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Comparative economics of indigenous Kulagar and Integrated Farming Systems under coastal agro-ecosystem of Goa

U K BEHERA[1], V PARAMESHA[2] and AMIT KUMAR[3]

ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India

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ABSTRACT

A study was conducted during 2016-17 at coastal ecology of Goa comprising farmers from different villages in North Goa and South Goa to assess the economic benefit of two prevalent types of farming systems. In this study, Integrated Farming System (IFS) and Indigenous Kulagar Farming Systems (IKFS) were compared; and overall it was revealed that both are useful in enhancing the livelihood of small and marginal farmers, attracted the rural youth through generation of additional income and employment opportunities. There is need to modify the IKFS with integration of high value crops and having high market demand to make the system more remunerative and attractive. The IFS and IKFS have been the mainstay of economy and livelihood of farmers in Goa state. The mosaic structure of Kulagar with variety of crops offers a scope for inbuilt biodiversity as an index of sustainability in agriculture. Besides, both systems are climate resilient and proved potential for adaptation and mitigation to climate change. IFS and IKFS may be promoted in large scale in coastal agro-ecosystem in other parts of the country as an important strategy for enhancing livelihood and climate resilience in agriculture.

Key words: Coastal agro ecosystem, Climate resilient, Dairy, Farming system, Plantation crops, Sustainability

The coastal eco-system is very important among the five agro-ecosystems, both economically and environmentally. It is having varied topographical features (mountains, valleys, and coastal plains), riverine systems, climatic conditions, soil and water bodies, and vegetation, which ranges from rich tropical rain forests to coastal mangroves (Mangala Rai 2004). The agro-climatic condition of the coastal zone is very congenial for growing various field and horticultural crops (Ghosh *et al.* 1991). The region occupies a commendable position in the export of horticultural produce, spices and marine products. It supports the livelihood of more than 20 million peoples whose socio-economic condition is very much dependent on the farming system (Singh *et al*. 2006). Appropriate crop management practices and cropping systems aiming at optimum use of land and water resources could go a long way in increasing production and improving the rural economy (Behera and Mahapatra 1999). A challenge exists in overcoming problems related to high salinity of soil and ground water (Bandyopadhyay *et al.* 2010). With an estimated 1.2 million ha of brackish water affected area available, coastal aquaculture is emerging as a major production activity. Apart from this, ponds, lakes, tanks and rivers offer scope for inland fisheries. But, production from these sources is hardly 45-50% of potential. The major soil of the state is mostly lateritic in nature and is not conducive for growing majority of the crops. The soil needs special treatment for its reclamation and improving the productivity of different field, horticultural and plantation crops. Peoples participation or involvement in agriculture is steadily declining, particularly attracting the youth to agriculture is major challenge (Behera and France 2016). On other hand due to more attention of people towards tourism and mining activities, getting labour for agriculture activities are declining. Besides, the state is having deficiency of 93%, 49% and 50% of concentrate, green fodder and dry roughages, respectively which affect livestock's (dairy) productivity (Devendra and Thamos 2002). Generally state is dominated with marginal (81% having < 1 ha) and small holding (11.5% having 1-2 ha) with 92.5 % of the farmers (Annual Report 2016). Considering all these problems and scope of the state of Goa, it is required to go for a multi-disciplinary and holistic approach for the overall development of the farming system and farming communities of the state. All these call for an integrated coastal systems research management strategy, based on

[1]Dean (ukb2008@gmail.com), College of Agriculture (CAU, Imphal), Kyrdemkulai, Meghalaya 793 105, [2]Scientist (paramesha.v@icar.gov.in), ICAR-Central Coastal Agricultural Research Institute, Ela, Old Goa-403 402, [3]Scientist (amitkumaricar13@gmail.com), ICAR-National Organic Farming Research Institute, Tadong, Sikkim 737 102

the technologies to improve the overall productivity of the systems through adaptation of (i) Integrated farming systems (IFS): rice-based IFS, pig- based IFS, dairy –based IFS, (ii) Kulagar based–farming systems and (iii) Mixed cropping farming systems, for augmenting the quality of life of the peoples (Behera *et al.* 2015). Hence, an attempt has been made, to evaluate the relative performance of IKFS and IFS under coastal agro ecosystem of Goa.

