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Integrating veterinary and poultry component with rice-based farming system for effective utilization of resources, environmental restoration and profitability

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Abstract
Dependence on crop alone is like a gamble where the farmer's face the problem of crop failure or poor returns. Integrating veterinary components into rice based cropping system seems to provide farmers a risk-free alternative that will enahcne their income and productivity while optimizing resource use for small and marginal farmers. Hence, a field investigaion was conducted to with the objective of effect utilization of resource by integrating veterinary component with rice cropping system for enhancing the productivity and profitability. The field study involves conventional farming system compared with integrated farming system. In regular system farming system rice - rice - pulses cropping system was followed in 4000 m^2 area. Under integrated farming system, rice - rice - pulses (2000 m^2), fish pond (800 m^2), veterinary component (1100 m^2) and animal fodder (100 m^2) were integrated. In an integrated farming system, the waste from one component is used as a resource for another. In comparison to a typical farming system, integrating veterinary, poultry, and fish production with rice crop yielded higher net returns, gross returns, and benefit cost ratios. It is recommended that dependence of crop alone will give less return, whereas integrating farming system would reduce the cost of input for crop and result in higher profitability.

Keywords: Conventional farming, integrating farming system, veterinary, poultry, profit

1. Introduction
Farmers' primary source of income and employment opportunities is agricultural production, which is highly unpredictable. The country's declining per capita land supply and steadily rising population limit the potential for horizontal land development for agriculture. The only viable option is vertical expansion through the integration of farming and related businesses, which will need less time and space while guaranteeing farm families adequate profits. In this situation, integrating different agricultural allied component such as cropping, veterinary, fisheries, poultry, etc. has a lot of promise for the agricultural economy and is a good way to help small and marginal farmers earn more revenue. In addition to supporting the sustainability of farming, these affiliated businesses help to increase family labor employment year-round and complement the income of farmers (Murugeswari, 2019) [12]. An integrated agricultural system is essential to addressing the issue of the world's growing population's need for food, as well as a means of boosting small-scale farmers' meaurements and nutrition. In order to complement farm revenue, elements like dairy, poultry, fish culture, sericulture, biogas generation, edible mushroom cultivation, agro-forestry, etc., are crucial. The ideal component guarantees complete bye-product use and should integrate seamlessly with farm level infrastructure. Furthermore, one alternate method for mitigating the effects of climate change is the integrated farming system. An integrated farming system is essential in this situation of coexisting land degradation and carbon emissions to guarantee food security. Moreover, rearing fish in ponds, cattle and poultry beside or above the pond provides continuous organic fertilization to the pond. Using cattle and feed wastes profitably improves the efficiency and profitability of fish culture as well as livestock production (Mali Hansram *et*

al., 2014) [10]. Usually the components differ in their use of resources when they are in integration, they can complement one another and use resources more efficiently, which typically results in higher productivity of the system (Harisudan *et al*., 2009) [7]. At present situation, the dual goals of improved resource efficiency and increased yield should be the focus of scientific agriculture (Harisudan and Subrahmaniyan, 2020) [5]. The primary goals of an integrated agricultural system are to reduce greenhouse gas emissions, provide livelihood and food security, accomplish sustainable crop production with increased productivity, and adapt to climate change. With this background field study was conducted by integrating various component with rice cropping system.

2. Materials and Method

Field experiment to identify a suitable Integrated farming system for wetland rice ecosystem was conducted at Regional Research Station, Vridhachlam, Tamil Nadu, India during 2020 to 2022. The objective of the study is to work out the profitability of integrated farming system and resource use efficiency. The study area's predominant soil type was red laterite soil, with a low available nitrogen, medium phosphorus and potash content. Two methods of farming system practices *viz*. Conventional farming system was compared with integrated farming system. In regular farming system practices, rice - rice - pulses cropping system was followed in 4000 m^2 area. The first crop rice was raised during kuruvai followed by second rice crop during Samba season followed by blackgram during summer season. Under integrated farming system, rice - rice - pulses in 2000 m^2, fish pond in 800 m^2, veterinary + fodder component in 1200 m^2 were integrated. The veterinary component involves 16 numbers of sheep and cumbu napier grass was raised as fodder for the sheep component. *Leucaena leucocephala* (Subabul) was raised as border crop which could be used as fodder for the cattle. The fish pond was erected in 40 x 20 m area with a depth of 1.8 m. The rain water is collected during rainy season wherein the pond could collect around 12 lakh litres of water. Fish composite culture *viz*., Cutla (surface feeder), Rogu, Mirgal, Common and grass carp each @ 300 fingerlings were let into the fish pond for rearing. Poultry shed of size 12' x 6' was erected over the fish pond. The poultry unit comprises of 50 aseel variety. Since it is a farming system experiment conducted in larger area specific design and replication is not required. Both poultry and sheep were vaccinated regularly. The productivity of each component was recorded and the total resources used for crop, poultry, veterinary and fishery component were calculated and the economics were computed in terms of Indian Rupee.

3. Results

The results of the comparison study of conventional farming system with integrated farming system showed significant result in productivity and profitability. Rice crop under conventional cropping system recorded lower grain yield of 4,796 kg/ha during first season and 5,124 kg/ha during second season and 658 kg/ha of black gram yield. However, under integrated farming system higher rice grain yield of 5,645 kg/ha was recorded during first season, 6,185 kg/ha was recorded during second season and blackgram yield of 784 kg/ha. The conventional farming involving rice - rice - pulses cropping system fetched a total gross income of Rs. 96,600 with net return Rs. 53,200 with benefit cost ratio of 2.25 in 4000m^2 in a year. Whereas in integrated farming system, the veterinary component fetched Rs.1,50,000 as gross income and net income of Rs.1,20,000 in a year. Fish rearing recorded Rs.1,30,000 as gross income and net income of Rs.1,15,000 in a year. By poultry rearing an additional gross return of Rs.15,000 and net return Rs.10,000 was obtained in a year. The integrated farming system as a whole integrating veterinary, poultry, fishery with crop component recorded higher gross income of Rs. 3,31,800 with net return Rs. 2,75,100 in the same area of 4000 m^2 in a year.

Table 1: Comparison of Conventional farming system with Integrated farming system

Enterprises	Area (m^2)	Productivity (kg/ha)	Expenditure (in Rs.)	Gross Income (Indian Rupee)	Net Return (Indian Rupee)	Benefit Cost Ratio
T_1 - Conventional Farming System (Rice - Rice - Pulses)						
Rice	4000 m^2	4796	16400	36600	20200	2.23
Rice	4000 m^2	5124	18400	44000	25600	2.39
Pulses	4000 m^2	658	8600	16000	7400	1.86
Total (4000 m^2)			43400	96600	53200	2.25
T_2 - Integrated Farming System (Crop + fish + veterinary + poultry)						
Rice	2000 m^2	5645	7700	18750	11050	2.44
Rice	2000 m^2	6185	8400	23100	14700	2.75
Pulses	2000 m^2	784	4100	8450	4350	2.06
			20200	50300	30100	2.49
Veterinary (15 Sheeps)	1200 m^2		30000	150000	120000	-
Fish pond (1500 fingerlings)	1200 m^2		15000	130000	115000	-
Poultry (50 Aseel)	-		5000	15000	10000	-
			70,200	3,31,800	2,75,100	

The waste from cattle and poultry is a significant resource that may be used as manure for agriculture and feed for other livestock enterprise (Karu Pasupathi. 2019) [9]. The average amount of urine and dung collected from the poultry and cattle is provided below.

Table 2: Amount of urine and dung from poultry and veterinary component

Animal type	Urine		Manure	
	Litre/day	Litre/year	Kg/day	Kg/year
Sheep	0.72	263	1.74	635
Poultry	-	-	0.03	11.0

4. Discussion

Under integrated farming system, the rice grain yield and blackgram yield is higher compared to conventional cropping system. The higher system yield may be because of integration of inorganic fertilizers along with organic manures received from the various component of the integrated farming system would have released nutrients to crops slowly and steadily during the entire crop period (Maruthupandi and Jayanthi, 2018) [11]. The organic nutrient source would have favoured the strong biological environment in the soil where microbes and plants interact directly, facilitating the plants' easy access to nutrients (Harisudan *et al*., 2010) [8]. Providing good soil health with enhance the crop productivity (Subrahmaniyan *et al*., 2018) [15].

In integrated farming system, agricultural wastes can be utilized as animal feed in a farming system, and manure from poultry and veterinary sources can increase agricultural production by boosting nutrients that improve soil fertility and lowering the need for inorganic fertilizers (Gupta *et al*., 2012) [4]. It has been claimed that the traditional farming system can be improved on sustainable and eco-friendly basis by integrating veterinary component with crops (Dhiman *et al*., 2003) [3]. The usage of manure from the veterinary component would have reduced cost of fertilizer resulting low cost of cultivation of rice crop. Including a cattle component in the system improves family nutrition, creates cash income, and recycles livestock waste and crop residues into valuable sources of nutrients for crops, all of which contribute to sustainability (Saxena *et al*., 2003) [14]. Similar results of high gross income and net income was recorded from the integrated farming system studies reported by Channabasavanna *et al*., (2002) [2]. Likewise, Bhuvaneswari *et al*., (2020) [1] evaluated several IFS models and determined that, in terms of output and employment creation (752 man-days/year), crop + fish + poultry + veterinary was the best integrated farming system since it better involved farm family laborers throughout the year. Location specific and economically viable technology will result in higher economic returns (Harisudan, C and Nisha Sapre. 2019) [6]. The best option to meet the rising per capita food demand is through vertical development combined with an integrated farming system (Ramesh *et al*., 2019) [13]. Utilizing the rice area by integrating with location specific component through proper understanding of the system ecology will increase the system's profitability and productivity (Harisudan and Nish Sapre, 2019) [6].

5. Conclusion

For sustainable agriculture and to increase the standard of living, farmers can switch to an integrated farming system that includes crop + veterinary + fish + poultry as a system, as opposed to crop alone.

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