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Research Paper

Participatory evaluation of choice and combination of enterprises for integrated farming system under dry-land and irrigated agro-ecosystems

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ABSTRACT

The Krishi Vigyan Kendra Sutur, Mysore, has developed 6 integrated farming system (IFS models), 3 each under dryland and irrigated farming situations, between 2012 and 2015. The models were analyzed using case-study approach to draw principles of enterprise combination. The average number of enterprizes for 3 dryland models, sericulture, horticulture and cotton (*Gossypium* sp.)-- based IFS, during base year and after 3 years was 3 and 13, respectively; it was 6 and 14, respectively, for the 3 irrigated models, organic horticulture, sericulture and agro-forestry-based IFS. The maximum annual net incomes under dryland in the base year were from agriculture (₹49,600/ha), coconut (*Cocos nucifera* L.) (₹39,800) and sericulture (₹16,700/ha); after 3 years, the order changed to coconut (₹46,000), sericulture (₹30,900) and agriculture (₹16,600). Under irrigated condition higher net returns in the base year came from coconut (₹94,000/ha), horticulture (₹42,300/ha) and vegetables (₹40,000/ha), which changed after 3 years to coconut (₹1,34,500/ha), sericulture (₹81,400/ha) and silviculture (₹77,600/ha). However, the maximum benefit: cost ratio under dry farming was from forage crops and goat/sheep rearing followed by vermicomposting, implying short-duration low-investment enterprises complemented the core enterprizes, coconut and sericulture. On the contrary, under irrigated farming system, the maximum profitability was in silviculture, coconut and goat/sheep rearing, indicating long-duration enterprises acting as supplementary enterprizes offered better returns. The results revealed that the choice of enterprises, their combination and contribution to the improvement of system productivity differed for dryland and irrigated farming systems but IFS enabled the systems more productive, profitable and sustainable under both the situations.

Key words: Complementary enterprises, Dryland, Integrated farming system, Irrigated, Livelihoods, Supplementary enterprises

At present, farmers concentrate mainly on crop production which is subjected to high degree of income and employment uncertainty. But, modern agriculture must produce high yields and there is possibility of occurrence of ecological and environmental problems such as alteration in the natural habitats of various animal and plant species (Ashby, 2001). The conventional type of agricultural system coupled with many challenging factors like incessant floods, manipulation of prices by traders, supply of spurious pesticides and seeds, decline in prices of agricultural produce, increase in the cost of agricultural inputs and successive drought, often lead to agriculture and farmers distress. In this context, it is imperative to evolve suitable strategy for enhancing the income of a farm throughout the year. Integration of various agricultural enterprises, viz. cropping, animal husbandry, fishery, forestry in the farming system has great potentialities in agricultural economy. These enterprizes not only supplement the income of the farmers but also help in increasing the family labour employment throughout the year (Jayanthi *et al*., 2003). Among the various risk-mitigating techniques, integrated farming system (IFS) is the simple, stable, most efficient, equitable, economically viable and environment-friendly practice (Thilakar *et al*., 2010).

Mysore district, as such, has diverse crops and cropping systems. However, over the years, there has been a clear shift towards monocropping in majority of the crops grown in the district. For instance, in case of irrigated crops like paddy, grown on over 1.24 lakh ha (30% of cultivable area), the crop yield has stagnated over the past 20 years at 45 q/ha. Part of the reason for stagnating paddy yields is attributed to the losing of blackgram-grown in paddy fallows–from the farming system. This has had

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implications on soil fertility as well as annual incomes of farmer's. Vegetables, grown on over 8,000 ha, and fast expanding, are witnessing input-intensive monoculture highly vulnerable to price fluctuations. Similarly, in dryland areas, finger millet being a staple food crop, the area under the crop has consistently come down and has reduced by more than 40% in the past 10 years, now occupying about 65,000 ha; cotton, also a rainfed crop, grown on over 41,000 ha, has become a monocrop in H.D. Kote taluk giving up finger millet and many pulses which were integral part of cotton farming system but have disappeared mainly due to human-animal conflict, due to the invasion by elephants and wild boars. Tobacco, another major dryland crop in Hunsur and Piriyapatna taluks, is generally followed by finger millet and field beans, provided the north-westerly rains are favourable. However, tobacco area has been constantly expanding at the cost of crops like finger millet. Two successive drought years have further unsettled the seasonal crops and the intricate traditional farming systems, implying renewed need for adoption of IFS.

