Farming Systems Approach: Real Time Way for Sustainability and Profitability in Agriculture

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The human population of India has increased to 1.385 billion at a growthrateof1.2% in 2020 and isestimated to increasefurther to 1.52 billion by 2036 with 70% of increase in urban areas. On the other hand, our national food grain production for past 3-4 years is hoveringaround 234 million tones. There are projections that demand for food grains wouldincrease to 355 million tonnes in 2030. The average size of land holding has declinedto 1.21ha during 2009-10 from 2.30 ha in 1970-71. Declining size of land holdings without any alternative income augmenting the opportunity is resulting in fall offarm incomeandcausing agrariandistress. The current scenario in the country indicates that area under cultivation may further decrease and more than 20% of current cultivable area will be converted into non-agricultural purposes by 2030.

Small and marginal farmers are the core of Indian agricultural rural economy consisting 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 small and marginal farmers. Also, in agriculture majority of the farm holdings are dry lands and even irrigated areas depend on the monsoon. In this context, if farmers are only concentrated on crop production they will be subjected to a high degree of unsustainability in income and employment. The income from cropping system only for an average farmer is hardly sufficient to sustain his family. Hence, it is imperative to manage certain strategies forrural marginal farmers by combining the different enterprises to ensure profitability while preserving the environment and increase the productivity and supplement the income. Integrated farming system is a multi-disciplinary holistic approach to solve the problems of small and marginal farmers.

The need for farming systems approach in the present scenario is mainly due to high cost of farm inputs, fluctuation in the market price of farm produce, risk of crop harvest due to climatic vagaries and biotic factors. Environmental degradation, depletion in soil fertility and productivity, unstable income of the farmer, fragmentation of holdings and low standard of living add to the intensity of the problem. To meet the multiple objectives of poverty reduction, food security, competitiveness and sustainability, several researchers have recommended the Farming Systems Approach to research and development.

What is Farming Systems Approach and what it does

It is an approach for developing farm - house hold systems, built on the principles of productivity, profitability, stability and sustainability. All the components are complimentary and supplementary to each other and the development process involves participation of rural communities. The Farming Systems Approach emphasizes understanding of farm house hold, community interlinkages, reviews, constraints and assesses potentials and it combines improvements desired from better technology. It needs efficient support services and requires better policies. It is continuous, dynamic and interactive learning process based on analysis, planning, testing, monitoring and evaluation.

Concept of Farming Systems

Farming system concept was developed in1970 and it is designed to understand farmer priorities, strategies and resource allocation decisions and is anintegrated set of activities that farmers perform in their farms under their resources and circumstances to maximize the productivity and net farm income on a sustainable basis. In other words, it is an appropriate mixes of farm enterprises and the means available to

the raise them for profitability. In its real sense it will help in lifting the economy of agriculture and standard of living of the farmers of thecountry as a whole. Its goal is to develop sustainable land use system which will optimize resource use and increase income and employment for farm families. The integration is made in such a way that the output of one enterprise/ component should be the input for the other enterprises with high degree of complementary effects. Crop residues can be used for feeding to animal, while enhancing the agricultural productivity should be done through utilization of manure from livestock by intensifying nutrients that improve soil fertility as well as reducing the use of chemical fertilizers.

Farming System represents an appropriate combination of farm enterprises (Cropping systems horticulture, livestock, fishery, forestry, poultry etc.,) and the means available to the farmer to raise them for profitability. It interacts adequately with environment without dislocating the ecological and socio-economic balance on one hand and attempts to meet the national goals on the other.

Specific Objectives

1. To identify existing farming systems in specific areas and access the irrelative viability.
2. To formulate farming system model involving main and allied enterprises for different farming situations.
3. To ensure optional utilization and conservation of available resources and effective recycling of farm residues within system
4. To maintain sustainable production system without damaging resources/environment
5. To rise overall profitability of farm household by complementing main /allied enterprises with other

Keyprinciples of Farming systems are

Cyclic: Farming system is essentially cyclic (organic resources– livestock –land–crops). Therefore, management decisions related to one component may affect the others.

Ecologically sustainability: Combining ecological sustainability and economic viability, the integrated livestock–farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

Rational: Using crop residues more rationally is an important route out of poverty.For resource-poor farmers, the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production.

Criteria for classification of Farming systems

Available natural resource base, including water, land, grazing areas and forest; climate of which altitude is one important determinant; land scape, including slope; farm size, tenure and organization; dominant pattern off arm activities and house hold livelihoods, including field crops, livestock, trees,aquaculture, hunting and gatheringand processing off farm activities; and taking into account the main technologies used, which determine the intensity of production and integration of crops, livestock and other activities.

Farming systems can be divided into eight broad categories depending on climate, resources and so on, available to the farmers in the regions. They are:

1. Irrigated farming systems
2. Wetland rice-based farming systems
3. Rainfed farming systems in humid areas of high resource potential
4. Rainfed farming systems in steep and high lands
5. Rainfed farming systems in dry or cold low potential areas
6. Dualistic (mixed large commercial and small holder)farming systems
7. Coastal artisanal fishing
8. Urban based farming systems, typically focused on horticulture and livestock production.

Key role of Farming Systems Approach in Agriculture is

- ❖ Food security
- ❖ Provide balanced food
- ❖ Quality food basket

- ❖ High productivity and enhanced farm income
- ❖ Effective recycling of resources
- ❖ Minimizing environmental pollution
- ❖ Employment generation

Farming Systems Strategies are

In view of serious limitations on horizontal expansion of land and agriculture, only alternative left is for vertical expansion through various farm enterprises required less space and time but giving high productivity and ensuring periodic income specially for the small and marginal farmers located in rainfed areas, dry lands, arid zone, hilly areas, tribal belts and problem soils. The location specific systems must be developed based on the available resources which will result into sustainable development of the region.

The following farm enterprises could be combined

- ❖ Agriculture alone with different crop combinations
- ❖ Agriculture+ Livestock
- ❖ Agriculture + Livestock + Poultry
- ❖ Agriculture + Horticulture + Sericulture
- ❖ Agroforestry+ Silvipasture
- ❖ Rice+Fishculture
- ❖ Rice + Fish + Mushroom cultivation
- ❖ Floriculture + Apiary (bee keeping)
- ❖ Fishery+ Duckery+ Poultry

For meaningful execution of integrated farm enterprises, the following activities should be under taken by multi-disciplinary team of extension professionals with farmer's participation and involvement at all stages.

Farming Systems Research for different Agro-Climatic zones in India

High altitude cold deserts: pastures with forestry, goats, rabbits and settled agricultural crops like millets, wheat, barley and fodders.

Arid and desert region: Animal husbandry with the camels, sheep and goats and growing fodder and field crops.

Western and central Himalayas: Horticultural crops as a major component and agriculture mainly on the hill terraces and slopes with maize, rice, wheat, pulsesand foddercrops.

Western Ghats: Major activity on plantation crops, cultivating rice and pulsesare the secondary agricultural activity. Cattle, sheep and goat are the livestock components which in most parts are maintain as large herds.

Delta and coastal plains: Rice cultivation with other enterprises like fishery, poultry and piggery etc., capture fisheries of marine ecosystem is a specialized enterprise.

Eastern Himalayas: Primitive crop husbandry with rice, millets and pulses etc.Agroforestry system is common. Piggery and poultry are the chief livestockactivity.

Indo-Gangetic plains: Intensive crop husbandry like rice–wheat–maize/mustard/pulses and livestock, dairy, cattle and buffaloes

Central and southern highlands: Cotton – sorghum – millets/pulses with dairy cattle, sheep and goats and poultry are the secondary livestock and animal husbandry enterprises.