MATERIALS AND METHODS

A study was conducted during 2016-17 to understand the farming systems in coastal agro-ecosystem of India with special reference to Goa state. For this, 50 farming systems were studied in the different villages of Pernem, Ponda and Sanguem- blocks of Goa. An analysis of role of indigenous Kulagar and IFS on livelihood, farm income, employment and sustainability of small farming system was made. The information on various aspects, *viz*. farmers' profile, farm size, income of different components of farming systems (Table 1 and Table 2), level of technology adoption, resource availability and constraints of farming were collected with the help of a well-structured questionnaire. Information was collected by making direct interaction with the farmer as well as the members of the farmer's family at the farmer's house or field. During the process of study and interview with the farmers, the line department officers as well as scientists of Central Coastal Agricultural Research Institute, Ela, Goa also took part in facilitating the process. In the process of recording/collecting the information emphasis was made to analyze various constraints for enhancing agricultural production, ecological and socio-economic constraints of the farmers. Two categories of farmers, one group having integrated farming systems and other group having Kulagar farming systems were included for the study. The data were processed and tabulated for scientific representation of facts. The findings were compared between two farming systems for various parameters included in the study.

RESULTS AND DISCUSSION

Performance of Integrated Farming Systems

IFS at Hankhane (Pernem taluk) in North Goa

A typical farming system in Hankhane village was analyzed with respect to generation of income, employment and livelihood security of the farmers. Gross and net returns of ₹ 39.45 and 23.33 lakh were generated from the IFS unit. Piggery was the most profitable among the different enterprises, followed by goatery and plantation crops (Table 3). Rice-fallow system was undertaken just to meet the food requirement of the family members. The profit from rice was nil. Similarly coconut generated net profit of ₹ 2.50

Table 1 Description of the farming systems in different villages in North Goa

Particular	Farming System 1	Farming System 2	Farming System 3	Farming System 4
Family size	8 (4+4)	7(7+0)	5 (3+2)	5 (3+2)
Education of farmer	10th Pass	6th Pass	BA	B. Com
Area operated (Acres)	10	5.0	5.0	27.0 (18 acres operated + 9 acres fallow)
Soil type	Laterite	Laterite	Laterite	Laterite
Irrigation level	100%	Rainfed	50%	30%
Dominant cropping system	Rice-fallow Variety : Korgut	Rice-Rice (Jyothi, Karjat-3)	Rice-Rice (Jyothi, Karjat-3)	Rice-Fodder (Karjat-3)
Plantation crops				
Cashew (spacing 7m × 7m)	Local variety	Local variety	Nil	Local variety
Coconut (spacing 9m × 9m)	Local variety	Local variety	Local variety	Local variety
Arecanut (spacing 3m × 3m)	Local variety	Local variety	Local variety	Local variety (Mangala)
Dairy	Nil	Crossbred cows	Crossbred cows	Local cows (Gir) Crossbred cows (HF)
Fodder	Hybrid napier (CO-3, CO-4)	Hybrid napier (CO-3, CO-4) + Karad grass (Marvel grass)	Hybrid napier (CO-3, CO-4) + Karad grass (Marvel grass)	Hybrid napier (CO-3, CO-4)
Piggery	Yorkshire	Nil	Nil	Nil
Goatery	Local (non-descriptive)	Nil	Nil	Nil
Poultry	Nil	Backyard (Local birds)	Nil	Banaraja and Grampriya
Biogas	Nil	Dinabandhu model (2 m^3)	Dinabandhu model (2 m^3)	Nil
Value addition	Nil	Nil	Nil	Nil

Table 2 Description of the farming systems in different villages (practicing Kulagar system) in South Goa

Particular	Farming System 1	Farming System 2	Farming System 3	Farming System 4
Family size	5 (3+2)	4(2+2)	5(3+2)	
Education	M.Sc. (Chemistry)	12th Pass	10th Pass	
Area operated (Acres)	2.5	5.0	5.0	2.6
Soil type	Laterite	Laterite	Laterite	Laterite
Irrigation level	100%	100%	60%	
Kulagar system (years after establishment)	62	40	42	17
Composition of Kulagar: major crops in Kulagar	Jackfruit, mango, banana, Tamarind, Sapota, Pine apple, coconut, arecanut, black pepper	Coconut, arecanut, black pepper, banana, Napier grass	Jackfruit, mango, banana, papaya, Guava, coconut, arecanut, black pepper	Kokum, Drumstick, Nutmeg, cinnamon, vanilla, clove, Jackfruit, mango, banana, Pine apple, coconut, arecanut, black pepper
Plantation crops				
Cashew (spacing 7m × 7m)	Nil	Nil	Local variety	Local variety
Dairy	Crossbred cows (Holstein Frisian and jersey)	Crossbred cows (Holstein Frisian)	Crossbred cows (Holstein Frisian)	Nil
Fodder source	Outside and partly from hydroponic fodder production.	Hybrid Napier grown in coconut trees and boundary+ Natural grass	Hybrid Napier grown in coconut trees and boundary+ Natural grass	Nil
Biogas	Dinabandhu model (3 m^3)	Nil	Nil	Nil
Value addition	Value addition for banana	Nil	Nil	Value addition of variety of products like banana, jackfruit, coconut

