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Study on organic vegetable production in embankment of farm pond

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Abstract
Innovative integrated farming system model comprising of a nutritional garden for growing fruits and vegetables, cattle, goat, desi poultry, duck, and turkey was evaluated in a lowland ecosystem. Round the year vegetable production on the pond embankment was evaluated over traditional pond management. The model aims at improving livelihood security through improving household nutrition, income and employment generation. From the system about 87 and 72 kg of radish, 72 and 64.5 kg of ribbed gourd, 59 and 52.9 kg of bitter gourd, 41 and 36 kg of snake gourd, 187 and 267 kg of banana, 194 and 178.9 kg of amaranthus, 158 and 132 kg of leafy coriander, 33 and 26 kg of mint and 17 and 11 kg of red gram were produced annually from an area of 160 m^2 during 2015-16 and 2016-17, respectively. In this regard, vegetables production in pond embankment increased the year round availability of vegetables for family consumption of the respective households. Moreover, cash from selling of surplus greens, fruits and vegetables contributed to increased total income of the households. Supplementary income of Rs. 9,918 and 10,401 was obtained from the greens, fruits and vegetables cultivated on the pond embankment with an area of 160 m^2 during 2015-16 and 2016-17, respectively. A total of 63 and 57 man days were generated by the nutritional garden during 2015-16 and 2016-17, respectively. Composting of organic residues on farm resulted in effective recycling of farm waste for crop production.

Keywords: Innovative, Nutritional garden, Organic vegetables, Pond embankment

Introduction

Integrated farming system approach is a multi-disciplinary holistic approach to solve the problems of small and marginal farmers. The declining trend of per capita land availability poses a serious challenge to the sustainability and profitability of small and marginal farming community. Under such conditions, it is appropriate to integrate land-based enterprises *viz.*, crop production, dairy, horticultural crops, poultry and fisheries within the farm with the objective of generating adequate income and employment for these small and marginal farmers and thereby improving livelihood and nutritional security. The consumption of fruits, vegetables and eggs are far below the recommended dietary allowance due to non-availability at local level and higher cost (ICMR, 2010) [3].

In general, the embankment of a pond and nutrient rich pond water is not utilized properly. But these unutilized resources could be used for cultivation of fruits and vegetables, especially of creeper types of vegetables round the year to meet out the nutritional requirements of small and marginal farmers. Vegetables production on the pond bank round the year is an additional innovation over traditional pond management. Generally, small farmers do not have access to sufficient vegetables round the year for their nutrition because of resource limitations. In this regard, vegetables production in integrated pond management increased the year round availability of vegetables for family consumption of the respective households. Moreover, cash from selling of additional vegetables contributed to increased total income of the households. Hence, this approach for vegetables production exhibited a remarkable impact on the resource poor small and marginal farmers for income generation and family nutrition (Alam *et al.*, 2009) [1]. Homestead garden with an area of 200 m^2 near farmhouse involving vegetables, fruit trees (guava, papaya and banana) and greens would supplement the family food requirement. The surplus produce can be sold, and this could provide income to meet out the seed cost and plant protection expenses. The nutrient requirement for the garden can be fully met out by using basal application of fish pond silt and vermicompost application. Multi enterprise agricultural system comprised the components of crop, animal, fishery, poultry, duckery and vegetables in 2 ha area. The animal, fishery, poultry and duckery components should get feed and fodder from the crop components. Dung produced by the animals will be used in different ways like composting, fertilizing fruits and vegetables cultivated on pond dykes. Nutrient rich pond water can be a source of irrigation for the crops around the pond and in the crop field.

Net income of Rs 127284 was obtained from the system and the additional income of Rs 18339 per annum was obtained from the fruits and vegetables cultivated on the pond dykes with the per day return of Rs 55 in Karnal (Pramanik *et al.*, 2013) [4]. The promotion of agricultural diversity through integration of different enterprises will have positive impact on food and nutritional security at household level (Caouette *et al.*, 2002) [2]. In small and marginal farm household the integration of home gardens with allied enterprises like goat, pig, poultry provides a possible solution to meet the demand for various food commodities to ensure nutritional security while supporting the stability of agro ecosystem existing in these areas. Hence, innovative integrated farming system model comprising of a nutrition garden for growing fruits and vegetables, cattle, goat, desi poultry, duck, and turkey was formulated in wetland ecosystem to improve the livelihood security of resource poor small and marginal farmers.

Material and Methods

The study was conducted during 2015-16 and 2016-17 in an integrated farming system unit, wetland farm, Tamil Nadu Agricultural University, Coimbatore. Considering the limited land availability and nutritional requirement of small and marginal farm families an innovative integrated farming system model comprising of a nutrition garden for growing fruits and vegetables, cattle, goat, desi poultry, duck, and turkey was evaluated in the wetland ecosystem. The system components are described below.

Nutritional garden in the embankment of farm pond (160 m^2)

In the nutritional garden, seasonal vegetables *viz.*, radish, bitter gourd, ribbed gourd, snake gourd and greens like amaranthus, mint, leaf coriander and fruit crops like banana, papaya and perennial redgram were grown in the border of fish pond. Irrigation requirement of nutritional garden around the fish pond area were met by nutrient rich fish pond water and nutrient requirements of crop grown around the pond area were met through the application of fish pond silt and vermicompost and no external nutrients were applied. The vegetables and fruits were harvested when they attained marketable size.

Livestock

The details of livestock component is given below

a. Cattle – 3 milch animal
b. Goat – 6 adults.
c. Desi poultry: 20 numbers of a dual purpose birds (Aseel) were reared under cage system over fish pond.
d. Duck: 20 numbers of Indian runner duck were reared under cage system at a corner of fish pond.
e. Turkey: 15 numbers of white breasted turkey were reared under cage system over fish pond.

Fowl component was allowed to open graze during day time and sheltered during night time and they were fed with dried azolla, rice and maize bran.

Vermicompost

Farm yard manures obtained from the animal components and crop residue from the farming system were used to prepare vermicompost in a constructed tank located near the integrated farming system unit with the capacity of 5 tonnes annually by the action of African earthworm (*Eudrillus euginiae*). Vermicompost produced in tank made by constructed cement with the dimension of 0.75 m width, 2.5 m length and 0.9 m height. Vermicompost were applied to meet out the nutritional requirement of crops grown around the pond embankment.

Results and Discussion

The interventions carried out in the fish pond embankment to produce fruits and vegetables to meet out the nutritional requirements of small and marginal farm families. The pond embankment produced a good amount of greens, fruits and vegetables. The nutritional garden of 160 m^2 for growing mainly vegetable like radish, fruit crops like banana and papaya, greens like amaranthus, mint and leafy coriander, gourds like bitter gourd, ribbed gourd and snake gourd on the fence. No external nutrients were applied, only vermicompost were applied to meet the nutritional requirement of crops in nutrition garden.

Fruits and vegetables production on the nutritional garden (160 m^2)

Space around the fish pond area was effectively utilized to produce healthy fruits, vegetables and greens to meet the nutritional requirements of small and marginal farm families. From the system, the pond embankment was effectively utilized and produced about 87 and 72 kg of radish, 72 and 64.5 kg of ribbed gourd, 59 and 52.9 kg of bitter gourd, 41 and 36 kg of snake gourd and 187 and 267 kg of banana, 194 and 178.9 kg of greens, 158 and 132 kg of leafy coriander, 33 and 26 kg of mint and 17 and 11 kg of redgram were produced annually from an area of 160 m^2 during 2015-16 and 2016-17, respectively (Table 1 & 2). Similarly, the production of vegetables under integrated pond management system recorded 778, 881 and 673 kg during the 2001, 2002 and 2003 respectively in Goyeshpur, West Bengal (Alam *et al.*, 2009) [1].

Table 1: Fruits and vegetables produced in embankment of fish pond during 2015 – 2016.

Fruits and vegetables	No. of times crop grown in a year	Fish Pond I (Desi poultry)		Fish Pond II (Duck)		Fish Pond III (Turkey)	
		Yield kg/cent	Net Return (₹)/cent	Yield kg/cent	Net Return (₹)/cent	Yield kg/cent	Net Return (₹)/cent
Amaranths	8	31.33	313	33.00	330	29.67	296
Coriander	9	49.33	493	54.00	540	44.67	446
Mint	2	11.00	110	17.00	170	5.00	50
Ribbed gourd	4	24.00	360	31.00	465	17.00	255
Snake gourd	4	13.67	205	16.00	240	11.33	170
Bitter gourd	4	19.67	295	22.50	337	16.83	252
Radish	3	29.00	435	33.70	505	24.30	364
Redgram	Perennial crop	5.67	226	9.00	360	2.33	93
Banana	1	72.33	868	84.50	1014	60.17	722
Total		256.00	3306	300.70	3962	211.30	2650

Table 2: Fruits and vegetables produced in embankment of fish pond during 2016 – 2017.

Fruits and vegetables	No. of times crop grown in a year	Fish Pond I (Desi poultry)		Fish Pond II (Duck)		Fish Pond III (Turkey)	
		Yield kg/cent	Net Return (₹)/cent	Yield kg/cent	Net Return (₹)/cent	Yield kg/cent	Net Return (₹)/cent
Amaranths	8	59.67	596	63.00	630	56.33	563
Coriander	8	44.00	440	47.00	470	41.00	410
Mint	3	8.67	86	10.00	100	7.33	73
Ribbed gourd	4	21.33	320	24.50	367	18.17	272
Snake gourd	4	12.00	180	15.50	232	8.50	127
Bitter gourd	4	17.67	265	20.30	304	15.03	225
Radish	3	24.00	360	26.90	403	21.10	316
Redgram	Perennial crop	3.67	146	5.00	200	2.33	93
Banana	1	89.33	1072	102.00	1224	76.67	920
Total		280.33	3467	314.20	3932	246.47	3002

Table 3: Quantity of vermicompost obtained through recycling of farm waste and employment generation during 2015-16 and 2016-17

Cycle	Vermicompost obtained (kg)	Employment generation of nutritional garden (man days/year)
2015 – 2016	15668	63
2016 – 2017	18803	57

Nutritional security

The production of fruits, vegetables and greens improved the nutritional security of the small and marginal farm family. The consumption of vegetables, fruits and greens increased 50-250 % in tribal people of Nicobar island, India (Swarnam *et al.*, 2014) [5]. The diet diversity also indicates the food and nutritional security where the diet which includes diverse types of foods is internationally considered as a healthy one. The number of food items consumed by the small and marginal farm family has increased by inclusion of variety of vegetables, greens and fruits indicating more diversified food consumption ensuring more food and nutritional security.

Supplementary Farm Income

The surplus produce of fruits and vegetables was sold in the market earning supplemental/additional income of about Rs. 9,918 and Rs. 10,401 per annum was obtained from fruits and vegetables cultivated on the nutritional garden with an area of 160 m^2 during 2015-16 and 2016-17, respectively. Similarly, the additional income of Rs 18339 per annum was obtained from the fruits and vegetables cultivated on the pond dykes with the per day return of Rs 55 in Karnal (Pramanik *et al.*, 2013) [4]. Supplementary income of Rs. 7750 was obtained from the farming system model within the limited resources available in the Nicobar island of India (Swarnam *et al.*, 2014) [5]. The additional income was reflected in the increased consumption of cereals and pulses enabling the household to improve the share of cereals and pulses in their daily food intake resulting in a more balanced consumption of food.

Employment generation

The integrated farming system has generated employment opportunities especially for women and is spread uniformly throughout the year. A total of 63 and 57 man days were generated in nutritional garden of the system only engaging family labour mainly women throughout the year during 2015-16 and 2016-17, respectively. As the small and marginal farm household women were directly involved in the farm activities enabled them to make decisions on farm operation and the use of surplus produce.

Residue recycling and resource flow

The nutritional garden wastes used for composting along with cattle, goat and poultry manure. A total of 15,668 and 18,803 kg of vermicompost was produced in a cycle of one year during 2015-16 and 2016-17, respectively. The vermicompost was used for manuring the crops grown in nutritional garden as no chemical inputs were applied and only organics were used. Continuous application of vermicompost to meet out the nutrient requirement of crops grown in nutrition garden has sustained the soil fertility. The synergistic interaction of the farming system in terms of labour, resources and residue recycled are depicted in Fig 1.

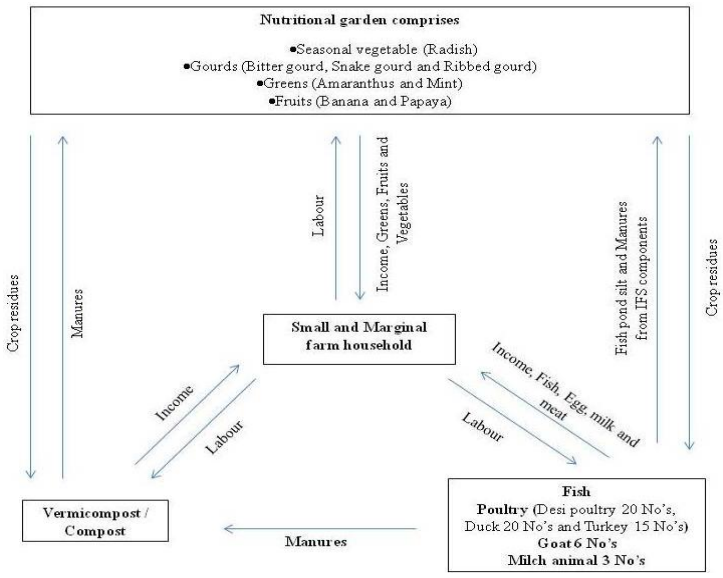

Fig 1: Resource flow between components in an innovative integrated farming system in lowland ecosystem

Conclusion

Integrated farming system research is a multidisciplinary holistic approach to solve the problems of small and marginal farmers. Small and marginal farmers are the core of the Indian agrarian rural economy constituting 80% of the total farming community but possessing only 36% of the total operational land holdings. The declining trend of per capita land availability poses a serious challenge to the sustainability and profitability of tribal farmers. Under such situations, it is appropriate to integrate land based enterprises, *viz.*, dairy, crop production and horticulture crops within the farm with the objective of generating adequate income and employment for these small and marginal farmers and thereby improve and sustain their livelihood. The small scale nutritional garden in integrated farming system model resulted in increased on farm production of diversified food items resulting in nutrition security of small and marginal farm household besides providing additional income and employment opportunities of small and marginal farm households especially for women. The composting of farm wastes resulted in residue recycling within the system and to meet the nutrient requirement for crop production in nutritional garden thereby reducing the dependence on external inputs. Such model can be formulated where the small and marginal farm household dominated areas to improve livelihood security of the individual household.

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