds/ha was maintained with 550 catla, 500 rohu, 450 mrigal and 50 grass carp in the ratio of 11:10:9:1 respectively. The pH of the pond water was maintained around neutrality by adding lime at intervals. A part of the biogas digested slurry (18-20 litres/day) was discharged to fish pond to encourage plankton growth. Besides, droppings of poultry birds and ducks were added to the pond water. The raw cowdung of 1.4 tonnes was applied as a basal manure. During day time (9.00 a.m. to 5.00 p.m.) the ducks were released to the pond. The fishes were harvested partially after 1 year. After harvesting, the individual weight and length of the fishes were recorded. From this, average fish weights were computed and fish biomass was calculated.

Crop husbandry

It consisted of field crops, viz. rice, maize and rice bean in 7,980 m^2, olericulture (seasonal vegetables) in 6,197 m^2, floriculture in 300 m^2 and multistoried cropping in 2,080 m^2 involving pumpkin, ridge gourd and *poi*, all as ground storey; ginger, turmeric, colocasia and pine apple as first storey; and coconut in the second storey. Pomology involving banana and papaya were grown in 450 m^2 on the dikes of the pond. Unutilised spaces on the dikes were used for rice bean. In the adjoining upland areas (2,550 m^2) the crop rotations followed were: (a) brinjal-amaranthus-maize, (b) maize-cowpea-bittergourd, (c) yard long bean-tomato-cucumber, (d) maize-cowpea-tomato, (e) maize-watermelon and (f) pumpkin-amaranthus-tomato. In the multistoried cropping unit, the existing 44 coconut plants, which were practically

neglected earlier, were managed scientifically. The crops like turmeric, ginger, colocasia and pineapple that can grow well in diffused light under coconut were grown in strips between the 2 rows of coconut plants, in *kharif* season followed by *poi*, ridge gourd and pumpkin in *rabi* season. In the lowland ecosystem, rice-rice crop sequence was followed with the variety 'Gayatri' ('CR 1018') in *kharif* and 'Lalat' in *rabi*. In the floriculture unit, ornamental crops like marigold (*Tagetes patula*), jasmine (*Jasminum Sp.*) and *rajnigandha* (*Polianthes tuberosa*) etc. were raised in front of the farm house to meet the aesthetic requirement of the farm family. The crops were raised as per the recommended practices.

Poultry and duckery

A low cost poultry house with bamboo and paddy straw was installed at 1 corner of the pond with the idea that the droppings of birds will directly fall into the water and help in the growth of plankton. Forty layer birds (White Leghorn) with a stocking density of 120 birds/ha water area were maintained in the poultry house adopting cage—system arrangement. A feed quantity of 110 g/bird was given, half during morning and half during evening hours.

Similarly, a low cost small duckery house was erected on the dyke of the pond. Twentyseven ducks (Khaki Campbell) were kept with a stocking density of 100 ducks/ ha water area. The excreta of ducks dropped into pond water and partially met the food requirement of fishes. A feed quantity of 90 g/duck was given during evening hour only. The observations were taken on the number of eggs layed every-day.

Mushroom production

The paddy straw (from March to October) and oyster (from November to February) mushroom were grown using the straw of rice variety 'Gayatri' in an area of 24.53 m^2 by taking 64 beds and 100 bags/ month respectively.

Valvariella volvacea spawn was used for paddy straw mushroom @ 1 bottle/bed. Over the spawn bits, gram powder was sprinkled to encourage the growth of fungus. On the 13th and 14th day, the harvest of mushroom was made from the 1st flush. For oyster mushroom, *Pleurotus sp.* was used. The paddy straw was cut into pieces of 7.62 cm length. Then it was sterilised in steam after 12 hr of soaking. After draining out the excess moisture, it was bagged in a polythene of 40 cm diameter and 80 cm length. Boiled wheat was put in each layer of straw after spreading the spawn. Polythene was removed when bag becomes single clump with whitish mycelial growth. After 1 week of removal of polythene bag, the mushroom was harvested consecutively for 2 days. Thus, 2-3 flushes were harvested at 1 week interval.

Apiary

Three units of ISI 8-framed bee hive boxes were installed for honey production using the bee species *Apis cerana indica*. Each box was containing a colony of queen with nearly 1,500 workers. During the lean season sugar solution was given as feed. Observation on honey production was recorded.

