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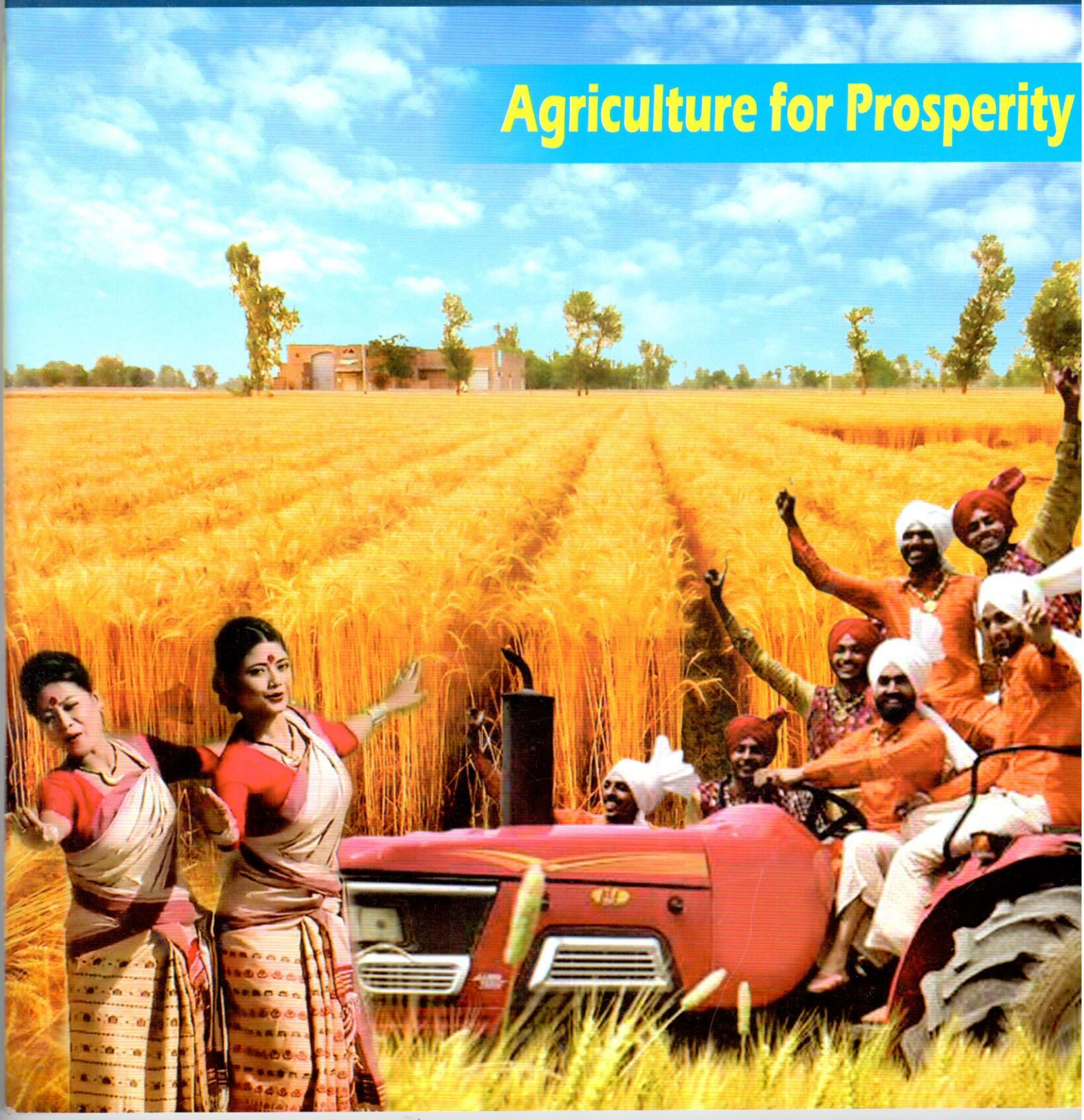

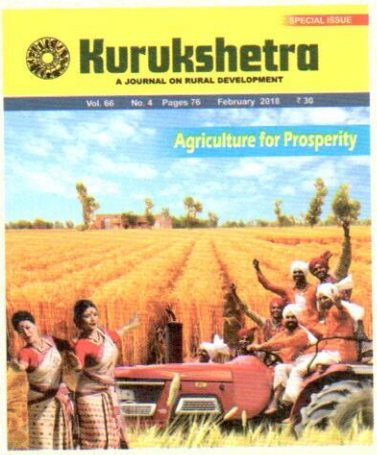

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Kurukshetra seeks to carry the message of Rural Development to all people. It serves as a forum for free, frank and serious discussion on the problems of Rural Development with special focus on Rural Uplift.