lakh with investment of 0.50 lakh. Overall, success of the IFS was commendable with ₹ 23.33 lakh as net profit and generating an employment for about 3 persons round the year (1010 man days) and maintaining a better livelihood through a monthly net income of about ₹ 2.00 lakh from the farming system. The income from cashew plantation was low. But in addition to nut yield, the cashew apple yield was around 1000 kg per year from 0.6 ha which served as a very good feed for pigs fattening.

IFS at Tamboxem (Pernem taluk) in North Goa

Overall, performance of the IFS was not very encouraging in terms of economic returns. However, the IFS played the key role in sustaining the livelihood of the

Table 3 Economics of Integrated Farming Systems of farmer in village Hankhane (Pernem taluk) in North Goa

Enterprise	Area (Acres)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)
Field Crops					
Rice-Fallow	2.0	0.15	0.15	0.0	30
Fallow-fallow	2.0				
Plantation crops	4.0				
Coconut	2.0	3.00	0.50	2.50	40
Arecanut	0.5	0.20	0.10	0.10	10
Cashew	1.5	0.30	0.10	0.20	20
Cattle (2 bullocks)	0.02	0.30	0.30	0	0
Fodder + Grazing land	0.50 + 0.25	NE	NE	NE	NE
Piggery	0.25	32.0	12.0	20.0	730
Goatery	0.50	3.50	1.50	2.00	180
Depreciation cost of infrastructure and rental value of land			1.46		
Total	10.0	39.45	16.1	23.33	1010

Table 4 Economics of Integrated Farming Systems of farmer at village Tamboxem (Pernem taluk) in North Goa

Enterprise	Area (Acres)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Field crops						
Rice-rice (Khazan land)	2.0	1.00	0.45	0.55	60	27.7
Plantation crops						
Coconut+ Arecanut	0.5	0.05 + 0.40	0.02 + 0.10	0.046 + 0.30	5 + 20	12.6
Fodder						
Karad grass (in waterlogged areas)	2.24	0.36	0.06	0.30	20	10.10
Dairy (4 cows (2 milch) + 1 buffalo)	0.25	1.70	1.90	-0.20	200	47.20
Biogas (Dinabandhu model : 2 m3)	0.01	0.07	0.01	0.06	5	1.9
Depreciation cost of infrastructure and rental value of land			0.30			
Total	5.00	3.60	2.74	0.85	310	

farmers being the only source of income. Farmer generated a gross and net income of ₹ 3.60 and ₹ 0.85 lakh in a year from 2.0 ha, with an employment generation of 310 man days (Table 4). Though dairy contributed 47.2% of the gross income of the farmers but the net returns from this unit was negative and contribution from rice–rice system to net return was maximum 27.7%. Dairy unit, helped in providing maximum employment (64.5%) and regular income to the farmer thereby served as a main stay of the farm economics. The valuable manure generated in terms of biogas digested slurry was recycled to plantation crops and rice field, which could meet the manure requirement of the farm and made the farm less dependent on external inputs. From the biogas plant on an average 4.5 hr/day gas was produced, which was sufficient for cooking the food for the farm family.

IFS at Ibrampur (Pernem taluk) in North Goa

The farm generated around 100 tonnes FYM out of which 20 tonnes of bio-gas slurry was made by recycling through biogas plant. The manure is recycled to crops, *viz*. rice, plantation crops and vegetables, thus cutting down the fertilizer requirement of the farm. Karad/marvel grass has been a good source of dry fodder and green fodder for the dairy unit. From 2.0 ha farming systems the farmer generated gross and net returns of ₹ 20.0 and 15.09 lakh respectively with an investment of ₹ 5.0 lakh and an employment of 845 man days was generated. Dairy was the backbone of the farming system contributing 85% of the total gross income and provided employment opportunity of 71%. Plantation crop and vegetable production was next remunerative enterprise.