Bio-gas production

To study the fuel-wood saving and

economics of gas production through bio-gas plant, 1 m^3 biogas plant (KVIC model) was installed in FSR unit with a filling requirement of 25 kg cowdung mixed with equal volume of water. The observations were recorded on hours of gas produced and quantity of fuel wood saved per day. A similar study was made in the FSR adopted village Rautarapur (Balasore district) and Ratanpur (Mayurbhanj district) of Orissa through questionnaire.

RESULTS AND DISCUSSION

Pisciculture

In the composite pisciculture system, the average monthly growth rates for grass carp, rohu and mrigal were 100, 75, 28 and 31g respectively. The average weight and length of the fishes after 12 months of stocking are presented in Table 1. The maximum biomass was obtained in grass carp followed by catla, mrigal and rohu. At harvest, fish biomass for catla, rohu, mrigal and grass carp was 445.5, 159.6, 153.9 and 54.0 kg respectively. The total fish biomass yield was 813 kg. Taking the economics into consideration, gross and net returns of Rs 20,325 and Rs 16,603 respectively were generated with an expenditure of Rs 3,722 (Behera and Mahapatra, 1998). No artificial feed was given to the fish pond except the cowdung, biogas digested slurry and droppings of poultry and duckery. The quantity of dropping fed to fish pond from poultry and duckery unit (of 21,666 bird days) was 1.6 tonnes. Besides, the slurry that fed from biogas plant into the pond @ 18-20 litres/day was 3.65 tonnes and a basal 1.4 tonnes of raw cowdung was fed into the pond system. Total 6,650 kg of manure yielded a fish

Table 1. Growth parameters and fish production and its economics of the cultivated carps in the FSR pond during 1992-93

Species	Initial average weight (g)	Initial total weight (g)	No. of fingerlings released	Culture period (year)	Final average		Monthly average growth rati (g)	Estimated fish production (kg)
					Length (cm)	Weight (kg)		
Catla	0.46	253	550	1	40.6	0.900 ± 0.102	75	445.5
Rohu	0.35	175	500	1	31.8	0.335 ± 0.033	28	159.6
Mrigal	1.56	7.2	450	1	33.8	0.380 ± 0.042	31	153.9
Grass carp	11.28	564	50	1	46.6	1.200 ± 0.300	100	54.0
Total		1,694	1,550					813
Return from fish production @ Rs 25.00/kg of fish								Rs 20,325
Expenditure on fish production								Rs 3,722
Net profit								Rs 16,603
Gross return/cost of fish production								Rs 5.46

biomass of 813 kg, with a conversion ratio of 8.2 kg of manure to yield 1 kg of fish biomass, Similar observations were reported by Jhingran and Ghosh (1988), Benerjee *et al.* (1989), Dutta and Goswami (1988) and Patro and Ray (1988).

Crop husbandry

Multistoried cropping gave the maximum net return of Rs 9,089 (Rs 43, 697/ha) and maximum return of Rs 3.37/rupee invested. This system gave scope for maximum utilisation of space and solar energy. In addition to this, the dry leaves of coconut plants were useful to meet the fuel requirement of farm house. Mid-ribs of dried leaves were useful in making broom sticks. Coconut and turmeric became useful for ceremonial and festival purposes. Besides, coconut served as foraging plants for honey bees. The second best remunerative cropping programme was olericulture, which gave a net return of Rs 8,301 (Rs 13,397/ha) and return/rupee invested was Rs 3.18. This unit met the vegetable requirement of farm house and provided ready cash to the family throughout the year. Almost all the plants served as foraging plants for honey bees. From the field crop unit, a net return of Rs 5,638 (Rs 7,066/ha) was obtained with return/rupee investment of Rs 2.70 and generating 98.2 man days of employment (Behera and Mahapatra, 1998). The rice straw was used directly for mushroom production, while grain of maize was used as an important component of poultry and duckery feed. Floriculture met the aesthetic requirement of the family and served as foraging plants for honey bees. Besides, a net income of Rs 100 was obtained with Rs 1.8/rupee invested in this enterprise.

Taking the overall income and expenditure into consideration, a farmer could generate a net income of Rs 24,596 from a cropping area of 0.83 ha with an expenditure of Rs 11,983. Resource use efficiency was Rs 3.05/rupee invested on production inputs. Additionally an employment of 304 mandays could be generated from this unit (Table 4). From labour employment point of view, multistoried cropping as well as pomology were more labour-intensive with 418 and 409 man days/ha respectively.