However, the extension workers have always found it difficult to promote IFS because each IFS is different, unique and constantly evolving. Unlike simple technologies, a technology complex like IFS cannot be easily replicated and up-scaled. One must identify the key principles of successful IFS models and combine enterprizes suiting to each farmer's resource-base and skill sets. It is in this context that this participatory study was conducted in Mysore district to draw principles from different IFS models and to make recommendations for promoting suitable IFS models under dry-land and irrigated farming systems.

MATERIALS AND METHODS

Mysore district falls under two agro-climatic zones, viz. Southern Dry Zone (Zone 6) and Southern Transition Zone (Zone 7), and hence, offers lot of scope for practicing enterprizes like crop, dairy, poultry, sericulture, agro forestry, fisheries etc. An attempt was made in the present study to develop and evaluate profitable IFS models in the district by effectively utilizing farm and family resources, both under dryland and irrigated farming situations.

Medium deep red clayey soils form large part of the district in all the taluks (2.09 lakh ha, 30.90%). An area of 59,951 ha has medium deep red gravely clayey soils. Deep alluvial clayey soils form about 1.44 lakh ha (21%). Deep lateritic clayey soils in the west of the district constitute 6.94% (46,899 ha). The western taluks of Piriyapatna, H D Kote and Hunsur are covered with hilly terrain and contain red, shallow gravelly soils. The taluks of T. Narasipur and Najangud have deep red loam occasionally interspersed with black soil. The climate is essentially tropical monsoon type which is a product of the interplay between the two opposing air-masses of the southwest and northeast monsoons. The main seasons are summer from March to June, the monsoon season from July to November and winter from December to February. The average maximum and minimum temperatures are 34.4°C and 11°C, respectively. The average annual rainfall of the district is 760 mm.

The study was conducted by the ICAR JSS Krishi Vigyan Kendra (KVK) employing case study approach during 2011–12 to 2014–15 with, 2011–12 as benchmark. Two farmers each from 7 taluks in Mysore district were identified for developing IFS models. The 14 farmers so selected were practicing multiple cropping system including other enterprises, 7 each from 7 dryland and irrigated situations.

A study tour was organized for the 14 farmers in 2012 to a few successful IFS models in and around Mysore district and to selected KVKs in Karnataka and Tamil Nadu where the farmers studied stall-feeding technology in goat farming, green fodder (Cumbu Napier hybrid Co-4), dairy and poultry management, vermicomposting, bee keeping etc. A one-day workshop was organised for the farmers following the study tour in which each farmer was asked to differentiate their existing enterprises as 'core enterprize' and other crops/enterprises based on area and income from each component. Each farm was then analyzed in the group specifically discussing 'what-is-coming-in' and 'what-is-going-out' of the farm in terms of inputs used and the outputs produced on the farm. The purpose of this exercise was to sensitize the farmers on the sources of inputs, especially those that are coming from external sources and their cost implications, and to match the output, both quantity of produce generated and their monetary value, so that the farmers understood the concept of 'self reliance' for inputs, ability and limitations of their farming system to generate the required inputs, on the farm, such as seeds and manure, see the interconnectedness between existing enterprises and identify possible new enterprises that could complement or supplement the existing enterprises. The workshop thus helped in participatory identification of core enterprise of each farmer and listing of complementary and supplementary enterprises suitable to each farm, for integrating in a phased manner.

Nine out of 14 selected farmers worked on their farming systems for the next 3 years, from 2012 to 2015, adding and strengthening different enterprises. The remaining 5 farmers dropped out due to lack of interest and consistency of efforts. Of the 9 models, 6 were chosen to study 3 each under dryland and irrigated conditions based on the diversity of core enterprise around which IFS was to be developed, size of the farm (small and medium farms),

number of integrations and the data made available. The three models selected, developed and strengthened under dryland condition included sericulture, horticulture and cotton-based IFS, one each in H.D. Kote and Hunsur taluks falling in the Southern Transition Zone and one in Nanjangud taluk falling under Southern Dry Zone of Karnataka state. The remaining 3 IFS models developed under irrigated condition were from Mysore, Nanjangud and T. Narasipur taluks, all under Southern Dry Zone, where majority of the cultivated lands are irrigated from one of the two reservoirs, Cauvery and Kabini. The models were organic horticulture, sericulture and agro-forestry-based IFS. The 6 IFS models are defined below while the details of components in each IFS model are described in results (Table 1).

