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An evaluation study on viable integrated farming system (IFS) model in Godavari delta of Andhra Pradesh

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Abstract
The farming community requires viable farming where they need to produce a continuous, reliable and balanced supply of foods, as well as cash for basic needs and recurrent farm expenditure. In order to avoid the uncertain income and high degree of risk through single crop production enterprise, there is a dire need to develop integrated farming system (IFS). This IFS system can eliminate the above mentioned constraints economically and also provide the other house hold needs besides increasing the productivity of the farm through effective utilization of space and time. In the present study, the farmer gets an additional income through various enterprises over the consecutive years. In terms of income generation, agricultural crop has dominated followed by horticultural crops, fisheries, dairying and poultry. The energy consumption and output during the last 4 years were calculated. The energy input was stabilized after first year and the energy output was higher than the energy input. In IFS system, the waste generated from one system is utilized as input for the other system.

Keywords: Integrated farming model; integrated farming system; agriculture cum animal husbandry; agriculture cum fisheries; horticulture cum fisheries

Introduction
East Godavari District in Andhra Pradesh can be broadly classified into three natural divisions namely the Delta, Upland and Agency or hill tracts. The general elevation of the district varies from a few meters near the sea to about 300 meters in the hills of the agency area. The Eastern Ghats rise by gradations from the level of the coast and spread throughout the erstwhile agency Taluks of Rampachodavaram and Yellavaram. The delta portion constituting the whole of Konaseema and portions of Kakinada, Ramachandrapuram and Rajahmundry erstwhile Taluks, presents a vast expanse of rice-fields surrounded by plantain, betel vine, coconut gardens and innumerable palmyrahs. The erstwhile Taluks of Tuni, Pithapuram, Peddapuram and Portions of Kakinada, Ramachandrapuram and Rajahmundry constitute the upland areas. The main soils in the district are coastal alluvial (clay loamy), red soil, sandy loam and sandy clay. There is mostly alluvial soil in Godavari delta and sandy clay soil at the tail end portions of Godavari river whereas red loamy soil in upland and agency areas of the district.
Agriculture in Godavari delta area of Andhra Pradesh is dominated by rice-rice mono-cropping system. More than 70% of the Indian farming community own less than one hectare of land and belongs to the category of small and marginal farmers. Such farmers feel that, except going for a single cropping system (like paddy in canal irrigated lands, irrigated dry crops in rainfed areas) there is hardly any possibility of trying new practices or methods for farm improvement. The potential of rice and further scope for enhancing yield is limited. The natural resource is fatigued. The need for diversification in some parts of this area is clear since the income of farmers who depend solely on the produce of their traditional mono crop pattern is decreasing due to narrow margin of profitability. This situation has demanded for an urgent need to develop profitable IFS model equivalent or superior to rice-rice system.
Integrated farming system (or integrated horticulture/agriculture/livestock) is a commonly and broadly used term to explain integrated approach to farming as compared to monoculture. It refers to agricultural/horticultural systems that integrate livestock, fish and other related bio-systems. In this IFS system an inter-related set of enterprises will be used so that the unused or waste or by product from one component will become an input for another part of the system, thereby reduces the input cost and improves the productivity or/and income. So, these systems works as a system of systems and ensure the reduction of wastes (Anon 2010; Chakrabati *et al.*,

2014; Soni *et al.*, 2014).
A low cost, integrated farming model for sustainable farming has been developed and adopted by the farmer in East Godavari District. The model emphasizes the significance of four important sectors i.e., agriculture, fisheries, horticulture and animal husbandry thus highlighting the concept of integrating one with another in assuring better yields and results. The main objective of evaluating this model is to enable a small farmer to substantiate his annual family requirements of food on a sustainable basis and supplemented with a regular income through one or two farm related enterprises.