Poultry and duckery

The poultry and duckery unit produced 8,521 and 5,475 eggs from 13,614 hen and 8,052 duck days with an average egg production of 62.2 and 68% of the total days respectively. A net return of Rs 981.50 and Rs 713.00 was generated from an investment of Rs 9,240/ and Rs 5,387 from poultry and duckery units (Table 2) respectively. From this a return of Rs 80/ and Rs 60/ month respectively and also an employment opportunity of 23 man days from each enterprise was generated. Besides, a valuable poultry dropping and excreta of ducks of about 1.0 tonne and 0.6 tonne respectively was obtained for fish pond. A higher level of fish production was achieved through recycling of these manures.

Mushroom production

Paddy straw and oyster mushroom of 768 and 400 kg respectively were produced in a year with a gross and net income of Rs 31,040 and Rs 12,856 respectively. This unit provided a total and a monthly income of Rs

Table 2. Economics of poultry and duckery units of FSR during 1992-93

	Particulars	Amount (Rs)	
		Poultry	Duckery
A.	*Expenditure*		
(i)	Cost of layer birds	1,560 (40 nos.)	810 (27 nos.)
(ii)	Feed for 1 year	6,105	3,422
(iii)	Medicine	200	180
(iv)	Labour	575	575
(v)	Depreciation on cost of house	400	400
(vi)	Depreciation on cage valued at Rs 4,000/ (for poultry only)	400	
	Total expenditure	9,240	5,387
B.	*Income*		
(i)	Sale of eggs @ Rs 1.00/egg	8,783	5,475
(ii)	Sale of empty gunny bags	100	50
(iii)	Return from manure	200	100
(iv)	Sale of cull birds	1,138	475
	Gross income	10,221	6,100
	Net income	981	713

12,856 and Rs 1,071 respectively (Table 3). It also generated an employment of 180 mandays in a year. Oyster mushroom was more profitable with return of Rs 2.10/ rupee invested in comparison to Rs 1.80 on paddy straw mushroom. A similar study in two sample villages revealed that marginal and small farmers of these villages were getting an income of Rs 2,010 and Rs 5,760/ month from oyster mushroom (November to February) of 450 and 900 bags with a daily installation of 15 and 30 bags respectively. Similarly, from paddy straw mushoom (March to October), a monthly income of Rs 3,150 and Rs 7,900 was obtained by taking 200 and 400 beds/ month respectively. This vocation was very important for small and marginal farmers, as it does not require much land and the by-product (rice straw) received from paddy cultivation was effectively recycled for mushroom production.

Apiculture

The apiary unit produced 15 kg of honey and generated a net and gross income of Rs 1,180 and Rs 1,350 respectively from an investment of Rs 170 (Table 4). A small and marginal farmer can earn a monthly income of Rs 98 from this vocation just by utilising the idle time of farm family in the way of supervision and providing feed (sugar solution) during lean season.

Biogas unit

Biogas plant of the FSR unit, produced gas for 1.75 hr daily with feeding requirement about 25 kg cowdung mixed with equal quantity of water. The gas produced was found to be sufficient for cooking for 2-3 persons. It was further observed that about 9 kg of fuel wood was saved per day by utilising this biogas, thus saved a fuel wood of 33.85q/ annum, costing Rs 2,031. The slurry produced, served as very good compost for manuring the crops and fish pond. Making a similar economic analysis in FSR adopted villages Rautarapur

Table 3. Economics of small unit of mushroom production in FSR unit during 1992-93

	Particulars	Rate (Rs.)	Amount (Rs)	
			Paddy Straw (64 beds)	Oyster (100 bags)
A.	*Recurring cost for one month*			
(i)	Paddy straw	0.5/kg	480	100
(ii)	Spawn	08.0/bottle	512	400
(iii)	Pulse powder @ 250 g/bed	10.0/kg	160	
(iv)	Wheat grain @ 250 g/bag	04.0/kg		100
(v)	Labour	25/man day	350	300
(vi)	Miscellaneous including chemicals	-	96	50
	Expenditure per month		1,598	950
B.	*Total expenditure*			
(i)	Total expenditure for 64 beds of paddy straw mushroom for 8 months			12,784
(ii)	Total expenditure for 100 bags of oyster mushroom for 4 months			3,800
(iii)	Depreciation from fixed cost incurred for infrastructure development			1,600
	Total expenditure			18,184
C.	*Total return*			
(i)	Return from 768 kg of paddy straw mushroom for 8 month @ Rs 30.00/kg			23,040
(ii)	Return from 400 kg of oyster mushoom for 4 months @ Rs 20.00/kg			8,000
	Gross return			31,040
	Net profit			12,856
D.	*Return per rupee invested*			
(i)	On paddy straw mushroom			1.8
(ii)	On oyster mushroom			2.1

Table 4. Economics of different components of F.S.R. unit during 1992-93

Components	Total labour (may days)	Total expenditure (Rs)	Gross return (Rs)	Net return (Rs)	Return per repee invested (Rs)
Field crops	98.2	3,315	8,954	5,638	2.70
Multistoried cropping	87.0	3,831	12,920	9,089	3.37
Pomology	18.4	900	2,366	1,466	2.63
Olericulture	96.4	3,812	12,114	8,302	3.18
Floriculture	4.0	125	225	100	1.80
Pisciculture	31.0	3,722	20,325	16,603	5.46
Poultry	23.0	9,240	10,221	981	1.11
Duckery	23.0	5,387	6,100	713	1.13
Mushroom	180.0	18,184	31,040	12,856	1.70
Apiary	1.0	170	1,350	1,180	7.94
Biogas	11.0	600	2031	1,431	3.38
Total	573.0	49,286	107,646	58,360	2.18

and Ratanpur of Balasore and Mayurbhanj districts respectively depicted that with an average installation cost of Rs 5,583 and the minimum operational expenses of Rs 13.50, led to a saving of fuel wood and straw to the tune of Rs 2,537 and Rs 1,230/ annum respectively.

Economics of farming systems and resource recycling

Taking the performance of different components of the whole system into consideration, it revealed that apiculture yielded the highest return of Rs 7.94/unit of investment for a minimum investment of Rs 170, but provided employment for 1 unit of labour and also regulated some idle time of farm family in the way of supervision etc. The performance of multilayer pisciculture stood next to apiculture where the magnitude of return was Rs 5.46 /rupee invested, creating employment opportunity to the extent of 31 mandays (110 man days/ha). In the supplementary enterprises the performance was in order of multistoried cropping > pomology > olericulture> field crops from the point of view of labour employment and income (Table 4) with returns per unit investment around Rs 3.0. The other sub-systems like poultry, duckery and mushroom cultivation yielded low returns from the view point of returns per unit of investment which ranged between Rs 1 and Rs 2. In the present system poultry and duckery recorded a return of Rs 1.11 and 1.13 respectively per rupee invested. Thus, the resource productivity was highest with apiary and lowest with poultry and duckery (Table 4).

Despite these differences in the magnitude of afoesaid indicator, the overall success was commendable since in a small land area of 1.25 ha, a net return of Rs 58,360 was realised from an investment of Rs 49,286 and employment equivalent of 573 man days was

generated. Based on this, the farmers of the locality can be advised to restructure the existing farming system, to get more returns and employment opportunity. Resource recycling clearly indicated that the interdependence of the different components of the total farming system to make the farmers self-sufficient in terms of ensuring the family members a balance diet for leading healthy life, increasing the standard of living through maximising the total net return and providing more employment. The by- product of dairy, i.e. cowdung, forms a major raw material for biogas. Digested slurry of biogas forms a major part of feed of pisciculture for increasing plankton growth as well as supplying valuable manure to raise the productivity of crops. Similarly, byproduct of field crops like paddy straw forms a major ingredient of mushroom cultivation. Again straw used for mushroom production may be utilised for cattle feed and compost preparation. The by-product of poultry, i.e. poultry dropping, forms an important ingredient of pisciculture for increasing the plankton growth as well as increasing the fertility of land. Even an item like apiary has lot of indirect bearing on crop enterprise by increasing yield and quality through improvement in pollination, apart from giving a wholesome product like honey to the farmers. Farmers like to have flowers which adds to the aesthetic sense of farm family and flowers also serve as foraging plants for honey bees. The entire philosophy of integrated farming system revolves around better utilisation of time, money, resources and family labourers of farm families. The farm family gets scope for gainful employment round the year; thereby ensuring good income and better standards of living.

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