Sericulture IFS

The sericulture enterprise is entirely dependent on rainfall and occupied major area and was the major source of income for the farm family. Eventually, the farmer has taken a leap from least number of enterprizes (2) in the base year to as many as 11 enterprises; while sericulture has remained the core enterprise (Table 1), a couple of *desi* cows, small scale sheep rearing and vermicomposting were added to generate cash income and biomass recycling.

Dryland Horticulture IFS

The model comprised a mixed orchard of mango (*Mangifera indica* L.), sapota [*Manilkara zapota* (L.) P. Royen] and aonla as major enterprize and the farmer grew finger millet [*Eleusine coracana* (L.) Gaesrtn.] and field bean (*Vicia faba* L.) as intercrops. The farmer has added (*Phyllanthus emblica* L.) large and small ruminants (cows, goat and sheep), farm pond, vermicomposting unit along with live fence consisting of silver oak (*Grevillea robusta* A. cunn. Ex R. Br.], casurina and teak (*Tectona grandis* L.f.) trees along the border to improve productivity of the existing orchard and the overall income.

Cotton IFS

Also, an entirely rain-dependent farming system that had cotton as major crop in terms of area and income and included intercrops like castor (*Ricinus communis* L.) and cowpea [*Vigns ungciculata* (L.) Walp.]. The newly added enterprises were small-scale dairy and NADEP method of composting.

Organic horticulture IFS

Organic vegetables, mostly leafy vegetables grown as intercrops in coconut orchard and are sold directly to consumers in Mysore. The farmer has added the maximum number of enterprises (19) in the 3 years, important ones being small-scale dairy, poultry, bee keeping, a small mother-orchard for grafting and air layering of lime (*Citrus* sp.) and guava (*Psidium guajava* L.). The farmer has also developed live fence with silver oak and teak trees along the border. However, the most significant enterprise that has brought about a marked change in the farm was the 'modified management' of goat and sheep. Fifteen sheep and goats were maintained in a conventional method and the farmer switched over to stall-feeding technique rendering the management easier and is generating about 2 tonnes of quality manure every 3 months that is used for growing vegetables and has had vital role in improving the productivity of coconut trees.

Sericulture IFS

The farming system has mulberry (*Morus alba* L.) garden, supplying leaf both for silkworms and chawki worms. Coconut orchard was added with blackgram [*Vigna mungo* (L.) Hepper] and cowpea as intercrops. Trees were planted on bunds and field borders. Stall feeding of goats, small-scale dairy, seasonal crops like cotton and chickpea (*Cicer arietinum* L.) were the new additions.

Agro-forestry IFS

The farm had trees of multiple timber species as dominant enterprise integrated with small-scale enterprises like sugarcane, paddy (*Oryza sativa* L.), dairy, coconut, kitchen garden; the special feature of the farm was the sheep breeding unit aimed at conserving and promoting the native 'Bandur' sheep.

Benchmark data were collected using pre-tested questionnaire during the rainy season (*kharif*) 2012, through which the technological gaps, constraints in enterprises and allocation of resources in each farm were identified. Suitable complementary and supplementary enterprises were then introduced based on location specificity, existing enterprises and available resources.

Primary and secondary information from each farm were collected at the end of three years, after *kharif* 2015. Economic analysis of the IFS farms was done separately for dryland and irrigated models and were evaluated and compared with the three-year pooled data. The average number of enterprises was calculated by the number of enterprises added into the 6 IFS models during the 3 years and converted into hectare basis under dryland and irrigated, separately. The gross annual return was calculated for individual enterprise based on the average productivity of enterprise/year multiplied by market value of the product. Under the agroforestry component, gross annual return from a given tree species was calculated by the height and girth attained by the tree at the maturity age,

multiplied by its current market value and dividing the same by the present age of the tree.