Methodology

Farm design and cultivation

The present study was conducted in the field of the beneficiary farmer Mr.A.Suryanarayana Murthy, resident of K. Gangavaram Village, Ramachandrapuram Mandal, East Godavari District. The village K. Gangavarm is in East Godavari district which is predominantly witnessed by Paddy along with coconut as bund plantation. The farmer was experimenting with many agricultural operations during the last 20 years of his farming experience and since 2010 the integrated agriculture/horticulture and live stock based activities are being practiced. Apart from many recognitions at district, state and national level, this farmer was awarded with "Pandit Deen Dayal Upadhyay Anthyoday Krishi Puraskar" for the year 2015-16 in Zone V (Andhra Pradesh, Telangana and Maharashtra), received during the Birth Centenary celebrations of Pandit Deen Dayal Upadhyay on 25.09.2016 at KVK, Venkatarmannagudem.
The farmer adopted a low cost IFS model from the year 2010 and the technical team of KVK Venkatarmannagudem evaluated the model by collecting the information through structured interview schedule and observations were recorded in the field. The model farm area is fenced by trees like coconut, banana, and papaya. A trench with dimensions of 2m x 1m having 5 ft depth was dugout around the paddy field. This trench has been used for cultivation of fish and the bunds on the trench were planted with papaya and banana. About 2500 fingerlings of Catla, Rohu, Mrigal and Grass carp ranging from 100 to 150 g size. were stocked in the trench for the first time. Rice bran and Raw Cattle Dung (RCD) was applied to manure the pond. In between papaya and banana plants, pulses, vegetables like yam, tomato, chillies, onion, leafy vegetables, sesamum, sugarcane were grown to a little extent (5 cents) on the bunds. pendals were also erected with bamboo sticks across the trench on the bunds. Cucurbits like bottle gourd, bitter gourd, ridge gourd and teasel gourd were grown and trained onto the pendal. Besides this trench and paddy field, elevated land of about 30 cents is used for growing seasonal vegetables, yam, red gram with high yielding and improved varieties recommended by the Department of Agriculture/Horticulture and KVK. On the other side, the land (10 cents) is divided into five sub components – i) house for livestock with a small pit where cow urine gets collected and recycled, ii) two units of organic manure production and Azolla, iii) poultry and a loft for pigeons iv) small shade net for raising nurseries and v) small farm pond (10 cents) at the lowest point of the field where the excess water gets harvested. On the whole, the farm is surrounded by annuals and perennials like marigold, chrysanthemum, rose and lily that act as trap crop as well as add aesthetic value to the field. Paddy is grown in the main field in both the seasons and optimum yields were obtained duly minimising the cost of cultivation.
All crops were grown organically since 2010 and by using the waste of one enterprise as input for the other system. Organic manure has been prepared at farm by using 10 tons of cow dung, 2 tons of dry leaves, 1 ton of sugar cane pulp and 1 ton of coconut husk powder which were mixed thoroughly and kept for decomposing for 6 months to 1 year.
The cropping pattern and yields during the period 2013 to 2017 (four years) were recorded and calculated in terms of energy input and output to study the sustainability of the model. The cost of cultivation and productivity along with cost benefit ratio were also evaluated.

Formulae used in energy calculations:

The following formulae were used in working out the energy consumption in various field operations and yields
Output-Input Ratio = Output Energy (MJ/ha) /Input Energy (MJ/ha)
Energy Productivity (kg/MJ) = Yield (kg/ha) / Energy Input (MJ/ha)
Net Energy Gain (MJ/ha) = Energy Output (MJ/ha) – Energy Input (MJ/ha)
Specific Energy (MJ/kg) = Input Energy (MJ/ha) / Production (kg/ha)

Results and Discussion

Soil fertility

Since 2010, there was a gradual shift towards application of organic manure. The crop residues on the bunds and the animal waste have been the major source for composting. Thus the soil fertility was managed by lowering chemical inputs with the addition of more of organic manure. Two compost units were established (vermicompost unit and another compost unit made up of sweet corn, sugarcane trashes, coconut dust and cow dung). Botanical extracts (Vavilakula Kashayam, Neemastram, Agniastram) and organic farm products like Jeevamrutham, Beejamrutham etc., are prepared at the farm site and used in farming as per the need. Since the crop removes large quantity of plant nutrients from soil, particularly the removal of NPK at the present level of crop production has been estimated at 125 kg/ha/annum whereas the annual addition is not more than 75 kg resulting in depletion of the nutrient reserves of the soil. To maintain the soil quality and retain the nutrients the manure prepared on the farm is applied @ 1 ton/acre frequently. Moreover, Indian soils are poor in organic matter and in major plant nutrients. Soil organic matter is the key to soil fertility and productivity and the regular recycling of organic wastes into the soil is the most efficient method of maintaining optimum levels of soil organic matter (Chandra 2005).

Agricultural crops

Paddy is grown in the main field in both seasons and obtained optimum yields duly minimising cost of cultivation. Majority of the paddy produce has been sold for seed purpose there by getting premium price. Sweet corn was cultivated on the pond dykes. Pulse crops like red gram, green gram and black gram grown with improved varieties also added to the income from field crops. The income generated through field crops was around Rs 80,000/- year. The stalks and husk from field crops are used as fodder for the milch animals.