IFS at Haspur (Pernem taluk) in North Goa

The net return from 5.4 ha of cashew plantation is ₹ 0.06 lakh which is very less due to local variety and very poor quality of management. Overall, from 10.8 ha farming system the farmer generated gross and net returns of ₹ 13.30

Table 5 Economics of Integrated Farming Systems of farmer at Ibrahampur (Pernem taluk) in North Goa

Enterprise	Area (Acres)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Field crops						
Rice-fallow	2.0	0.60	0.21	0.39	80	2.98
Vegetables	0.75	0.85	0.20	0.65	50	4.23
Plantation crops						
Coconut+ Arecanut	1.5	1.10	0.48	0.62	60	5.47
Fodder						
Karad grass (in waterlogged areas)	0.4	0.25	0.20	0.05	50	1.24
Dairy (20 crossbred cows of which 20 cows are in milch condition)	0.25	17.19	3.39	13.80	600	85.56
Biogas (Dinabandhu model: 2 m^3)	0.01	0.10	0.02	0.08	5	0.05
Depreciation cost of infrastructure and rental value of land			0.50			
Total	5.0	20.09	5.00	15.0	845	

Table 6 Economics of Integrated Farming Systems of farmer at Haspur (Pernem taluk) in North Goa

Enterprise	Area (Acres)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Field crops						
Rice-rice	2.0	0.60	0.21	0.39	80	4.5
Plantation crops	15.5					
Coconut+ Arecanut	2.0	0.70	0.20	0.50	40	5.3
Cashew	13.5	0.60	0.20	0.40	60	4.5
Dairy						
Local cow (4 cows of which 2 are in milch)	0.01	3.26	2.55	0.71	300	24.6
Crossbred cow (8 cows of which 6 are in milch)	0.01	7.95	4.24	3.71	300	60.0
Poultry (30 birds of Banaraja and Gram priya breed)	0.01	0.15	0.15	0	20	1.1
Depreciation cost of infrastructure and rental value of land			1.00			
Total	18	13.26	8.74	3.52	800	

and 3.56 lakh respectively. Also an employment of 800 man days was generated. Dairy unit contributed maximum to the gross returns. This was followed by plantation crops. The farmer is having a plan to convert 3.6 ha of fallow land into agro-tourism for generating income.

Performance of Indigenous Kulagar Farming Systems (IKFS)

IKFS at Kuncolim (Ponda taluk) South Goa

The farmer is maintaining an IKFS in 1.0 ha area. Overall the Kulagar system proved to be sustainable and remunerative with net returns of ₹ 2.03 lakh from 0.95 ha area of land with employment generation of 365 man days. The farmer maintained dairy unit of 20 cows, which was linked to a 3 m^3 Dinabandhu model biogas plant. The dairy unit was producing about 170 l of milk every day, which was sold to Goa Dairy Board. Besides, around 100 tonnes/year of cow dung was produced, which were partly recycled to the Kulagar system through biogas plant and a part was directly applied on crop residues which helped in decomposition. Overall, the system was remunerative with gross and net returns of ₹ 30.67 and 11. 62 lakh, respectively. Besides an employment opportunity of 1105 man days per year (Table 7). The rural youth could get gainful employment by managing such an IFS model. The farmer himself has the satisfaction that he is able to earn around ₹ 1.0 lakh per month as manager of his own farm from 1.0 ha area and not dependent in the private company for employment. Earlier, he was an employer in a chemical industry @ ₹ 0.60 lakh per month. Besides, he has given employment to 4 youth in his farming system.

IKFS at Veling (Ponda taluk) in South Goa

The farmer is managing a farming system in 2.0 ha area involving fallow-rice, Kulagar, cashew plantation and dairy.