The data related to number of enterprises, expenditure, net returns and benefit: cost (B:C) ratio were collected component-wise for each farming system under both dryland and irrigated conditions for the base year and after 3 years and the same is presented in Table 2 and 3.

RESULTS AND DISCUSSION

Three IFS models each for dryland (sericulture, horticulture ad cotton-based) and irrigated (organic horticulture, sericulture and agroforestry-based IFS) were evaluated and component integration from base year to the next 3 years are presented below.

Integration of enterprises and income enhancement

The average number of enterprises for 3 farmers under dryland situation during the base year and after 3 years was 3 and 13, respectively, indicating a phenomenal increase in the added enterprises (Table 1). On the other hand, the average number of enterprises under irrigated situation for the 3 farmers was 6 and 14, respectively, also showed a significant increase in the number of enterprises in 3 years. The three-fold change in dry land situation as compared to just over two-fold increase in irrigated situation could be attributed to the dryland farmers' perceived vulnerability to the climatic vagaries and hence greater acceptance of the idea of adding complementary and supplementary enterprises as means of risk diversification and optimization of resource use.

This was further confirmed by the expenditure and income pattern. The mean per hectare expenditure on dryland farms during the base year was ₹48,400 which, interestingly, has reduced to ₹46,000 (5% decline) in the next 3 years. Their income, however, has increased from ₹81,300 in the base year to ₹1,54,000/ha (89%). On the contrary, the mean per hectare expenditure for 3 farms under irrigated conditions in the base year was ₹1,15,400 which increased to ₹1,60,500 in the next three years (about 40% increase). The income, on the other hand, has increased from ₹3,63,700/ha to ₹9,49,600/ha, an increase by 161%. This increase was attributed to the increased number of enterprises and the cumulative income arising out of the newly added complementary and supplementary enterprizes. It was

Table 1. Nature of integrated farming system (IFS), enterprize integration and economics

Sl. No	Name of the farmer and location	IFS model	Area (ha)	Number of enterprizes/ha				Cost of production/Maintenance cost (× 10^3 ₹/ha)				Annual/income (× 10^3 ₹/ha)			
				2011–12	2012–13	2013–14	2014–15	2011–12	2012–13	2013–14	2014–15	2011–12	2012–13	2013–14	2014–15
Dryland farming system															
1	Mahesh S/o Gurusiddappa, Chinnamballi, Tq: Nanjangud	Sericulture-based	3.2	2	6	6	11	68.0	85.0	69.8	64.0	125.0	189.0	210.2	233.4
2	Sudharshan S/o Narayanarao Shinde, Hulyal Tq: Hunsur	Horticulture-based	2.8	4	11	11	15	47.5	62.2	58.2	47.5	74.0	116.0	126.0	134.1
3	Veerabhadrachari S/o Veerappachari, Hyrige, Tq: HD Kote	Cotton-based	1.2	4	6	10	12	29.7	32.5	29.1	26.6	44.9	63.2	78.9	94.5
			Mean	3	8	9	13	48.4	59.9	52.4	46.0	81.3	122.7	138.4	154.0
Irrigated farming system															
4	Shankaregowda S/o Nagarajegowda, Devagalli, Tq. Mysuru	Organic Horticulture-based	2	8	13	13	19	105.7	156.0	180.2	152.2	452.3	562.0	642.0	900.1
5	Guruprasad S/o Prasanna Channabasappa, Devanur, Tq: Nanjangud	Sericulture-based	3.2	4	9	9	13	160.0	185.0	167.0	212.0	438.0	693.0	868.0	1131.5
6	Ramesh S/o Papegowda, Rangasamudra, Tq: T. Narasipur	Agroforestry-based	1	5	5	9	10	80.5	80.5	104.2	117.2	200.8	200.8	306.8	817.2
			Mean	6	9	10	14	115.4	140.5	150.5	160.5	363.7	485.3	605.6	949.6

apparent from the data that the farmers under irrigated situation were not averse to investing more on new enterprises so long as they were reaping greater returns, whereas the dryland farmers have shown a tendency towards reducing their production costs due to uncertainty of the critical resource like water.

Benchmark performance of enterprizes

The 3 dryland IFS farms represented typical systems where soil-moisture stress was the main constraint for crop production. Maximum number of enterprises were found in agricultural crops (6) followed by dairy, coconut and sericulture (1 each), whereas backyard poultry, silviculture, vermicomposting and cultivation of fruit trees, vegetables, forage crops and rearing of goat/ sheep were conspicuous by their absence during the base year (Table 2). The focus was on seasonal crops for bulk income and dairy for daily cash income; enterprise integration for risk diversification and optimization of resource use was not in the scheme of things.

Accordingly, the economic analysis of dryland farming systems during the base year revealed that bulk of the hectare-wise gross and net incomes were recorded in agricultural crops (₹81,700 and ₹49,600, respectively) followed by coconut (₹56,300 and ₹39,800 respectively) by sericulture (₹24,000 and ₹16,700 respectively). The least gross and net returns were recorded in dairy (₹10,300 and ₹7,000 respectively). This was mainly due to poor productivity of milch cows on account of limited fodder which in turn was due to scarcity of water resource. Evidently, the B:C ratio was found to be the same, 3:1, from all the enterprises, indicating that returns on investment were same due to lack of complementary and supplementary relationship among the enterprises in dry-land farming system before intervention.

The data revealed that the maximum number of enterprises, and units within the enterprises added under irrigated farming, were in agricultural crops, fruit crops, goats/sheep (4 each) followed by vegetables and silviculture (2 each). It was found that, backyard poultry, vermicomposting, coconut, forage crops and sericulture were not much preferred in irrigated farming system either. Plantation crop such as coconut was already part of all the models and hence it was not a preferred enterprise during the study period. Coconut trees grown under irrigated farming system recorded the maximum gross income (₹1,12,500/ha) followed by enterprises like agriculture crops (₹62,400/ha), fruit crops (₹57,700/ha), vegetable crops (₹55,700/ha), trees (₹39,700/ha) and sericulture (₹41, 700/ha), whereas the net income was found maximum under coconut trees (₹94,000/ha) followed by fruit crops (₹42,300/ha), largely due to reduced cost of cultivation of perennial crops (only maintenance cost) compared to agriculture crops (₹39,500/ha). Sericulture (₹26,700/ha) and silviculture (₹24,700/ha) were relatively less profitable compared to fruit crops (₹42,300/ha) and agriculture (₹39,500/ha) because of high input and maintenance cost of both mulberry orchard and silkworm rearing and high establishment cost of trees during base year. However, the expenditure incurred on vegetable crops was less (₹15,700/ha) due to cultivation of local varieties, mainly as intercrops. The least net income was recorded from forage crops (₹7,000/ha), goat/sheep rearing (₹10,000/ha) and dairy (₹11,800/ha) enterprises. The maximum B:C ratio was recorded under goat/sheep rearing (9 : 1), followed by coconut trees and forage crops (6 : 1). This could be attributed to little management required in goat/sheep rearing, coconut orchard and forage crops. The small number of enterprises, lack of interrelationships among them and poor B:C ratio indicated that there was large scope to enhance the system productivity by bringing in complementary and supplementary enterprises.

Performance of enterprises after intervention

The number of enterprizes increased gradually in all farming systems every year under dry-land condition owing to better allocation of resources and complementary and supplementary nature of relationship among the enterprizes. The maximum number of enterprizes although was recorded with agriculture crops (6), it was actually a *status quo* compared to the base year. This was followed by rearing of cows, goat/sheep (3 each) and cultivation of fruit crops (2). This is because of the seasonality of the agricultural crops and the willingness of the farmers to generate more manure by adding cows and more cash income by adding 'easy-to-manage' small ruminants, especially using stall-feeding technology. Apparently, the farmers recognized the complementary and supplementary relationship among the enterprizes that enhanced overall efficiency of farm resources and the system productivity. Nhan *et al*. (2007) also recorded the farming system with dairy + goat + poultry as the most beneficial system.

The economics of dryland farming system revealed that the income generation was very less because of less number of enterprizes, smaller area/size/number and low productivity. This signified subsistence nature of dryland farming system, more on account of perceived resource constraints, especially water and organic manure. However, as the KVK scientists suggested growing perennial trees on hedges and bunds as sources of biomass, fruit crops as less labour intensive long-term income sources and rearing of goat/sheep and sericulture for regular cash flow, adding 2 to 3 cows for converting biomass quickly into organic manure and as sources of daily income, the

farmers readily accepted the idea of strengthening their conventional season-based agriculture crops with multiple enterprises.

The maximum annual per hectare net income was recorded from coconut trees (₹46,000) followed by sericulture (₹30,900), agriculture crops (₹16,600), rearing of cows (₹14,100) and silviculture (₹13,700) in dry-land farming. Coconut and sericulture here being dryland enterprizes, the expenditure on them was relatively less (₹13,500 and ₹8,000 respectively) unlike in irrigated coconut and sericulture where these 2 enterprises had an investment of ₹15,500 and ₹28,800 for earning a net income of ₹1,34,500 and ₹81,400 respectively. The addition of net incomes from fruit crops (₹9,400), vegetable crops (₹8,200), goat/sheep rearing (₹2,600) and vermicomposting (₹7,800) into the existing dryland farming systems were found to be profitable enterprises eventually contributing to improvement of the system productivity, yet again a recognition of the complementary and supplementary relationship among the enterprises. Senthilvel *et al.* (1998) suggested the integration of cropping with rainfed fruit trees and goat rearing in dryland that resulted in a considerable increase in income of small and marginal farmers of Southern Zone of Tamil Nadu. Similarly, Radhamani (2001) reported that integration of crop + tree + goat system provided higher net return than cropping alone for Western Zone of Tamil Nadu under dryland situation.

The B:C ratio is an important parameter to assess profitability of enterprises in any farming system. The maximum profitability was observed in forage crop (7 : 1) due to less expenditure incurred as an intercrop in mulberry plantation followed by goat/sheep rearing (7 : 1), vermicomposting (6 : 1), rearing of cows, fruit crops and sericulture (5 : 1), as the waste of one enterprise became input for other enterprise reducing the external inputs which in turn reduced the expenditure in dryland farming system. The B:C ratio has thus improved significantly over the base year. This meant that the short-duration, low investment enterprises such as forage crops, goat/sheep rearing and vermicomposting complemented the other enterprises like agricultural crops and sericulture under dryland situation. However, coconut enterprise recorded a B:C ratio of 4:1 which indicated that the returns on every rupee investment are rather less compared to forage crops and goat/sheep rearing. This might be due to moisture stress under dry-land situation, resulting in smaller nut size and poor yield, which in turn leading to low price and net incomes.

Goat and sheep rearing in stalls was found most attractive to many famers under irrigated situation and was readily adopted for its easy maintenance and high returns. Subsequently, the KVK started promoting backyard poultry, vermicomposting, sericulture and organic cultivation of vegetables in irrigated farming system resulting in gradual increase in the number of enterprises from the second year onwards.

The economic analysis of irrigated farming system during the three years (Table 3) indicated that the maximum per hectare improvement in annual net income was observed in coconut (₹1,34,500) followed by sericulture (₹81,400) and silviculture (₹77,600). This was attributed to better nutrition and water management in coconut orchard on account of cultivation of vegetables in coconut orchards, adding goats and sheep manure, establishment of chawki rearing unit and trees planted on hedges in multistoried cropping method. Thamizoli *et al.,* (2006) found that the introduction of tree crops with agriculture along with the farm-based allied enterprises like dairy, goat rearing, etc. worked as risk-management strategies to

Table 2. Economics of enterprises during benchmark (2012)

Sl. No	Enterprize	Number of crops/ animals/ units added/ha		Gross income (× 10^3₹/ha)		Expenditure (× 10^3₹/ha)		Net income (× 10^3₹/ha)		Benefit: cost ratio	
		Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland
1	Agriculture	4	6	62.4	81.7	22.9	32.1	39.5	49.6	3	3
2	Dairy farming	2	1	17.7	10.3	5.8	3.3	11.8	7.0	3	3
3	Horticulture/ fruit crops	4	0	57.7	-	15.3	-	42.3	-	4	-
4	Vegetable crops	2	0	55.7	-	15.7	-	40.0	-	4	-
5	Coconut	1	1	112.5	56.3	18.5	16.5	94.0	39.8	6	3
6	Forage crops	1	0	8.3	-	1.3	-	7.0	-	6	-
7	Goat/ sheep rearing	4	0	11.3	-	1.3	-	10.0	-	9	-
8	Backyard poultry	0	0	-	-	-	-	-	-	-	-
9	Sericulture	1	1	41.7	24.0	15.0	7.3	26.7	16.7	3	3
10	Vermicomposting	0	0	-	-	-	-	-	-	-	-
11	Silviculture	2	0	39.7	-	15.0	-	24.7	-	3	-

Table 3. Economics of enterprises after intervention (pooled data of 3 years)

Sl. No	Enterprizes	Number of crops/ animals/units added/ha/year		Gross income (× 10^3₹/ha/year)		Expenditure (× 10^3₹/ha/year)		Net income (× 10^3₹/ha/year)		Benefit: cost ratio	
		Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland
1	Agriculture	4	6	73.7	23.9	22.1	7.2	51.7	16.6	3	3
2	Dairy farming	2	3	44.8	17.8	9.6	3.7	35.2	14.1	5	5
3	Horticulture/ fruit crops	4	2	78.3	11.6	19.4	2.2	58.9	9.4	4	5
4	Vegetable crops	5	1	56.6	13.3	18.8	5.1	37.8	8.2	3	3
5	Coconut	1	1	150.0	59.5	15.5	13.5	134.5	46.0	10	4
6	Forage crops	2	1	10.9	3.0	2.0	0.4	9.0	2.5	6	7
7	Goat/sheep rearing	12	3	12.0	3.1	1.8	0.4	10.2	2.6	7	7
8	Backyard poultry	3	1	12.4	1.9	3.0	0.4	9.4	1.4	4	4
9	Sericulture	1	1	110.2	38.9	28.8	8.0	81.4	30.9	4	5
10	Vermi-composting	2	1	7.2	9.3	1.3	1.5	5.9	7.8	5	6
11	Silviculture	5	1	84.6	18.0	7.0	4.3	77.6	13.7	12	4

cope with disasters like prolonged drought and heavy floods. However, there was marginal improvement in net income from fruit crops (₹58,900), agriculture crops (₹51,700), vegetable crops (₹37,800) and dairy (₹35,200) during 3 years as compared to the base year under irrigated farming system, since these were the formative years of the complementary and supplementary enterprises. Jagadeeshwara *et al.,* (2011) reported dairy + piggery + agriculture as an important IFS model in southern Karnataka.

The B:C ratio was maximum in silviculture (12 : 1), followed by coconut (10 : 1) and goat/sheep rearing (7 : 1), showing significant improvement of the enterprises over base year, as compared to short-duration seasonal crops like field crops (3 : 1), horticultural/fruit crops (4 : 1) and vegetables (3:1). Contrary to dryland farming where short-duration low investment enterprises offered better returns it was the long-duration high-investment enterprises which offered better returns under irrigated farming system. More importantly, these long-duration crops were supplementing the agricultural and horticultural crops by providing the much-needed biomass that was converted into manure for improving soil fertility. Tripathi and Rathi (2011) identified crop + dairy, crop + dairy + goat + horticulture as important IFS components in Uttarakhand.

It was concluded that coconut + sericulture + agriculture + dairy + silviculture complemented by fruit crops + vegetables + vermicomposting could be the ideal choice of enterprise combination for dryland farming in Mysore district. Similarly, coconut + sericulture + silviculture + horticulture crops + agriculture emerged as choice of enterprises for irrigated farming. The complimentary enterprises were more suitable for IFS under dryland situations, viz. goat/sheep rearing, forage crops, two milching cows, vermicomposting, whereas supplementary enterprises were suitable for irrigated IFS models, viz. plantation crop like coconut, vegetable crops, tree component and sericulture. It was also observed that the dryland farmers were keen on adding short-duration enterprises and reducing production costs because perceived risks whereas irrigated farmers tended to invest on long-duration enterprise aimed at higher returns due to assured natural resource, i.e. water.

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