Horticultural crops

During 2013-14, the model plot was able to produce 20 kg sweet corn, 490 kg onion, 100 kg coriander, 90 Kg

spinegourd, and 500 kg tomato from the first two bunds, 200 kg of sesamum, 10 kg cotton, 100 kg chillies, 1 ton of cucurbits from third bund, 20 kg pumpkins, 200 bunches (each bunch containing 100 leaves) of betel vine from the fourth. On the whole, the family food requirements of cereals, pulses and oilseeds were largely met from these plots.

In addition, 4 different types of green leafy vegetables were also grown along the bunds. These leafy vegetables served for a period of 8 months and green chillies for 3 months for the family. The remaining chillies were dried and stored which weighed 6 kgs. Tomato grown based on the availability of water in the farm pond is another source of nutrition for the family. During the first year, vegetables worth Rs. 17,600/- were produced.

Trap Crop- Marigold

Animal Husbandry

The inputs for agriculture and horticulture crops were cow-urine, Jeevamrutham, Coco-compost and occasional manual weeding ensured chemical free plot giving scope for population enhancement of beneficiary insects like ladybird beetles, grass hoppers, wasps, etc. thus mitigating pest attack.

A dairy unit with both buffaloes and cows (two Murrah buffaloes, one jersey cross bred cow, a pair of Ongole cows and a pair of Kapil bulls) was maintained in the shed to serve the dual purpose of milk and supplying manure for fish pond and crops. The animals were fed with waste from paddy, jowar sugar cane, azolla etc. The Murrah buffalo produces 8 litres milk per day. Two bulls are being used for farm operations instead of a tractor. A shed was constructed for the shelter of animals as well as to store the grains, concentrated feed, coconuts, ripening of fruit etc. Loose house grazing was also done during morning hours. It is observed that higher net income under dairy-based mixed farming and 174 man-days of additional employment was generated over mono cropping (FAO 1992; FAO 2001; Patel and Dutta 2004).

The bunds are planted with sweet corn (stalks), paddy straw, served as a regular source of fodder supply. To get a continuous supply of fodder plants, the crop was cut from one bund at a time. Thus, by the time the fourth bund is harvested, the first bund is once again ready with vegetation for harvest. By this way, feed for livestock was ensured for 8 months in a year. The animals were fed with the fodder crops, sugarcane, rice bran, paddy straw, jowar, azolla, etc. Initially, the dairy unit was in loss and then slowly it picked up. Since, the labour was the constraint in that year. After meeting the households' milk requirements, the income generated from sale of milk was Rs. 1,51,200/- during 2014-15 (Fig 1). Integration of a remunerative enterprise like dairy with conventional enterprise like crop husbandry can greatly enhance the net income obtained from the limited land area and thus improves the standard of living of farmers (FAO 1997). Rangaswamy *et al.*, (1995) studied an integrated farming system with cropping, dairy, spawn production, biogas and silvi-pasture as components and obtained remarkably higher additional net income. Cattle-fish integrated system is very common in rural India. People generally mix cow dung with paddy husk and spread over water bodies as a ready source of fish food (Chakrabati *et al.*, 2014).

Azolla, a water fern plant is inoculated in the trench which had luxuriant growth and extended to the Paddy field. It acted as supplementary feed for fish. When fed to milch cattle, the quality of milk was improved with higher fat content. It may be due to the carbohydrate, protein content and other components, like carotenoids, biopolymers, probiotics etc., may be contributing to the overall increase in the production of milk. It is also a potential source of nitrogen and is a potential feed ingredient for livestock (Lumpkin, 1984). Azolla can increase flexibility of diet and makes possibility for cheaper production in poultry breeding and have been known as the cheapest and most abundant potential protein sources (Sivakumar and Balasubramaniam, 2000; Kathirvelan *et al.*, 2015).

A poultry unit is set up with 100 Vanaraja, Giriraja fowls along with desi fowls. A loft is also arranged for pigeon keeping. Even their droppings are collected and used as manure in the trench for fish. Poultry excreta is an excellent feed for fish as it contains highly soluble organic salts, more N and P as compared to other livestock manure.1500 eggs/year were attained from this poultry unit and sold at an average price of Rs. 6-8 /egg. The poultry birds were also sold for Rs. 300/kg live weight. This unit generated an additional income of Rs.8000-10000/annum by selling 30-40 poultry birds.

Composite fish culture

Composite fish culture involving surface feeder (Catla), column feeder (Grass carp and rohu), and bottom feeder (Mrigal) constituting 30, 40 and 30%, respectively were adapted in the trench around the paddy field. Initially the stocking density was 2500 nos and in the consecutive year the trench has been widened and the stocking density was increased to 5000 Nos. The natural food i.e. plankton (phyto and zoo) borne out of continuous fertilization due to poultry droppings, manuring and jeevaamrutham was sufficient for the fish to feed upon in addition to azolla. In addition to this rice bran was also fed and the fish was reared till it attains table size, weighing more than 500 g. to 1Kg. Partial harvesting was done after 8 months and based on the demand of the fish, the periodical harvesting was done using cast net. The maximum growth was observed in grass carp, followed by catla, rohu and mrigal. The maximum size of grass carp was attained after complete harvest of around 4 kgs. This may be due to the consumption of plankton, grass and azolla. The results are in accordance with the earlier findings of Das *et al.* (2014) and Chakrabati *et al.* (2014).

In low land rice areas there is considerable scope for growing of fish along with rice (Sivakumar and Balasubramaniam, 2000). Azolla as a component in the rice and rice + fish farming system helped to record higher grain yield by improving its manurial value and by smothering the aquatic weeds. This is in line with the results obtained by Shanmugasundaram and Ravi (1992); Kathiresan and Ramah (2000). The favourable effect of rice + azolla +fish was also reported by Shanmugasundaram and Balusamy (1993).

Other benefits

Over a couple of years, besides the above-mentioned benefits, the farm family was benefitted from production of fruits from horticulture plants, like water apple, melons, guava, sweet orange, apple ber, marigold, chrysanthemum, tube rose etc. They can serve nutritional needs and also provide some cash income. These types of enterprises provide labour for the family over the entire year.

Income generation

Agriculture stands first and contributes highest income generation followed by horticulture, fisheries and animal husbandry. In the starting years, the income was less, since the plantation of horticulture crops was less and then increased over the next years. Income through fisheries has shown steady increase over the years (Table 1 a, b & c). The income generation through animal husbandry was high in the year 2014-15, as the poultry and dairy animals yield was high. However, in the next year, the poultry rearing was not done (Fig 1).

Table 1a: Farm Economics for the year 2013-14

S. No.	Details of crops	Fish rearing	Azolla	Paddy (Kharif)	Marigold	Sweet corn (Kharif)	Paddy (Rabi)	Corriander	Sesamum	Dairy
1	Preparation of Land/Trench	25000	0	2000	500	1500	1800	500	200	0
2	Seed/Sapling	7000	75	190	800	2000	200	200	80	0
3	Nurseries/Transplantation	0	0	2500	500	1000	2000	100	100	0
4	Weed control	0	0	1000	0	2700	1200	200	400	0
5	Manure/Feed	4000	0	1600	0	1650	1400	200	100	43200
6	Pests & Diseases	500	0	310	0	150	400	0	0	0
7	Harvest of crop/Fish	500	0	4000	200	1000	4000	1200	800	0
8	Others	1000	0	400	0	2000	1000	600	320	36000
9	Yield (Kg)	1500	700	1875	213	2500	1575	130	200	0
10	Unit cost (Rs.)	50	5	24	45	20	26	100	120	0
11	Gross Income	75000	3500	45000	9600	50000	40950	13000	24000	86400
12	Total Expenditure (Rs.)	38000	75	12000	200	12000	12000	3000	2000	79200
13	Net Profit (Rs.)	37000	3425	33000	7600	38000	28950	10000	22000	7200

Gross Income	347450
Total Expenditure	158475
Through Financial assistance under ATMA	
An Innovative activity on Integrated Farming System	25000
Demonstration on Cultivation of Sweet corn	4000
Remaining Expenditure	129475
Net Profit	187175
Cost Benefit ratio	1 -- 1.45

Table 1b: Farm Economics for the year 2014-15

S. No.	Crop details	Paddy (70 cents)			30 cents elevated land			On Bunds							Vanaraja (Poultry unit)	Fish reared in trench	Dairy
		Paddy MTU 3626 (Kharif)	Paddy MTU 7029 (Rabi)	Bottle gourd (summer crop)	sweet corn (Kharif)	Tobacco	Onion, Corriander	Leafy Vegetables	Tomato on trellies	Chillies	Cucurbits on Pendals	Banana	Papaya	Coconut			
1	Preparation of Land/Trench	1200	1100	0	300	100	300	0	200	200	2400	200	0	0	0	0	0
2	Seed/Sapling	100	100	300	1100	300	350	300	100	150	200	300	250	0	10000	7000	0
3	Nurseries/ Transplantation	1800	1800	600	500	600	400	0	100	200	0	100	150	0	0	0	0
4	Weed control	2400	2400	0	0	100	0	0	0	300	0	0	0	0	0	0	0
5	Manure/Feed	900	1000	500	500	500	300	100	400	200	300	500	100	0	8000	4000	73000
6	Pests & Diseases	800	900	400	150	400	200	100	300	150	200	50	50	0	0	500	0
7	Harvest of crop/Fish	2400	2500	600	800	500	600	0	0	200	0	0	0	0	0	500	0
8	Others	0	0	2100	450	0	0	0	200	0	0	0	0	0	2000	1000	36000
9	Yield (Kg)	15	21	100	25000	150	490/120	300	500	200	360	90	700	0	1500/120	450	3780
10	Unit cost (Rs.)	2000	2000	10	10	100	12/100	5	13	30	30	200	10	0	8/200	120	40
11	Gross Income (Rs.)	30000	42000	10000	25000	15000	17880	1500	6500	6000	10800	18000	7000	10500	39000	58500	151200
12	Total Expenditure (Rs.)	9600	9800	4500	3800	2500	2150	500	1300	1400	3100	1150	550	0	20000	13000	109000
13	Net Profit (Rs.)	20400	32200	5500	21200	12500	15730	1000	5200	4600	7700	16850	6450	10500	19000	45500	42200

Gross Income	448880
Total Expenditure	182350
Net Profit	266530
Cost Benefit ratio	1 -- 1.46

Table 1c: Farm Economics for the year 2015 – 16

S.No.	Crop details	Paddy (70 cents)		30 cents elevated land		On Bunds										Fish reared in trench	Dairy
		Paddy MTU 3626 (Kharif)	Paddy RNR 15048 (Rabi)	sweet corn (Kharif)	Intercropping of Onion +Corriander	Leafy Vegetables	Protels (Orissa)	Spiny gourd	Cucurbits on Pendals	Banana	Papaya	Coconut	Redgram	Bengal gram	Groundnut		
1	Preparation of Land/Trench	0	600	1000	300	100	200	200	0	0	0	0	0	100	150	0	0
2	Seed/Sapling	0	90	1100	450	100	0	300	50	0	0	0	0	0	0	7000	0
3	Nurseries/ Transplantation	0	0	500	400	0	0	0	0	0	0	0	50	50	50	0	0
4	Weed control	1000	0	600	0	0	0	0	0	0	0	0	0	0	50	0	0
5	Manure/Feed	500	0	500	300	100	100	0	100	0	100	0	0	0	0	4000	36500
6	Pests & Diseases	0	0	150	500	100	50	0	200	0	50	0	100	50	50	500	0
7	Harvest of crop/Fish	2600	0	1000	0	0	0	0	0	0	0	0	200	50	50	500	0
8	Others	0	0	0	0	0	0	0	0	0	0	0	200	100	100	1000	18000
9	Yield (Kg)	2000	0	2500	0/200	200	120	90	80	45	175	0	20	8	10	550	26
10	Unit cost (Rs.)	20	0	10	0/5	5	30	15	30	200	10	0	130	60	90	120	60
11	Gross Income (Rs.)	40000	0	25000	0/1000	1000	3600	1350	2400	9000	1750	6000	2600	480	900	66000	75600
12	Total Expenditure (Rs.)	4100	0	4850	1800/150	400	350	500	450	0	150	300	550	350	400	13000	54500
13	Net Profit (Rs.)	35900	0	19650	0/850	600	3250	850	2050	9000	1600	5700	2050	130	500	53000	21100

Gross Income	170680
Total Expenditure	67050
Net Profit	103630
Cost Benefit ratio	1 -- 1.55

The income generation from integrated systems was high and the present results are concorded with the earlier findings of Panke *et al*. (2010) and Bahire *et al*. (2010). Edwards (1997) and Jitsanguan (2001) defined the IFS as an aquaculture system that is integrated with livestock in which fresh animal waste is used to feed fish and also reported that there are synergies and complementarity between enterprises that comprises a crop and animal component which form the basis of the concept of IFS. According to this concept, integration usually occurs when outputs (usually by-products) of one enterprise are used as inputs by another within the context of the farming system (Khan *et al.*, 2015). Agbonlabor *et al*. (2003) defined the IFS as a type of mixed farming system that combines crop and livestock enterprises in a supplementary and / or complementary manner. Bahire *et al*. (2010) defined the IFS as an integrated mixed farming system, the practice of raising different yet dependent enterprises and are primarily complementary and supplementary to each other.