Table 7 Economics of Kulagar-based Integrated Farming Systems of farmer (Ponda block) in South Goa

Enterprise	Area (ha)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Kulagar system	0.95	3.63	1.59	2.03	365	11.8
Arecanut (3000 plants)		1.00				3.26
Coconut (250 plants) (4800 nuts)		0.72				2.34
Black pepper (1500 plants)		1.00				3.26
Other crops in the Kulagar systems		0.91				2.97
Dairy (20 cows) including hydroponic fodder unit and farm house	0.04	26.82	16.4	10.4	730	87.4
Biogas (Dinabandhu model : 3 m^3)	0.01	0.22	0.02	19.0	10	0.7
Depreciation cost of infrastructure and rental value of land			1.00			
Total	1.0	30.67	19.0	11.62	1105	

Table 8 Economics of Kulagar-based Integrated Farming Systems at Veling (Ponda taluk) in South Goa

Enterprise	Area (ha)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Fallow-rice	0.8	0.57	0.26	0.31	60	6.37
Kulagar system Consists of arecanut (plants), coconut (plants), black pepper (plants), other crops in the Kulagar systems	0.4	0.62	0.20	0.42	40	6.93
Cashew	0.48	0.15	0.05	0.10	10	1.67
Dairy (4 cross-bred cows) and other kitchen garden area including farm house	0.32	7.60	4.00	3.60	365	85.0
Depreciation cost of infrastructure and rental value of land			0.60			
Total	2.0	8.94	5.11	3.83	475	

The Kulagar system is 40 years old. This system is linked to a dairy unit for last 3 years with 4 crossbred cows. In addition to Kulagar system, the farmer is also managing 1.2 acre of cashew plantation. The local variety of cashew along with traditional management resulted in low productivity. The farmer is fully engaged for the management system and it is the only source of income and employment. Overall from the 2.0 ha of farm, the farmer is able to earn gross and net return of ₹ 8.94 and 4.33 lakh respectively (Table 8). The farmer is needed to establish a biogas plant to link the Kulagar, cashew plantation and rice cultivation with livestock through manure recycling to use biogas slurry as valuable manure.

IKFS at Mardol (Ponda taluk) in South Goa

Farmer from the 2.0 ha of land, could earn a gross and net income of ₹ 6.76 and 3.50 lakh respectively (Table 9). From this, the family gets an employment of 475 man days and a variety of products like banana, coconut, arecanut, pepper, chilli, brinjal etc from the Kulagar system, which is directly consumed by the farm family. The dairy enterprise contributed 74.3% of the gross income followed by Kulagar system with 10.0%.

IKFS at Netravali (Sanguem Taluk) in South Goa

The farming system is developed in 2.6 ha area involving a Kulagar, which was established 17 years before. The farmer has modified the traditional Kulagar system is linked with agro-tourism by making tree house, creating yoga centre, dinning and other facilities. Overall Kulagar system generates a gross and net income of ₹ 22.35 and 12.25 lakh, respectively (Table 10). The farm could generate an employment opportunity of 880 man days for the rural youth for about 3 persons who got involved in various activities of farming and agro-tourism. The Kulagar system contributed about 65% to the gross income of the farm followed by pine apple plantation in 0.8 ha area, which contributed 26.8%. The coastal agro-ecosystem maintain a wide bio-diversity having fishery, duckery, dairy, poultry, piggery, plantation crops (cashew, coconut, arecanut), ornamental crops, etc. rice-based farming system has been the backbone of the farmers economy and livelihood security.

Comparative performance of IFS vs IKFS

Integrated farming systems (IFS)

In the four IFS studied, in North Goa only two farmers

Table 9 Economics of Kulagar-based Integrated Farming Systems at Mardol (Ponda taluk) in South Goa

Enterprise	Area (ha)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Fallow-rice (Khazan land)	0.8	0.54	0.20	0.34	60	7.98
Kulagar system Consists of arecanut (plants), coconut (plants), black pepper (plants), other crops in the Kulagar systems	0.4	0.70	0.20	0.50	30	10.30
Cashew (200 plants)	0.7	0.50	0.10	0.40	20	7.39
Dairy (3 cross-bred milch cows) and other kitchen garden area including farm house	0.1	5.02	2.72	2.30	365	74.26
Depreciation cost of infrastructure and rental value of land			0.50			
Total	2.0	6.76	3.72	3.04	475	

Table 10 Economics of Kulagar-based Integrated Farming Systems of Netravali (Sanguem Taluk) in South Goa

Enterprise	Area (ha)	Gross returns (Lakh ₹)	Production cost (Lakh ₹)	Net returns (Lakh ₹)	Labour requirement (man days)	Contribution to gross returns (%)
Kulagar system	1.0	14.5	6.60	7.95	500	65.1
Arecanut (1000 plants)	1.0					
Coconut (25 plants) (4800 nuts)	1.0					
Black pepper (500 plants)	1.0					
Nutmeg (100 plants)	1.0					
Nutmeg mace (red colour flower of nutmeg)	1.0					
Banana (variety- