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Evolving Suitable Integrated Farming System Model for Irrigated Upland

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ABSTRACT

The field experiment was carried out to identify the best suitable farming system for irrigated upland conditions in the Cauvery delta region. Four cropping systems were practiced in the Zaid season of 2023 at Block F_2 in the experimental farm of the MIT College of Agriculture and Technology, Vellalapatti, Mangalam village, Musiri, Trichy, Tamil Nadu. The farming systems included fish, poultry, Azolla, and crops like maize, cowpea, brinjal, bhindi, banana, coconut, moringa, papaya, cucumber, watermelon, and ridge gourd. It was framed as if the integration of ridge gourd, cucumber, and watermelon with fish and poultry produced more profit. The crop sequence involved in crop activity in the integrated farming systems contributed to 45.60 percent of the productivity, followed by poultry (27.77 percent) and fish (26.63 percent). The integration of poultry and fish with an improved cropping system of ridge gourd yielded the highest gross and net return of Rs. 33597 among different farming systems.This system also resulted in a higher per-day return of Rs. 627 with a benefit-cost ratio of 2.4. The lowest BC ratio of 1.4 was recorded in poultry, fish, and Azolla with an improved cropping system. Multi-component farming is the only way to efficiently recycle resources within the system with increased economic profitability, economic stability, enhanced soil sustainability, preserving environmental quality, and maintaining biological diversity and ecological stability.

KEYWORDS: Integrated Farming System, Effective utilisation, Profitability,by products.

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INTRODUCTION

A farming system is the result of complex interactions among a number of interdependent components, where an individual farmer allocates certain quantities and qualities of four factors of production, viz., land, labor, capital, and management, to which he has access[2].IFS are an integrative whole-farm approach that is effective in solving the problems of small and marginal farmers. The aim of IFS is to boost employment and income from smallholdings by integrating various farm enterprises and recycling crop residues and by-products within the farm itself. The farmers need to receive a regular income to live at least above the poverty line. Components of IFS include: A. Agriculture: horticulture, forestry, dairy, fish farming, and duck rearing B. Mushroom cultivation: sericulture, azolla farming, kitchen gardening, fodder production, nursery C. Seed Production: Vermiculture, Pigeon Rearing, Apiary, Goat Rearing, and Poultry D. Sheep rearing: piggery, rabbitry, Value addition[3]. IFS helps reduce the use of chemicals (fertilizers and pesticides) to provide chemical-free, healthy produce and better environment for the society[4]. Lack of scientific knowledge on the rearing of animals, unavailability of improved breeds in the local markets, and lack of financial support respectively are the major constraints in IFS[5].The integrated farmers from Palladam district of the Western Zone of Tamilnadu indicated the insufficient quantity of fodder for their livestock during the off-season as a constraint in IFS[6]. IFS is the scientific integration of different enterprises, such as crops, fruits, vegetables, livestock, poultry, and fish, along with adequate nutrient recycling strategies (composting and vermicomposting) and the use of water from farm ponds.[1]The study of farming systems and the application of components in farming systems approaches can bring a ray of hope for the betterment of farmers. Keeping all these factors in mind, the present study was conducted to identify the optimum combination of crops, poultry, and other farming enterprises that can provide maximum benefit.

2. MATERIALS AND METHODS

2.1. Site Description

A field experiment was conducted in the Zaid season (March to June) during the year 2023. The study was practiced at the F2-block in the experimental farm, at MIT College of Agriculture and Technology, Vellalapatti, Mangalam village, Musiri, Trichy district of Tamil Nadu. The farm is located at 78.4496° E longitude and 11.1220° N latitude. The soil type is red loamy and the elevation is about 82 MSL.

2.2. Experiment

2.2.1.Land Preparation

First, select the 52.5 cents area of low, elevated, and waterlogged fields nearest to the livestock units located in the F2 block of the experimental farm. A fish pond was excavated in an area of 7.1 cents, with a length of 13.7m, width of 13.9m and a depth of 4.5 meters. Initially the pond was puddled using a tractor for soil compaction. The bunds of the pond were plastered to prevent seepage. A poultry shed of the size of $12m^2$ was constructed using iron mesh above the pond in the left-side corner. The shoulders of the pond was cleared of weeds levelled and planted with crops like banana, coconut, brinjal, tomato, chilli and maize. Drip irrigation system was provided for these crops.

2.2.2. Area Covered Under Different Farming System

Field experiments through non-replicated trial, was carried out on 52.5 cents area to identify the best combination of integrated farming system. The area was divided into different components. The cropping sequences tried were maize 0.63 cents, cowpea 4.6 cents, brinjal 1.8 cents, bhendi 1.5 cents**,** coconut 28 cents, banana 3.2 cents, moringa 0.5 cents, papaya 1.6 cents**,** cucumber 1.06 cents, watermelon 1.06 cents and ridge gourd 1.06 cents. Total cropping area is around 45 cents in the integrated farming system. The remaining area of 7.5 cents was allotted to other allied components in the farming system, *viz.*, the fishery unit and the poultry unit.

2.2.3. Poultry with Fish Integration

In the direct integration method, the sheds are placed 1.2–1.5 m above the pond's upper surface. One bird requires 1 to 2 square feet of space in the shed so 60 number of Aseel birds were reared in the cage.The poultry feed is pellets, broken rice, and vegetable waste. Their droppings fell into the fish pond and acted as feed for the fish. The fish grown were tilapia (5 months) and common carp (7 to 10 months). In the early stages, fish consume 1/4 kg of groundnut cake and 1/4 kg of rice bran tied in the gunny bag and hung in the pond with the help of rope. Poultry manure contains 25.5% organics, 1.63% nitrogen, 1.54% phosphorus, and 0.83% potassium.

2.2.4. Crops

Most of the crops are fast growing. The crop components include maize, cowpea, brinjal, bhendi, banana, coconut, moringa, papaya, cucumber, watermelon, and ridge gourd. The waste materials obtained from these components were used as input for other components. Intercultural operations were

done on time, including weeding, earthing up, nutrient management, and controlling pests and diseases by spraying neem oil and panchagavya in an organic way.

The seedlings were transplanted after root-dipping with *pseudomonas fluorescence* to control soil-borne pests and diseases. The crops were planted on the shoulders of the pond such that smaller areas were allocated for each crop and irrigated through drip system. Cowpea a drought tolerant crop was grown on the walls of the pond, as it doesn't need much water, can tolerate drought and grow well. Maize was sown on the outer slope of the IFS unit, which had the possibility of being affected by army worm and cutworm. The maize seeds were pre-treated with cow urine to avoid fungal diseases and pests. The pest incidence in maize was controlled by traditional method of applying dry sand on top of the plant. Apart from the different crops used in the upland ecosystems, fish and poultry help in best integration.

Table:1. Treatment details of Farming system

S.No	**Treatments**
T_1	Conventional cropping system with crop alone
T_2	Cropping system +Poultry
T_3	Cropping system + Poultry +Fish
T4	Cropping system + Poultry +Fish+Azolla

2.2.5. Measurement

Growth parameters like plant height, leaf area index (LAI), and number of branches per plant were measured in different growth stages like 30, 60, and 90 DAS. Yield parameters like grain yield and dry matter production were also recorded. The weight of the chicken was recorded at weekly intervals, and the total eggs produced were recorded. The fish were harvested and the total production was recorded.

3. RESULTS AND DISCUSSION

The productivity of components, economic returns, employment generation and resource recycling of different farming systems were evaluated to identify the best integrated farming system. Observations on yield attributes, yield and economic returns of each crop and the cropping system were

recorded to identify the sustainability of the system through the recycling of residues. Experimental results on farming systems for irrigated uplands revealed that integration of improved cropping systems with allied components, like poultry and fish components, resulted in higher productivity when compared to other systems. During 2023, the highest productive yield of 126 kg of ridge gourd was obtained. An equivalent yield was obtained by the integration of poultry and fish with the cropping systems of bhendi, brinjal, maize, cowpea, and ridge gourd. The above result was similar to the findings[10].The crop sequence involved under crop activity in the integrated farming systems contributed 45.60 percent of the productivity, poultry (27.77 percent), and fish (26.63 percent), respectively. Among the different farming systems, the highest gross and net returns of Rs. 33597 were obtained due to the integration of poultry and fish with the cropping systems of Bhendi-brinjal and maize + cowpea-ridge gourd, respectively.