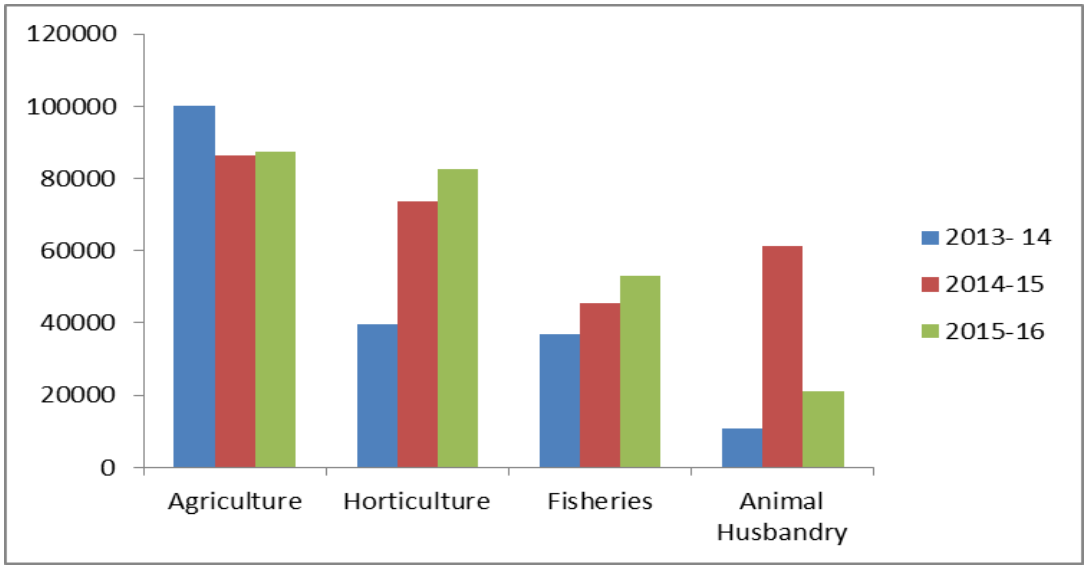


Fig 1: Income generation through various sectors

Energy Calculation

The energy calculations were made using standard values for human energy (1.96MJ/h), bullocks energy (14.05 MJ/h), traditional plough (1.32 MJ/h), manual hand tools-local sickle, (0.05 MJ/h), water (0.63 MJ/ cubic m and FYM (0.30 MK/kg). The energy input for paddy, fisheries, banana, sweet corn, onion, tobacco, sesamum, papaya, coriander, vegetables, flowers, poultry, dairy, compost and azolla was found to be 5887.92 MJ/ha; 213.64 MJ/ha; 262.68 MJ/ha; 336.87 MJ/ha; 833.32 MJ/ha; 660.84 MJ/ha; 488.36 MJ/ha; 155.41 MJ/ha; 456.28 MJ/ha; 976.20 MJ/ha; 770.40 MJ/ha; 762.44 MJ/ha; 1901.20 MJ/ha; 282.24 MJ/ha; and 47.04 MJ/ha respectively (Table 2a). The total energy input was found to be 14034.84 MJ/ha during the first year and later it has reduced to 13435.08 for the next 3 years (Table 2b). The total energy input was 54340.08 MJ/ha. The productivity and the total energy output was 70721.8 MJ/ha (Table 2c). The energy output-input ratio was 1.3014 and energy productivity was found to be 0.67 kg/MJ. The net energy gains and specific energy was found to be 16381.72 and 1.49 respectively. The present results were collaborated with the earlier findings of Chauhan *et al*. (2017).

Table 2a: Energy consumption for production of crop

Unit operation	Time (h)	Direct energy		Total energy (MJ/ha)	Total energy per crop duration (MJ/ha)
		Human (MJ/ha)	Bullock (MJ/ha)		
Paddy					
Ploughing (animal drawn tradition plough)	12+12	23.52	168.6	192.12	384.24
Transplantation of seedlings	90	176.4	-	176.4	352.8
Fertilizer application	24	47.04	-	47.04	94.08
Weeding	90	176.4	-	176.4	352.8
Harvesting	120	2352	-	2352	4704
				Sub Total	5887.92
Fisheries					
Preparation of bunds	18	35.28		35.28	35.28
Water filling	18	35.28		35.28	35.28
Manuring	18	35.28		35.28	35.28
Stocking	1	1.96		1.96	1.96
Feeding	9	98		98	98
Harvesting	4	7.84		7.84	7.84
				Sub Total	213.64
Banana					
Ploughing (animal drawn tradition plough)	12+12	23.52	168.6	192.12	192.12
Bunds preparation	12	23.52		23.52	23.52
Plantation and fertilizer application	6	11.76		11.76	11.76
Fixing poles	12	23.52		23.52	23.52
Harvesting	6	11.76		11.76	11.76

