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Integrated Farming Systems for Rainfed Areas

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Integration of farming systems where, each component of the system has an important role in boosting ecosystem productivity and thus, ecologically, economically and socially, the integrated farming system is more sustainable. The emphasis in such systems is on optimizing resource utilization in addition to maximization of profits from individual component of the system. This article discusses some basics of integrated farming system with few examples of prominent components of the system in rainfed area.

Introduction

The modern agriculture emphasizes two dimensions viz., time and space concept. Time concept relates to increasing crop intensification in situation where there is no constraint for inputs. In rainfed areas where there is no possibility of increasing the intensity of cropping, the other modern concept i.e. space concept can be best suited. In space concept, crops are arranged in tier system combining two or more crops of different duration by modifying the planting method. Income through arable cropping alone is insufficient for bulk of the marginal farmers. Activities such as dairy, poultry, fish culture, sericulture, bio-gas production, edible mushroom cultivation, agro-forestry and agri-horticulture, etc., assumes critical importance in supplementing their farm income. Rainfed agriculture occupies 68% of India's cultivated area and supports 40% of the human and 60% of the livestock population. It produces 44.5% of the food requirement, thus has and will continue to play a critical role in India's food security. However, aberrant behaviour of monsoon rainfall, eroded and degraded soils with multiple nutrient and water deficiencies, declining ground water table and poor resource base of the farmers are principle constraints for low and unstable yields in rainfed areas. Increasing crop productivity to meet food requirements of increasing population in our country is a greater challenge. In this context, there is a need to enhance the productivity of rainfed crops from at least 1 to 2 tonnes to meet the food requirements by 2020 AD. Hence, the situation calls for efforts to intensify the production in both time and space. This

could be possible by developing appropriate cropping and farming systems in rainfed agriculture.

Cropping Systems

In order to critically analyse the crop and area specific problems and potentials, the rainfed areas have been divided into five major production systems *viz*., nutritious cereals/millets, oilseeds, paddy, pulses, cotton and soybean based systems. The guiding principles for selection of crops and varieties for efficient management of resources in rainfed areas are: land use capability concept, water availability concept, crop substitution, quantity and distribution of rainfall, soil depth and performance of crops. Effective growing period concept is mostly used in deciding cropping systems in different agro-climatic zones. In *kharif* or rainy season, the rainfall both in terms of quantum and distribution decides the effective growing season and it becomes critical in selecting cropping systems for a given reason. A beneficial effect of 15-25% on yield was demonstrated by the crop substitution strategy (Singh et. al., 1998), which means by replacing one crop with another appropriate crop, better yield can be obtained. Soil depth and available moisture determines the selection of crops and cropping systems for a given region. In *rabi* season available moisture in soil profile at sowing time dictates the choice of crops in a given cropping system. Intercropping (150% cropping intensity) is possible in regions having 20-30 weeks of effective growing season from 650-750 mm of rainfall (Singh, 2002). In areas receiving more than 750 mm of rainfall and having an effective growing season of more than 30 weeks double cropping (200% cropping intensity) is assured. Early planting and harvesting at physiological maturity of crops, less number of tillage operations, deep placement of fertilizers for *rabi*/winter crops are crucial for succeeding double cropping.

In rainfed agriculture, sustainability of yield becomes more important. While considering rainfall, and sustainable yield index, it was observed that paddy + Raddish (4:1) and Paddy + Blackgram (4:2) in Oxisols of Phulbani, Pigeonpea + Okra (1:1), Maize + Okra (1:1) in dry sub-humid inceptisols of Ranchi, Sorghum + Cowpea (Fodder) under delayed sowing conditions of Arjia, Pearlmillet + Pigeonpea (1:2) in vertisols of Solapur, Sunflower + Pigeonpea (2:1) in vertisols at Indore and Greengram + Castor in 230 mm semi arid entisols of Dantiwada recorded higher sustainability over the system (Ramarao et.al., 2005).

Crop Diversification

Cultivation of crops for dyes, medicines, and aromatics is economical in rainfed lands. They also played a vital role in sustained use of degraded lands. These crops are both perennial and annuals with plants mostly of bushy nature. The advantages of bushes over larger perennial are that the former offers less competition to associated crops. The promising plants for cultivation in drylands are dyes like Indigo (*Indigofera tinctoria* L.), Henna (*Lawsonia innermis* L.) and Bixa (*Bixa orellana* L.). Medicinal plants like Ashwagandha (*Withania somnifera* (L.). Dunal, Senna (*Cassia angustifolia* Vahl.),

Mucuna (*Mucuna pruriens* (L.), DC), and aromatics like curry leaf (*Murayya koenigii* (L.) Spreng), lemon grass (*Cymbopogan martini* (Roxb.) Wats), and sweet basil (*Ocimum basilium* L.).

Integrated Farming System

Integrated farming system (IFS) a component of farming system research (FSR), introduces a change in farming techniques for maximum production is a cropping pattern and take care of optimal utilization of resources. The farm waste is better recycled for productive purposes in the integrated farming system. Unlike specialized farming system (SFS), integrated farming systems activity is focused around a few selected, inter-dependent, inter-related and often inter-linking production systems based on few crops, animals and related subsidiary professions. Integrated farming system involves the utilization of primary produce and secondary produce of one system as basic input of other system, thus making the mutually integrated as one whole unit. There is a need to effective linkages and complementarities of various components to develop holistic farming system. (Singh et. al., 2007).