Factors influencing Integration of Farm Enterprises

1. Soil and climatic features of the selected area.
2. Availability of the resources, land, labor and capital.
3. Present level of utilization of resources.
4. Economics of proposed integrated farming system.
5. Managerial skill of farmer.

Integrated Farming System (IFS)

IFS is a component of Farming system research introduces a change infarming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources. The farm wastes are better recycled for productive purposes in the IFS. Unlike the specialized farming system, IFS's

activity is focused round a few selected, interdependent; inter related and often interlinking production systems based on few crops, animals and related subsidiary professions. IFS envisage harnessing the complementarities and synergies among different agricultural subsystems, enterprises and augmenting the total productivity, sustainability and gainful employment.

An intensive IFS addresses two issues; reduction of risk with the monoculture activities and promoting enterprise diversification, value addition and development of alternative income sources with efficient utilization of farm resources and it brings about enterprise diversification for sustainability and additional benefits, better management of important farm resources like land, labour and capital etc., provides an opportunity for effective recycling of the product and by–products, helps to generate flow of cash to the farmers round the year by way of disposal of milk, fruits, fuel, manure etc., beside other agricultural output.

Goals of IFS are

- Maximization of yield of all component enterprises to provide steady and stable income.
- Rejuvenation of system's productivity and achieve agro-ecological equilibrium
- Avoid the build-up of insect-pests, diseases and weed populations through natural cropping system management and keep them at a low level of intensity.
- Reducing the use of chemicals (fertilizers and pesticides) to provide chemical-free healthy produce and environment to the society.

Different components of IFS

1) Field crops 2) Crop production 3) Vegetables 4) Fruit cultivation 5) Poultry farming 6) Livestock integration 7) Duckery 8) Aquaculture 9) Agroforestry 10) Bee-keeping 11) Mushroom cultivation and 12) Bio-gas plant.

The possible components to be included for sustainable IFS models in Andhra Pradesh are field crops (Rice in low land areas, ID crops in upland areas), Vegetables (seasonal vegetables includes leafy vegetables for year round production), fruit cultivation (Papaya, banana, guava, sapota, pomegranate, citrus etc.), Poultry farming (Desi chicks, Kadaknath, aseel, grama priya *etc.*,), livestock integration (Dairy, goatary, piggery etc.,), Aquaculture (Fish & Prawn farming in coastal and agency areas), Agro-forestry, Beekeeping, Mushroom cultivation (Oyster mushroom in rice grown areas, Button mushroom in cooler areas etc.,) and Bio-gas plant.

Integrated Farming System models for different farming situations are

Wetland situation: Rice based cropping system with poultry cum fish culture

Crop –poultry–fishery

Cropping with diary

Cropping with goat rearing

Cropping with aquaculture.

Irrigated areas: Cropping with diary, biogas and silviculture

Rainfed areas: Cropping with goat and silvipasture

Hill regions: Majority ofthe farmers in the region are maintaining fruit tree likeapple, dairy cattle and the

major sources of green fodder comes from lopping of the fodder trees and locally available grasses

Research on Integrated Farming Systems in ANGRAU - Regional Agricultural Research Station, Maruteru, Andhra Pradesh

The preliminary research investigations under IFS approach advocates the benefits of farm productivity improvement by 30-50 % and more than double increase in the employment generation than arable farming alone, depending upon the number and kind of enterprises integrated. Integrated farming system works as a system of systems, which ensure that the wastes and/ or by product from one enterprise become a resource for another enterprise with high degree of synergy and complimentary effects on each other. The harvested straw/ stover and fodder fed to the cattle produces milk. The livestock excreta and litter produced from poultry will be used as manure for crops and fishery.

By analyzing these facts an improved IFS model was designed, tested and validated for 0.6 ha (1.5 acre) area to support a farm family of five members at RARS, Maruteru under AICRP on IFS Scheme with the main objective of generating adequate income and employment for the small and marginal farmers and identifying appropriate cropping systems with high productivity which suits the specific needs of the Godavari zone and efforts will be made with the aim to double the real farm income. The IFS model, presently have different enterprises *viz.*, crop production, horticulture, dairy, fishery, poultry, boundary plantation and vermicompost/ recycling of farm waste. This IFS model is eco-friendly having great potential to small and marginal farmers of Andhra Pradesh.

The five years of research study on wetland IFS model developed at ANGRAU-RARS, Maruteru shows that this 1.5 acre model produced an average gross returns of Rs. 1,41,115 which is equivalent of Rs. 2,35,192/- per hectare model (Table 2). After meeting all possible cultivation expenses, the average net returns of Rs. 90,977/- which is equal to Rs. 1,51,629/- per hectare with B:C ratio of 1:2.82 in addition to 429 Man Days. This clearly shows that, the small and marginal farmers can reap profits of minimum one lakh after meeting his family and livestock requirements.

Future research thrust

- Need to study the sustainability of the identified systems under different topographical situations in the long run including high value crops.
- Need to study the nutrient dynamics of soil with continuous cropping and recycling of manurial resources with different systems over time.
- Modeling of the identified farming system options to suit a given agro–climatic and socio–economic situation.

Need to identify the constraints in adoption of identified farming systems by the farmers for further refinement.

Conclusion

- Efficient utilization of scarce and costly resources is the need of the hour to make crop production a viable pre position in the present day competitive scenario.
- Following the concept of IFS through supplementation of the allied agro–enterprises by recycling the waste of one enterprise in another is a right step inthisdirection
- It provides alternate and sustainable avocation to marginal and sub – marginal farmers. Fruit, mushroom, apiary, animal production and poultry have been more viable with them.
- The crop residues and biomass available in plenty in the crop production system need to be properly managed to harness full benefits
- Improving the integrated approach not only enhances farm income but also overcomes environmental pollution
- A better planning and utilization of the available resources will make bright prospects for the farm economy as a whole.

Table 1. Components of Wetland IFS model developed at ANGRAU-RARS, Maruteru

#	IFS Components	Unit area
1	**Crop Component**	**2900 m²**
	i) Paddy-Paddy-Pulse	**1600 m²**
	ii) Maize-Green gram-Sesamum	**400 m²**
	iii) Red gram + Green gram – Sweet corn	**400 m²**
	iv) Fodder Jowar – Berseem/Cowpea	**400 m²**
2	**Dairy Unit**	**250 m²**
	Two Crossbred Buffaloes and Cattle shed	**100 m²**
	Vermicompost units (2 Nos)	**150 m²**
3	**Fishery Unit**	**1200 m²**
	Fish fingerlings @ 7500/ha and Fish Pond (1.5 – 2.0m depth)	
4	**Poultry Component**	**100 m²**
	Poultry shed on four corners of the fish pond (15 Nos Units - 2 Nos)	
5	**Horticulture Unit**	**1550 m²**
	i) Fruit trees like Banana, Papaya, Guava etc, including boundary plantations ii) Need based intercropping of seasonal vegetables with 5 boxes of Apiary iii) Floriculture (seasonal flowers) and Bio-fencing of Karonda at boundary iv) Threshing floor and submersible pump	
	TOTAL AREA (1.5 acres)	**6000 m²**

Table 2: Economics of wetland IFS model over 5 years average study from 1.5 acre model

#	Components	Gross Returns (Rs)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	B:C Ratio	Man Days
1.	Crop component	38,172	14,225	23,947	1:2.68	79
2.	Horticulture	18,193	5,250	12,943	1:3.47	55
3.	Poultry	6,886	1,950	4,936	1:3.53	24
4.	Dairy	42,852	22,750	20,102	1:1.88	255
5.	Fishery	20,546	5,500	15,046	1:3.74	14
6.	Value Addition	14,466	579	13,887	1:24.98	2
	1.5 acre	**1,41,115**	**50,138**	**90,977**	**1:2.82**	**429**
	I Hectare	**2,35,192**	**83,563**	**1,51,629**		

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