				Sub Total	262.68
Sweet corn					
Ploughing	6+6	11.76	28.01	39.77	119.31
Bunds preparation	6	11.76		11.76	35.28
Plantation and fertilizer application	12	11.76		11.76	35.28
Weed management	3	5.88		5.88	17.64
Water management	4	7.84		7.84	23.52
Harvesting	6	35.28		35.28	105.84
				Sub Total	336.87
Onion					
Ploughing	6+6	11.76	28.01	39.77	159.08
Nursery raising	2	3.92		3.92	15.68
Transplantation and fertilizer application	6+3	35.28+5.88		41.16	164.64
Weed management	5	9.8		9.8	39.2
Water management	10	19.6		19.6	78.4
Harvesting	12	94.08		94.08	376.32
				208.33	833.32
Tobacco					
Ploughing	6+6	11.76	28.01	39.77	159.08
Nursery raising	2	3.92		3.92	15.68
Transplanting and fertilizer application	6+3	35.28+5.88		41.16	164.64
Weed management and topping	6	23.52		23.52	94.08
Water management	5	9.8		9.8	39.2
Harvesting	6	47.04		47.04	188.16
				165.21	660.84
Sesamum					
Ploughing	6+6	11.76	28.01	39.77	159.08
Sowing and fertilizer application	6	35.28		35.28	141.12
Weed management	3	5.88		5.88	23.52
Water management	3	5.88		5.88	23.52
Harvesting	6	35.28		35.28	141.12
				122.09	488.36
Papaya					
Ploughing	6+6	11.76	28.01	39.77	39.77
Plantation and fertilizer application	9	52.92		52.92	52.92
Water management	20	39.2		39.2	39.2
Harvesting	6	23.52		23.52	23.52
				155.41	155.41
Coriander					
Ploughing	6+6	11.76	28.01	39.77	159.08
Sowing and fertilizer application	6	35.28		35.28	141.12
Weed management	3	11.58		11.58	46.32
Water management	2	3.92		3.92	15.68
Harvesting	6	23.52		23.52	94.08
				114.07	456.28
Vegetables					
Ploughing	6+12	11.76	168.6	180.36	541.08
Manuring	18	35.28	35.28		105.84
Watering	8	15.68	15.68		47.04
Harvesting	48	94.08	94.08		282.24
				Sub total	976.20
Flowers					
Ploughing	6+12	11.76	168.6	180.36	541.08
Manuring	4	7.84			23.52
Watering	3	5.88			17.64
Harvesting	32	62.72			188.16
				Sub total	770.4
Poultry					
Construction of shed	24	47.04			47.04
Maintenance	365	715.4			715.4
				Sub total	762.44
Dairy					
Construction of shed	60	470.4			470.4
Maintenance include cleaning, milking and feeding	730	1430.8			1430.8
				Sub total	1901.2
Compost					
Preparation	144	282.24			282.24
Azolla					
Construction of pond	6	23.52			23.52
Maintenance	12	23.52			23.52
				Subtotal	47.04
Total (all crops)					14034.84

