Integrated Farming System In Rainfed Eco-System

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Manuscript No: KN-V1-01/020

Introduction:

Rainfed agriculture accounts for 68% of India's cultivated land and provides food for 40% of the human and 60% of the animal populations. It generates 445 percent of India's food requirements, and so has played and will continue to play a key part in the country's food security. However, abnormal monsoon rainfall behaviour, eroded and degraded soils with numerous nutrient and water deficits, a diminishing ground water table, and a poor farmer resource base are the primary restraints for low and unstable yields in rainfed areas (Singh et al, 2004). Increasing agricultural production to fulfil the food needs of our country's millions offers a significant challenge. In this context, it is necessary to increase the yield of rainfed crops by at least 1 to 2 t in order to fulfil food demands by 2020 AD. As a result, the situation necessitates measures to increase output in both time and space. This might be accomplished through the development of appropriate agricultural and farming methods in rainfed agriculture.

Cropping Systems:

Rainfed regions have been split into five key production systems in order to critically analyse crop and area specific issues and potentials, namely, Nutritious Cereals, oilseeds, Rainfed rice, Pulses, Cotton, and Soybean based systems.

The following concepts serve as a guide for choosing crop types and quantities in rainfed areas: land use capability, water availability, crop substitution, rainfall quantity and distribution, soil depth, and crop performance. The idea of an effective growth time is primarily utilised to determine cropping patterns across various agroclimatic zones. The amount and distribution of rainfall throughout the kharif season determines the effective growing season, which is important when choosing agricultural methods for a particular purpose.

Crop substitution, or the practise of substituting one suitable crop for another, has been shown to have a positive impact of 15–25% on production. A region's crop and cropping system selection is based on the depth of the soil and the amount of moisture that is available. The crops chosen in a specific farming system during the Rabi season depend on the amount of moisture present in the soil profile at the time of sowing and obtaining an effective growth season of 20 weeks and 350–600 mm of rainfall in some areas. It is possible to intercrop (150% cropping intensity) in areas with an effective growth season of 20–30 weeks and 650–750 mm of rainfall. Double cropping, or 2000% cropping intensity, is guaranteed in regions with an effective growing season of more than 30 weeks and more than 750 mm of rainfall (Singh and Subba Reddy, 1986). Successful double cropping depends on deep fertiliser placement for rabi crops, less tillage operations, early planting and harvesting of crops at physiological maturity, and these factors.

In rainfed agriculture, sustainability of yield becomes more important. While considering rainfall, and sustainable yield index it was observed that Rice + raddish (4:1) and Rice + blackgram (4:2) in Oxisols of Phulbani, pigeonpea + okra (1:1), Maize + Okra (1:1) in dry sub-humid inceptisols of Ranchi, Sorghum + cowpea (F) 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 semi-arid entisols of Dantiwada recorded higher sustainability over the system (Vittal, et al., 2002).

Crop Diversification: In rainfed soils, crop production for medicines, dyes, and aromatics is cost-effective.

They were also essential to the continued usage of degraded areas. These crops are both annuals and perennials, with bushy plants predominating. Bushes are preferable to bigger perennials because they provide related crops with less competition. Henna (Lawsonia innermis L.), bixa (Bixa orellana L.) and Indigofera tinctoria L. are among the dye plants that show promise for growth in arid regions. Herbal remedies such as Ashwagandha (Withania somnifera L. Dunalo, Mucuna (Mucuna pruriens (L.), DC), Senna (Cassia angustifolia Vahl.), and aromatics such as sweet basil (Ocimum basilium L.), lemon grass (Cymbopogan martini (Roxb.) Wats), and curry leaf (Murayya koenigii (L.) Spreng).

Rainfed Farming Systems:

Rainfed farmers are often modest subsistence landowners that combine agricultural and animal production. Increasing agricultural and livestock systems are essential to preserving rural livelihoods in the face of ongoing population expansion. Farming systems are the planned cultivation of crops, fruit and forest trees, fish, poultry, sericulture, mushrooms, and other animals on a specific area of land with the goals of improving the environment overall, boosting productivity and profitability, and upgrading the base of natural resources (Singh, 2005). The idea behind switching from a cropping system to a farming system is to: (i) lessen reliance on chemicals by recycling organic leftovers in situ, including agricultural waste produced on the property. (ii) lowering cultivation costs by improving input utilisation efficiency; (iii) making efficient use of one component's wastes or bye-products to benefit another component or components. (iv) improving the biodiversity and quality of the soil and water; (v) increasing water productivity; (vi) ensuring nutritional security by reducing chemical residues in the soil, plants, animals, and human food chain; and (vii) ensuring environmental security by reducing the amount of greenhouse gases released into the atmosphere from the soil. For small landholders, farming systems offer a wide range of livelihood collecting opportunities, improved risk management techniques, and year-round income and employment. Through reciprocal integration, it entails using the primary and secondary output of one system as the foundational input of another.