INTEGRATED FARMING SYSTEMS: A NEW APPROACH

N. Ravisankar and A.S. Panwar

Holistic and innovative approaches of Integrated Farming Systems (IFS) provides ample opportunities for the farmers especially small land holders to produce the multiple commodities for the household & market, on-farm generation of employment, balanced nutrition for the family, round the year income & employment, reduction of weather and market related risks. It also reduces the market dependency of farms for inputs.

Small farm agriculture (up to 2 ha) holds the key to ensuring food and nutritional security of India and nurturing them in right perspective with sustainable farming systems are essential for rural prosperity. These farms are characterized by low income (at all-India level, average monthly income per agricultural household during the agricultural year July 2012- June 2013 was estimated as Rs.6426), leading to smaller re-investment in farm development, seasonal employment, higher dependency for market inputs especially for seeds, fertilizers, pesticides and large machineries like mechanical harvesters, distress sale due to low storage capacity & market price. These farms are also more vulnerable to weather vagaries like flood, drought and other natural calamities and farming remains risky compared to large size farms. To change the status of these farmer categories, it is essential to enhance the income and employment opportunities within their household (land less) and farm (marginal & small) by promotion and adoption of efficient secondary/ tertiary enterprises like animal husbandry, horticulture (vegetables/ fruits/ flowers/ medicinal and aromatic plants), apiary, mushroom cultivation, fisheries etc.

What is IFS approach?

"A judicious mix of two or more components using cardinal principles of minimum competition and maximum complementarity with advanced agronomic management tools aiming for sustainable and environment friendly improvement of farm income, family nutrition and ecosystem services". Preservation of bio-diversity, diversification of cropping/farming system and maximum recycling is the base for success of the farming systems approach (Singh and Ravisankar, 2015).

The essential components of integrated farming systems are keeping the soil alive and provide sustainable support to farm and family through effective management of natural resources. They are as follows

- **Enrichment of soil:** Need based use of chemicals, use of crop residue as mulch, use of organic and biological fertilizers, adopt crop rotation and multiple cropping, avoid excessive tilling and keep soil covered with green cover or biological mulch.
- **Management of temperature:** Keep soil covered, plant trees, orchards and bushes on bund
- **Conservation of soil and rain water:** Create percolation tanks, maintain contour bunds in sloppy land & adopt contour row cultivation, Create farm ponds, maintain low height plantation on bunds.
- **Harvesting of sun energy:** Maintain green stand throughout the year through combination of different cropping systems and other plantations.
- **Self-reliance in inputs:** Develop own seed to the maximum extend, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts
- **Maintenance of life forms:** Develop habitat for sustenance of life forms, minimal use of permitted chemicals and create enough diversity.
- **Integration of animals:** Animals are important components of farm management and not

only provide animal products but also provide enough dung and urine for use in soil.

- **Use of renewable energy:** Use solar energy, bio-gas and other eco-friendly machines.
- **Recycling:** On-farm recycling of wastes as input to other enterprises
- **Meeting the basic needs of family:** Create and integrate components for meeting the family needs such as food, fodder, feed, fibre, fuel and fertilizer (6Fs) to maximum extent with in the farm boundaries in a sustainable way.
- **Round the year income for meeting social needs:** Create marketable surplus and integrateallied activities such as bee keeping, mushroom production, on-farm processing & value addition, tailoring, carpeting etc to get round the year income for the family to meet social needs such as education and family functions besides health.

The Food and Agriculture Organization[3] (FAO) classified the integrated farming systems as natural and intentional integrated systems. The natural integrated systems are one which is practiced by farmers where in linkage among components / enterprises of the systems often do not exist. The intentional integrated systems are one which addresses the multiple objectives of increased production, profit, cost reduction through recycling, family nutrition, sustainability, ecological security, employment generation, economic efficiency and social equity.

Holistic and Innovative approaches of Farming System:

Two approaches namely holistic and innovative are used in farming systems. The holistic approach involves identification of constraints using Participatory Rural Appraisal (PRA) and other techniques and addressing them through scientific approach for improving the productivity, income, cost reduction, environmental benefits etc from the existing components of a farming system. The other approach, i.e innovative approach encompasses the holistic improvement of existing systems besides diversification of existing components by way of introducing new components/enterprises/modules in to the system. In this, diversification aims to provide the alternative avenues available for enhancing the income in a sustainable way and it is good alternative to improve system yield with enhanced profitability. Modules comprising of cropping system diversification

(most efficient cropping systems keeping in view of the farmers resources, perception, willingness, market and requirement of other components in the system), livestock diversification (introduction of location specific low cost livestock components viz., backyard poultry, duckery, piggery, goat etc), product diversification (both physical change of product and process of production like from inorganic to organic production) and capacity building (training of farm households on farming systems including post-harvest and value addition and assessing its impact) can be implemented to get desired changes in the farm households.

Need for Farming System Diversification:

Spatial and temporal expansion in small farms is possible by integrating appropriate farming system components requiring less space and time and it can ensure diversified options of food and nutrition to the rural mass besides providing insulation against market price fluctuations, weather vagaries, reducing dependency on market for inputs, ensuring periodic income and employment to the farmers. Analysis of farming systems of marginal households across the different zones indicates though, the mean holding and family size of marginal households having up to 2 components and more than 2 components remains almost same (0.82 ha with 5 no's in 2 component category and 0.84 ha with 5 no's in > 2 component category), the mean income level is much higher (Rs 1.61lakhs)inthefarmshavingmorethan2components (e.g. crop+dairy+goat; crop+dairy+goat+poultry; crop+dairy+goat+poultry+fish etc.) than with farms having 2 or less components (Rs 0.57 lakhs only in crop alone, dairy alone, crop + dairy, crop + goat etc.). Diversification of one and two component systems (crop alone, dairy alone, crop+dairy, crop+pig, crop+poultry, crop+fisheries, crop+horticulture, crop+goat, dairy+goat) in the 59 % marginal household is essential to augment the per capita income.

Multiple Benefits of Integrated Farming System Approach:

Productivity enhancement: Farming system provides an opportunity to increase the yield and economics/unit time by virtue of intensification of crop and allied enterprises. Many studies from India have shown significant improvement in livelihood of small and marginal farmers through IFS approaches. The results of study conducted at Andaman and Nicobar Islands reveals that integration of crop with fish + poultry and cattle resulted in higher productivity than cropping alone. The animal component yielded 25 t of manure, each cow yielded 5250 litres / lactation, each bird laid about 150 eggs / bird / annum apart from the manure for fish pond which are additional contributors for the system productivity. Though fish yield was recorded only 60 kg / year from 0.036 ha, it ensured the supplementation of protein for the household.

Income enhancement: Integrated farming system as a whole provides opportunity to make use of recyclable waste material of one component as input for other at the least or no cost at farm level. Thus there is a possibility for reduction of production cost of enterprises from one to another and finally the return per rupee invested is very much enhanced. Recycling also reduces market dependency for inputs. The homestead model developed for 0.2 ha area under Kerala situation comprising of cropping systems (80 % area)+ dairy (1cow+1 buffalo)+duck (150 nos.) + fishery (20 % area) + vermicompost (1 % area) gave net return of Rs 0.60 lakhs in 0.20 ha area/year.

On-farm employment generation: Integration of other components with cropping increases the labour requirement and thus provides scope to employ family labour round the year without much lean and peak demand for labour. The employment generation can be increased to 221mandays/ha/ year by way of integrating fish cum poultry and cattle rearing with cropping compared with cropping alone

Utilization of homestead area for vegetable production at 24 South Paragnas (West Bengal)

(58 mandays /ha/year). An additional employment of 15 man days from poultry and 15 mandays from fishery could be generated by diversifying the existing farming systems.Floriculture, bee keeping, processing also gives additional employment for the family.

Meeting the household food and nutrition and reducing market dependency: The present average monthly consumption expenditure per agricultural household ranges from Rs 5108 (<0.01 ha) to 6457 (1.01-2.00 ha).

Every farm household should be self-reliant in 6F's (Food, Fodder, Feed, Fuel, Fibre and Fertilizer). Diversified farming systems having cropping systems + livestock + fisheries + horticulture + boundary plantations can produce sufficient quantity of cereals, pulses, oilseeds, vegetables, fruits, milk and fish per annum as per ICMR standards to meet the nutritional requirement with in the farm. Apart from this, these type models also ensures sufficient availability of green fodder throughout the year thus improving the health of the animals also. Due to the on-farm production of multiple commodities with in the farm, market dependency is reduced besides meeting the nutrition which results in additional saving for the family.

Soil health improvement throughrecycling: Residue recycling is an integral part of the farming systems which is one of the most promising approaches of recycling agriculture residues for sustainable development, the adoption of

Boundary plantation of Ardu in farming system model at SK Nagar (Gujarat) (Source: AICRP-IFS centre, SDAU, SK Nagar, Gujarat)

Small scale mushroom production for diet diversification

which paves way for higher input use efficiency. Considerable quantity of nitrogen, phosphorus and potassium besides micro nutrients can be generated within the farm through recycling.

Multiple uses of resources: Multiple use of the resources such as land and water are essential to enhance the system productivity and profitability. Multiple uses of water for household (washing), irrigation, dairy, poultry, duckery and fish rearing is the best example. Small and medium size water bodies can be brought under multi-component production systems using in and around areas which will ultimately lead to improved income, nutrition and livelihood of small farm holdings. Integration of proper waste resource recycling in the small and marginal farmers holding will pave way for reduced fertilizer usage which in turn will have positive effect. For example, the egg laying khaki cambell duck produces more than 60 kg of manure per bird on wet basis. The duck droppings provide essential

Pond based integrated farming systems involving crops on embankments + poultry + duckery + fishery

nutrients such as carbon, nitrogen and phosphorus in the aquatic environment which stimulates natural food for fish. Besides this, 10 to 20 % of duck feed (23 to 30 g/day) are lost in the normal circumstances of feeding ducks. In the farming systems mode, feed given to ducks were also partially utilized by fish while washing the shed.

Risk reduction: IFSapproach also helps to reduce the risks involved in farming especially due to market price crash as well as natural calamities. Due to the presence of multiple components at a time, price crash of one or two crop produce may not affect the economy of the household. Further, it also protects against weather related risks. For example, Phailin, a monster cyclone had hit Odisha during October, 2013. It was packed with heavy rains and destructive winds. Being a coastal district, Kendrapara was also affected by the cyclonic storm. Generally, the district gets an average rainfall of 183.7 mm during October. But during the said year, the district received 95.67 mm on 13 October, 2013 and again 163.67 mm on 25 October 13 and 51.44 mm on 26 October, 2013.The paddy crop that were at either at flowering stage or in low lying tracts were affected. In the households practicing the farming system approach comprising of advanced agronomic management tools coupled with livestock, jute, fishery, theper cent loss was ranging from 8 to 28% only while the farmers who have not had the components of farming systems had complete loss of crop.

IFS approach based Production Systems:

Under AICRP on Integrated Farming Systems and Network Project on Organic Farming, IFS approach is used in on-station and on-farm research programmes. The models developed at on-station (research farm) and on-farm (farmer participatory) for different states demonstrates that IFS approach can empower the marginal and small households by generating sustainable livelihoods.

Family Farming Model for nutrition & round the year income : A one hectare area with 5 member family farming model comprising of diversified cropping systems (0.78 ha) + horticulture (0.14 ha)+ dairy (2 cows) + goat (11 no's) + fish (0.1 ha) + ducks (25 no's) + boundary plantation (subabul, 225 plants &Moringa, 50 plants) developed for the South Bihar Alluvial Plain zone in Middle Gangetic Plains region provides round the year income which ranges between Rs 13,160 (September) to 51,950 (April)/ha/ month (Fig 1). The diversified cropping systems [rice - wheat - greengram (grain +residue incorporation), rice - maize + potato - cowpea (fodder), rice - mustard - maize (grain) + cowpea (fodder), sorghum + rice bean – berseem /oat- maize + cowpea (fodder) and seasonal vegetables (brinjal, tomato, cauliflower, cabbage, vegetable pea, okra, lettuce) grown in 0.78 ha area could meet the full family requirement of cereals, pulses, oilseeds, fruits (guava & papaya) and vegetables and livestock requirement of green and dry fodder per annum. The model also meets the milk, egg and fish requirement of 550 litres, 900 no's and 120 kg respectively. Besides meeting the family and livestock requirement, the model produced marketable surplus of 4810, 986 and 35 kg of cereals, vegetables and fruits with surplus of milk, egg and fish of 4243 litres, 950 numbers & 124 kg respectively which resulted in round the year income. The model also ensured fuel wood availability of 4 t/year for the family and could add 4 t of enriched vermicompost and 2.3 t of manure to improve the soil health. A total net return of Rs 3.14 lakhs which is 3.2 times higher than existing pre-dominant crop+dairy system of the zone was observed.

Organic Farming System model for improving productivity and livelihood of tribal areas: Promotion of organic farming in niche locations especially low nutrient consuming tribal areas have great scope to enhance soil and crop productivity along with

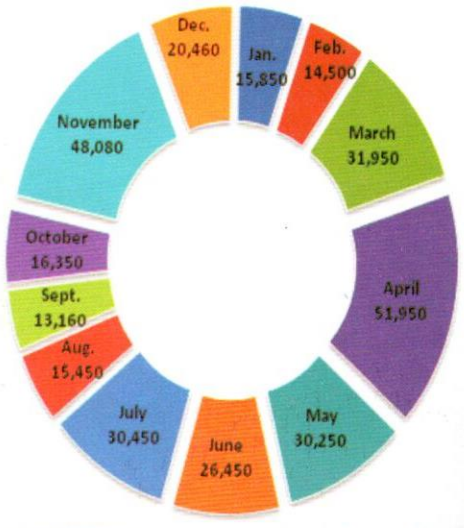
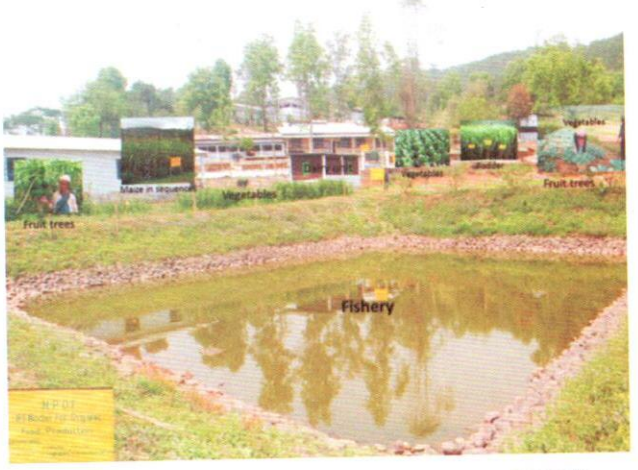


Fig 1. Round the year net income (Rs/ha) for the family from crop (0.78 ha) + horticulture (0.14 ha) + dairy (2 cows) + goat (11 no's) + fish (0.1 ha) + ducks (25 no's) + boundary plantation (subabul&moringa) farming system model at Sabour (Bihar)

livelihood for the people. A 0.43 ha organic farming system model comprising of cereals viz. rice and maize, pulses and oilseeds viz. soybean, lentil and pea, vegetable crops viz.french bean, tomato, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chilli, coriander, fodder, fruits viz. Assam lemon and papaya, dairy (1 cow + 1 calf) and a farm pond of 0.04 ha with depth of 1.5 m for life saving irrigation and fisheries developed at Umiam under Network Project on Organic Farming (NPOF) could able to meet the nutrient requirement of all the crops.

Land configuration based farming systems: Raised and Sunken Bed (RSB) system also known as Broad Bed and Furrow (BBF) system in Andaman and Nicobar Islands can serve as climate proof technology in the rice based farming systems especially in the coastal areas where in inundation of rice fields are expected due to the sea level rise. It is a technique of land manipulation to grow vegetables, fish and fodder right in the midst of rice fields. The technology involves making of broad bed and furrow alternatively. In the BBF, depressed area is used for rice cultivation and the raised broad bed area, which is above the water level of the paddy field, are used for cultivating of seasonal vegetable or fodder crop during monsoon season. Because of the long term sustainability, easy to adopt and efficient utilization of land area, this techniques is having lot of potential especially for the coastal areas. This type of system gives scope for producing multiple commodities. These types of models have been tested in West Bengal also and found successful.



Organic Farming System model (Source: ICAR-RC-NEH, Umiam, Meghalaya)

Land configuration based farming systems for water logged areas to produce rice, vegetables, fish and fodder together

Farmer participatory refinement and improvement of farming systems: Innovative approach of farming systems employed for enhancing the income of marginal households indicates addition of components especially small ruminant (goat) and poultry to the existing system improves the income and employment considerably. The additional income and employment generated will help to increase the livelihood status of marginal farmers.

Comparative performance of Systems:

Comparative performance of mono-cropping with that of farming systems evaluated in Andaman and Nicobar Islands is given in Fig 2 clearly indicates integrated farming systems and land shaping based interventions (Broad Bed and Furrow system) are much better in terms of net returns and B:C ratio.

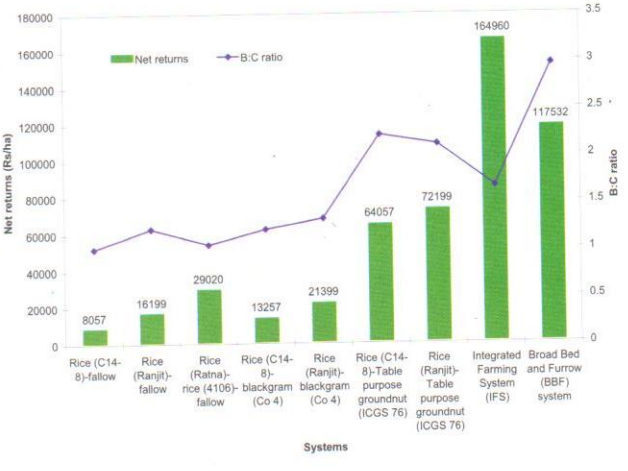


Fig 2.Comparative performance of various systems in terms of net return and B:C ratio in A&N Islands

Way Forward:

Diversification of existing farming systems with change in crop (s), cropping systems, addition and improvement of livestock components, inclusion of horticulture, kitchen garden, primary and secondary processing, boundary plantations are essential to improve the on-farm income of small holders in India. This also paves way for meeting the household demand of balanced food, improved recycling of nutrients and water besides increasing the on-farm employment for family. Diversification of existing farming systems clearly demonstrates the advantages. It has been observed that productivity and profitability gain of 2 times is possible with improved systems. Further, resource saving of 40 to 50 % can also be ensured besides providing round the year income. The following steps are essentially required for up-scaling of science based integrated farming systems.

1. Focus should be given mainly on market-oriented diversification and livelihood improvement by considering the options of alternative cropping, novel livestock systems and adding of value to primary (raw) products.
2. Initiation of National Mission on Integrated Farming Systems by converging the schemes of crops, horticulture, livestock and fisheries to give impetus in promoting integrated farming systems approach.
3. Large scale spread of IFS concepts through front line demonstrations in farming systems perspective will help to improve the households in holistic way.
4. There is a need to move from soil health card (SHC) to Farm or Farming System health card comprising the health components of soil, plant, livestock and human at household level.
5. Capacity building of stake holders (farmers & extension functionaries) including skill development supplemented with physical and technology inputs.
6. Crop and forage rotation: includes crops, forages and high value crop options including vegetables, fruit trees, medicinal and aromatic plants, orchards.
7. Introduction of farmer perception based location specific livestock components especially small ruminants such as goats, sheep & poultry, pig with component technologies
8. Improving/ ensuring monthly income flows through product diversification (both in terms of process and physical change of products)
9. Integration of less land requiring activities such as mushroom farming, bee keeping etc in the existing systems.

Footnotes:

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