Goals of Integrated Farming System

The primary goal of FSR is to maximize the yield of all component enterprises to provide steady and stable income at higher level, rejuvenation of systems productivity and achieve agro-ecological equilibrium. Biotech stress management through natural cropping systems management and reducing the use of fertilizers and other harmful agro-chemicals to provide pollution free, healthy produce and environment to the society. Thus farming system as a concept takes into account of components of soil, water, crops, livestock, labour and other resources with farm family at the centre managing agriculture related activity. Integrated farming system has the advantages of increasing economic yield per unit area per unit time, profitability, sustainability and provides balanced nutritious food for the farmers, pollution free environment and provide opportunity for effective recycling of one product as input to other component, money round the year and solve the energy, fodder, fuel and timber crisis, avoids degradation of forests and enhance the employment generation, increase input use efficiency and finally improve the livelihood of the farming community.

Methodology to Organize Farming Systems under On-Farm Conditions

- **Farm selection**: Select the agro-ecological zone in which FSR is to be initiated. If necessary, further divide this agro-ecological zone to identify specific farming situation.
- **Selection of villages and farmers**: Select the village in each farming situation comprising marginal / small and medium / large farmers. Selection of village and farmers should be random so as to represent all farming community of the target area.
- **Diagnosis of constraints in increasing farm productivity**: Carry out survey through rapid rural appraisal. Prepare an inventory of farm resources and support services. Identify the production constraints.

- Research, design and technology generation and adoption
- Technology transfer and diffusion of improved farming systems within recommended domain.
- Impact of technology of improved farming system – productivity, economic returns, energy input – output, employment, equity (gender issue) and environment.

Rainfed Farming Systems

Traditionally rainfed farmers are small subsistent land holders integrating livestock with crop production. With continuing population growth, intensifying crop and livestock systems continue to play vital role in maintaining rural livelihoods. Farming systems refers to deliberate raising of crops, forest and fruit trees, animals including fisheries, piggery and duck farming, sericulture, mushroom, on a given unit of land to increase the productivity and profitability, to upgrade natural resource base and to achieve overall improvement in the environment. The philosophy behind shifting from cropping system to the farming system mode involves

i. *In situ* recycling of organic residues including farm wastes generated at the farm to reduce the dependency on chemicals.
ii. Decreases in cost of cultivation through enhance input use efficiency.
iii. Effective use of bye-products/wastes of one component for the benefit of other component/components.
iv. Upgrading of soil and water quality and bio-diversity.
v. Increased water productivity.
vi. Nutritional security through minimizing chemical residues in soil plant animal human chain, and
vii. Environmental security by operating flow of green house gases from the soil to environment.

Farming system provides a vast canvass of livelihood gathering, a better risk coping strategy, continuous flow of income and employment throughout the year for small landholders. It involves utilization of primary and secondary produce of one system as a basic input of other system through making them mutually integrated.

Predominant Components in Rainfed Systems

Crop based farming systems: In this system, animals are reared on agricultural wastes and animal power is used for agricultural operations and voids are used as manure and fuel. In rice based production system at Orissa, in situ conservation of rain water by optimum wear height, conserving excess water in the refuges constructed at the down stream of rice field and rearing of fish in the refuges in the medium land enhanced the total productivity (Sinhababu, 2001)

Agro forestry based farming systems: Perennial grass components, besides imparting stability to crop production in arid areas, also act as vegetative filter strips for prevention of wind and water erosion. Moreover, the grass component improves the soil organic matter and starts giving production from the establishment year onwards. Growing of grasses and legumes reveals that moth bean and mung bean in the ratio of 2:1 with grasses like *Lasiurus*

sindicus, *Cenchrus ciliaris*, *Cenchrus setigerus* and *Dicanthium annulatum*, are quite promising.

Livestock based production system: The livestock farming system in rainfed agriculture are complex and generally based on traditional socio-economic considerations. An understanding of production factors (livestock, capital, feed, land and labour) and processors (description, diagnosis, technology design, testing and extension) that effect animal production is pre-requisite for livestock integration. The productivity of livestock in farming systems in rainfed agriculture can be improved by increased fodder production as an intercrop with cereals, relay and alley cropping, forage production on bunds, improving the feeding value of stover by chopping, soaking with water, urea treatment, strategic supplementation of concentrate, urea molasses mineral block for enhanced utilization, improvement in productivity of grasses quantum and distribution decides the effective growing season and it becomes critical in selecting cropping systems for a given reason. (Ramarao *et.al* 2005)

Advantages of Integrated Farming System

Increased productivity, profitability, and sustainability are ensured with protective food and environmental safety. Recycling of waste material, income round the year, saving energy, meeting fodder crisis, employment generations and ultimately increasing the standard of living of the farmers are other major benefits of integrated farming system.

Conclusion

The integration of various enterprises on land holdings of various sizes tend to be more profitable than arable farming alone. Therefore, there is a need to spread IFS models in different agro-ecological regions to promote and widespread adoption of appropriate integrated farming systems for higher profitability.

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