COMPONENT OF IFS IN RAINFED ECOSYSTEM:

*Crop husbandry
*Livestock production (dairy)
*Poultry
*Duckery
*Horticulture
*Goatery

Characteristics of farming systems:

In order to complement mainstream disciplinary research, the agricultural system research activities should be inter-disciplinary, farmer-oriented, system-oriented, problem-solving approach, test the technology in on-farm trials, and get input from the farmers. The focus of the FSR strategy should be on clearly defining the requirements of farmers via an understanding of the current agricultural systems, as opposed to the researchers' perspective of those needs.

Farming systems research and extension should be approached holistically, with a problem-solving perspective, gender equality, and an inter-disciplinary and interactive approach. IT should prioritise substantial on-farm efforts to supplement experimental on-station research, recognise the location-specificity of technology solutions, and record the inter dependencies across numerous clients. More emphasis is focused on feedback in order to adjust the content of following on-farm trials, if necessary, by shifting research goals and concentrating policy shifts on micro level analysis. Thus, a farming system is an adequate combination of farm activities, such as cropping systems, horticulture, livestock, fisheries, forestry, and poultry, as well as the tools accessible to the farmer to produce them profitably. It interacts with the environment appropriately without revealing the ecological and socioeconomic balance on the one hand, while attempting to accomplish national goals on the other. As a result, there is a need to do research on agricultural methods in order to provide a sustainable income while also protecting natural resources. It is intended to comprehend the tactics,

priorities, and resource allocation choices made by farmers.

Integrated farming system:

Integrated farming system (IFS), a component of farming system research (FSR), proposes an improvement in agricultural practices to maximize crop yield and ensure optimal resource utilization. In the integrated farming system, the agricultural base is better recycled for productive uses. Unlike specialized farming systems (SFS), the activity of integrated farming systems is centered on a few carefully selected, interdependent, inter-connected, and frequently inter-linking production systems centered on a few crops, animals, and associated secondary professions. The use of primary and secondary product from one system as the principal input for another system, resulting in the mutual integration of the two systems as a whole. To build a holistic agricultural system, good links and complementarities between various components are required.

Methodology to organize farming systems under on-farm conditions:

Farm selection: Determine which agro-ecological zone will see the start of FSR. This agro-ecological zone can be further divided if needed to identify certain agricultural situations.

Selection of villages and farmers: Select the village in each farming circumstance that includes marginal / small / medium / large farmers. The village and farmers should be chosen at random to reflect the whole agricultural sector in the target area.

Diagnosis of constraints in increasing farm productivity: Conduct the survey using a quick rural appraisal. Make a list of the resources and support services available on the farm. Determine the limits on production.

Research, design and technology generation and adoption

The dissemination of improved agricultural practices and the transmission of technology within the recommended domain.

The effects of enhanced agricultural system technology on equality (gender problem), employment, productivity, economic returns, and the environment.

Predominant components in rainfed systems:

1. Crop based farming systems:

Animals are reared on agricultural wastes in this system, and animal power is employed for agricultural activities, while voids are used as manure and fuel. In an Orissa rice-based production system, in situ conservation of rain water by optimal wear height, conservation of excess water in refuges built downstream of rice fields, and raising of fish in refuges on medium land increased overall output (James et al., 2005). When compared to rice cultivation along 915294/ha, this method produced the best net returns (Rs.2197/ha) with the highest BC ratio (2.78). In six months, the average fish output in this system was 1107 kg/ha. Cropping intensity was raised from 100 to 131%. In comparison to the farmers' practise of leaving the rice fallow (Rs. 2770/ha), the improved rice (IR-64) + fish (mixed carps), and wheat (PBW-443) increased the net returns (Rs. 58557/ha) in Ranchi (TAR-IVLP, 2004).

The cropping pattern with 35.39% food grains, 25.71% pulses, 20.7% oilseeds, 17.3% commercial crops, and 1.17% fodder crops in total holdings of small farmers with backyard poultry (6 birds) helped the farmers stabilise the farm income at Dharwad under the nutritive cereal-based production system (TAR-IVLP, 2005). When compared to crops alone, the animal component (poultry birds) helped the farmers stabilise their farm revenue throughout the drought year. A marginal farmer in Hyderabad reported BC ratios of 3.47 and 4.43 for his 0.5 ha of cotton (bunny) and maize + pigeonpea systems, respectively. On average, a milch animal provided an extra net profit of Rs. 380 per year. Therefore, with an investment of Rs. 1460/-in the farm, the marginal farmers' net income might increase to the extent of Rs. 3275/ha (TAR-IVLP, CRIDA 2003). In comparison to sole finger millet (Rs. 11266/ha), crop diversification in Bangalore that included 60% of the area under finger millet (GPU 28), 40% of the area with pigeonpea (BRG-1), and 60% of the finger millet area with a combination of 40% area under drumstick produced additional net returns by 16 and 48%, respectively (TAR-IVLP, 2003).

Agri-sheep farming with 10 lambs and producing crops and using farm by products on one hectare of marginal lands yielded net returns of Rs. 8700/ha when compared to cotton production alone in Warangal,

Andhra Pradesh (Rs. 27500/ha) under cotton-based production system (TAR-IVLP, 2003). Mohammad Ali et al. (1984) demonstrated that a dairy-poultry-based integrated agricultural system could create 550 man-days of employment per year, whereas cropping alone yielded 245 man-days. In the North Telangana zone, the agricultural system combining agriculture and dairy created more than 200% more jobs than agriculture alone. Agriculture and dairy had the highest net returns, followed by agriculture and poultry and agriculture and sheep (Reddy, M.D. 2005). Groundnut cake is the most major byproduct utilised as a protein source and cow feed in an oilseed-based production system in Ananthapur. Groundnut haulms are fed to cattle and sheep. In rainfed areas, the integration of sheep production within the groundnut agricultural system provides profitable employment. The greatest net returns were obtained in this scanty rainfall zone of Andhra Pradesh with poultry of broilers (Rs. 43360), followed by dairy farming with three buffaloes having 2 ha (Rs. 40606), and lone crop of groundnut (2.6 ha) produced net returns of Rs. 14872/ha.

Agro forestry based farming systems:

In addition to stabilising crop productivity in dry regions, perennial grass components serve as vegetative filter strips which prevent erosion from wind and water. Additionally, the grass component increases the organic matter in the soil and begins producing from the first year of growth. When legumes like mung beans and moth beans are grown in a 2:1 ratio with grasses like Lasiurus sindicus, Cenchrus ciliaris, Cenchrus setigerus, and Dicanthium annulatum, the results are quite encouraging. In addition to producing the entire amount of grass component, these crops also produce extra grain (1.3 to 2.8 q/ha) and fodder (3.5 to 6 q/ha). However, in a farmer's microfarming condition, intercropping grasses and dryland crops is frequently impractical. As a result, it is advised to plant grasses and kharif legumes in 1:2 ratios with 5m strip width. Compared to areable farming, the grass component of agri-pasture and silvi-pasture systems was more lucrative. CAZRI, Jodhpur conducted an economic study of the aforementioned alternative land use enterprises in comparison to dryland agricultural farming, using an 18-year effective time. In comparison to pure arable farming, all tree-based systems had greater benefit-cost ratios.

Assuming a typical rainfall per year of 750 mm, the agri-silviculture method should be considered as land capacity class IV. In Alfisols and Vertisols, a wide range of tree-crop combinations were assessed, especially those that involved N2-fixing trees with sorghum, peanuts, castor, and pulses. In semi-arid tropical regions, short-duration dryland crops including pearl millet, blackgram, and greengram have been shown to work well with widely spaced tree rows of Faiderbia albida and Hardwickia binata (Korwar, 1992).

In the rainfed guava and custard apple system at CRIDA, where stylos reported 5.6 tonnes of dry fodder in the second year of planted, while Cenchrus provided dry forage of 7 t/ha with 17.5% of crude protein during the first year. Promising outcomes were observed in rainfed environments with Pearlmillet + Pigeonpea (Solapur), Pigeonpea + Blackgram (Rewa), Castor (Dantiwada) and Clusterbean (Hyderabad) in the ber-based agri-horti system. In addition to the 100 kg of horsegram and 450 kg of cowpea grown in interspaces, ber produced, on average, 40 kg of fruits per tree (Osman et al., 1989). According to Radhamani (2001), an integrated agricultural system using goats and crops under rainfed vertisols resulted in an additional 314 man-days of employment each year.

2. Livestock based production system:

Rainfed agriculture uses a complicated cattle farming method that is mostly founded on long-standing socioeconomic factors. Livestock integration requires an awareness of the production variables (stock, capital, feed, land, and labour) and processors (description, diagnosis, technology design, testing, and extension) that affect animal production. Increased fodder production as an intercrop with cereals, relay and alley cropping, forage production on bunds, improving the feeding value of stir fry by chopping, soaking with water, urea treatment, strategically supplementing concentrate, urea molasses mineral block for enhanced utilisation, and improved grass productivity quantification and distribution determine the effective growing season all contribute to increasing livestock productivity in rainfed agriculture.

Legumes in degraded lands, the construction of fodder banks in areas with surplus fodder available, artificial insemination using semen-approved bulls, the castration of low-grade animals, and the adoption

of preventive measures like vaccination and de-worming through health camps were all beneficial ways to increase yield by 15–25% (Mishra, A.K., 2002). According to field experiments conducted at CRIDA, the milk yield in IVLP villages in Ranga Reddy district rose with urea-treated straw, with an average rise of 0.8 l/ccw/day. The milk output ranged from 0.47 to 1.2 l/day. This intervention also resulted in an increase in the intake of paddy straw by 1-1.2 kg/animal.

In cows and buffaloes, urea molasses mineral block (UMMB) increased milk production and quality by 25–30%. It aided in keeping livestock healthy and productive overall, especially during periods of severe drought when fodder shortage was severe. When mineral supplementation was used instead of farmers' grazing alone, which produced a milk output of 1.8 lit/day with net returns of Rs. 2156, the milk yield increased to 58% and the net returns to Rs. 816. When rice bran was added at a rate of 1.5% of body weight, the growth rate of goats and sheep was greatly increased.

Poultry farming:

Poultry farming is growing as a significant livestock activity in the farming system, offering financial security, nutrition, and consistent employment and income flow.

Poultry meat constitutes around 27% of total meat consumption worldwide, with consumption increasing at a rate of 5% per year on average. The global average is 120 eggs per person per year, however India barely consumes 32-33 eggs per capita per year. According to dietary guidelines, the average person should consume 180 eggs per year and 9 kgs of meat per year.

BREEDS: Specific poultry stocks for egg and broiler production are available.

A large portion of egg production stocks are hybrids involving strains or inbred lines of white Leghorn. Under excellent management, these breeds have an egg production capability of 280 - 310 eggs per year. Other breeds, such as Rhode Island Red, California Grey, and Australop, are employed to a lesser extent.

FEED: The bird's feed conversion rate is significantly superior than that of other animals. chicken feed accounts for about 70-75% of overall chicken farming expenses. As a result, using inexpensive and efficient rationing will yield the greatest return. A balanced diet should include carbs, lipids, minerals, and vitamins. The amount of food required varies with the age of the bird.

Cereals (Maize, barley, oats, wheat, pearl, millet, sorghum, rice-broken); cakes/meal (Oil cakes, maize-meal, fish meal, meat meal, blood meal); minerals/salt (Limestone, oyster shell, salt, manganese) are some of the popular feed materials used for creating chicken ration in India. Feedings can be given up to three times each day. Aside from food, feed additives such as antibiotics and medications may be added to the chicken ration. Oyster shell or pulverised limestone is given to laying hens. Riboflavin is very important. The key difference between layers' feed and other feeds is the calcium and amino acid concentration. It ranges between 0.9 and 1.0% for children and 2.5 and 3.0% for adults.

Duckery:

Duckery is a vital element of rainfed farming.It is a highly common and successful business that may be accomplished with minimal attention or administration. This business may be utilised for both meats and eggs, and it gives supplemental and steady revenue on a daily basis in addition to nourishment and energy. It can successfully combine with other businesses. And each egg costs at least Rs. 5.5 on the market.

Operational implications in farming systems:

Farm households have a lot of room for testing, learning, and sharing their experiences. To build acceptable agricultural systems in rainfed regions, it is necessary to recognise gender and youth roles. During the program's execution, women should be awarded more credit than males in comparable scenarios.

Through decentralization, widespread use of participatory techniques for planning, analysis, and implementation should be connected with relevant public sector services, and planning and implementation should be better matched to the various demands of local agricultural systems. Decentralization substantially simplifies the gathering of interested parties for cooperative planning, execution, oversight, and assessment. In order to

meet the different requirements of farmers, particularly those connected with chronic poverty and hunger, a broad variety of financial organisations must be identified. Encourage the use of competitive matching mechanisms at the local level to enhance the lives of rainfed farmers using a farming systems approach. Using global and national agricultural systems frameworks, the farming system should examine the impact of policy and institutional changes.

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