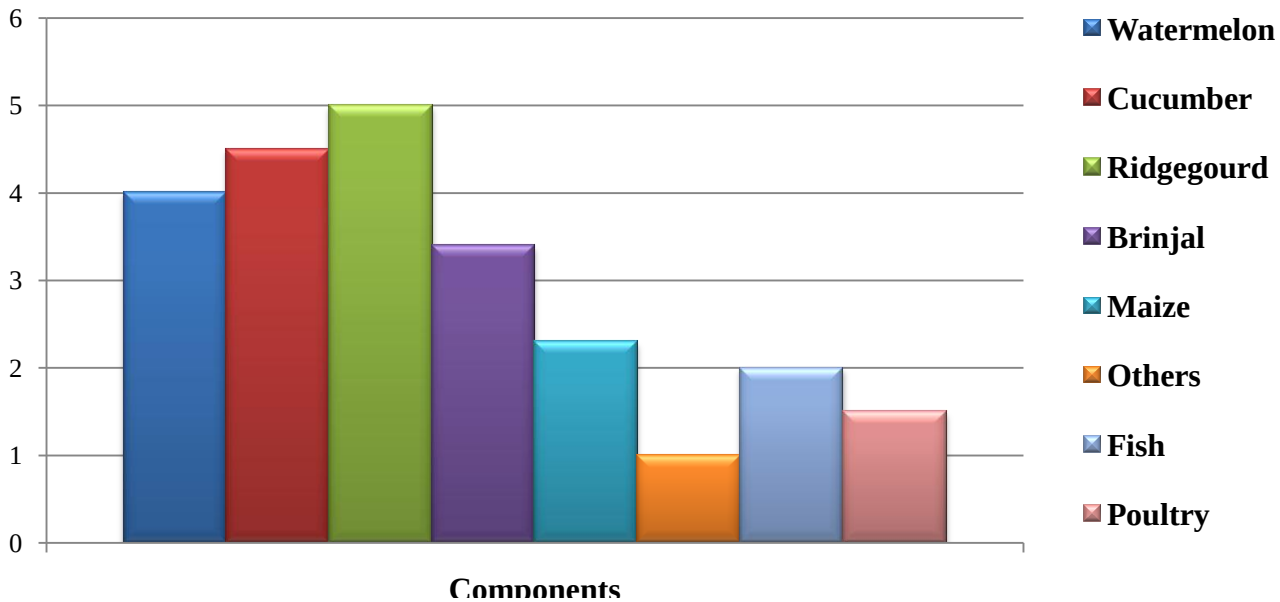
This system also resulted in a higher per-day return of Rs. 627 with a benefit-cost ratio of 1.9. Lowest BC ratio of 1.4 recorded in poultry, fish, and azolla with improved cropping systems in this finding before.[7]An integrated farming system with cropping systems, along with the integration of poultry components and fish, provided higher employment opportunities for family labor. The conventional cropping system alone provided an employment opportunity of 97 man days (0.26 ha) per year during 2023, whereas integrated farming systems involving maize, cowpea, bhendi, brinjal, coconut, and banana generated 115 man days of employment during 2023. Integration of improved cropping systems with poultry and fish farming systems provided the highest employment opportunity of 196 man days (0.26 ha) per year, with a contribution of crop activity in the integrated farming systems contributing 45.60 percent of the productivity, poultry (27.77 percent), and fish (26.63 percent) components during 2023. The above results are similar to those.[9]

Table: 2. Economics analysis of different cropping system during -2023

Sl. No	Treatments	BCR
T_1	Conventional cropping system with crop alone	1.5
T_2	Cropping system +Poultry	1.7
T_3	Cropping system + Poultry +Fish	1.9
T_4	Cropping system + Poultry +Fish+*Azolla*	1.9

Table:3.Yield parameters different of crops in cropping system with crops alone

Sl.No	Crops	No of branch /plant	No of fruits/branch	No of fruits /plant	Area (ha)	Total yield(kg)
1.	Ridge gourd	7.2	15	100	0.00375	126
2.	Water melon	6.5	1	4	0.001	30
3.	Cucumber	6.9	2	10	0.008	50
4.	Brinjal	10.3	2	18	0.0072	72
5.	Bhendi	3.09	6	19	0.00612	25
6.	Moringa	5	60	300	0.00201	201.6
7.	Papaya	1	-	40	0.0064	86
8.	Banana	**No of hands / bunch**	**No of fingers / hands**	**No of fingers / bunch**	Area	Yield (kg)
		9	13	100	0.01296	259
9.	Maize	**No of cobs / plant**	**No of grains / row**	**No of rows / cob**	Area	Total yield (kg)
		2	25	12	0.0025	51
10.	Cowpea	**No of pod/plant**	**No of pod/branch**	**No of grains/pod**	Area	Total yield(Kg)
		20	4	15	0.0187	56



Graph.1: Yield parameters of different components in integrated farming system

4. CONCLUSION

To enhance and sustain productivity, economic returns, year-round employment for family labor, and enhanced soil fertility with nutrient recycling, poultry (60 chicks) and fish (300) with an improved cropping system of Bhendi-brinjal and maize-cowpea-ridge gourd (126 kg) could be the best integrated farming system for irrigated upland. Banana, coconut, cucumber, watermelon, fodder maize, papaya, and bhendi cropping systems integrated with allied components, viz., fish (7.5 cent area) and chicken for egg production, could be the alternate integrated farming system for irrigated upland.

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