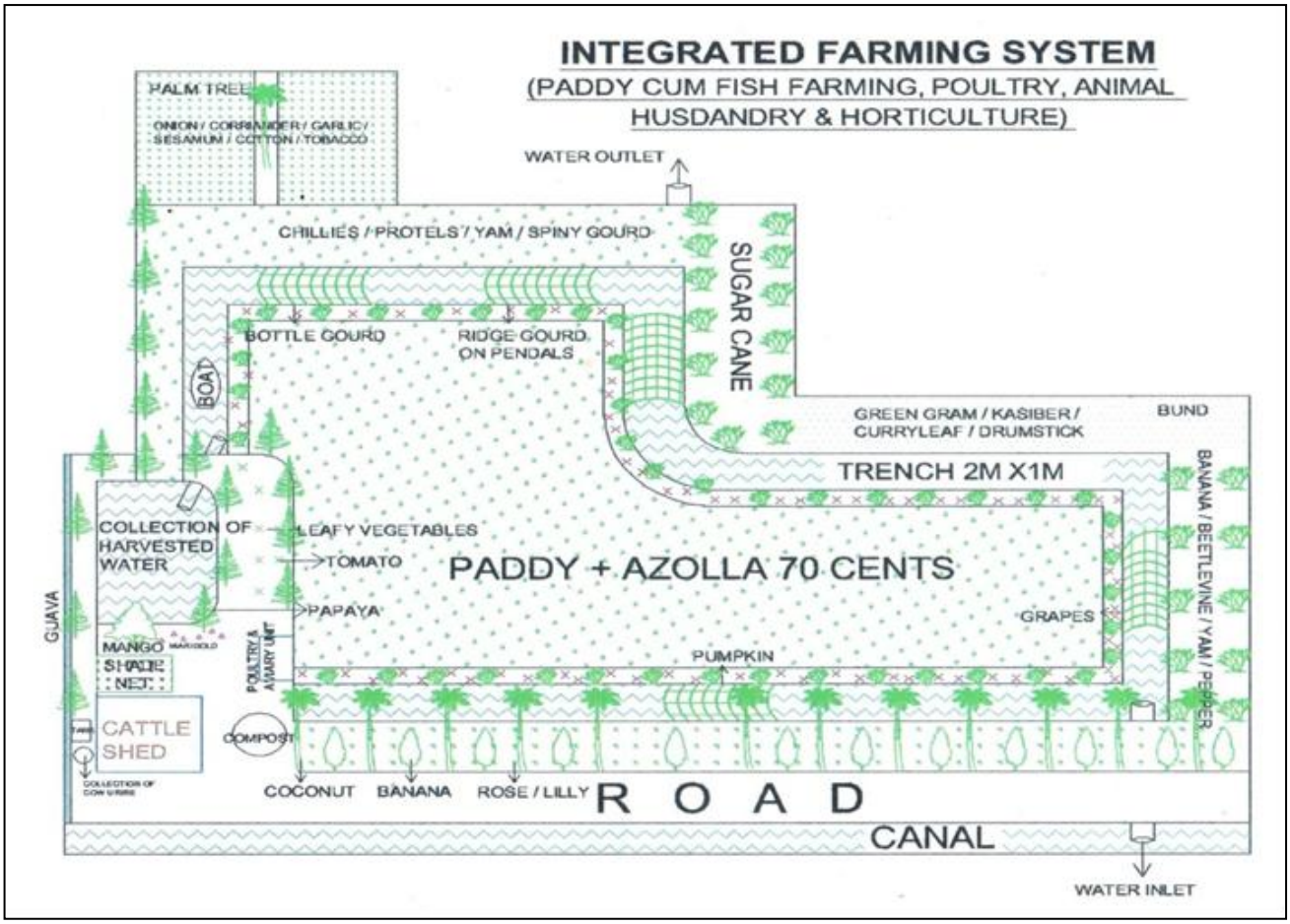
Table 2b: Energy input of crops

Year	Energy output (MJ/ha)
First year energy input (2013-14)	14034.84
Year 2014-15 (14034.84-23.52-35.28-47.04-470.4-23.52)	13435.08
2015-16	13435.08
2016-17	13435.08
Total energy input	54340.08

Table 2c: Energy output of crops during 4 years (2013 to 2017)

Crop	Yield in kgs	Crop Duration	Total out put (*1.9)
Paddy	1875	3450	6555
Fisheries	1500	1500	2850
Banana	90	90	1710
Papaya	700	700	1330
Sweet corn	2500	7500	14250
Vegetables	1460	5840	11096
Coriander	120	480	912
Sesamum	200	800	1520
Onion	490	1960	3724
Tobacco	150	600	1140
Flowers	213	852	1618.8
Poultry		2160	4104
Animal husbandry	3780	3780	7182
Compost	6000	6000	11400
Azolla	700	700	1330
		36412 kgs	70721.8

Successful pilot initiative: Design of the farm



Successful pilot initiative: Design of the farm

Conclusion

It has been established that Integrated Farming System (IFS) focuses on increasing farm productivity by increasing diversification, resource integration and creating market linkages. This initiative attempted to address the critical gaps of small family farms falling in between the modern and primitive production systems and this model has had its impact in two ways. Better conservation and use of on-farm natural resources thus establishing natural eco system and secondly, this model can generate income every month due to

various farming systems available. Since the model depicts a fine blend of all the farm enterprises where in each and every component feeds into the other, thus making efficient utilisation of products, by-products and also wastes generated on the farm. Multi cropping as well as farming systems always gives higher returns than mono cropping as such it can be replicated in other parts of the district and across the state based on the feasibility of the water source.

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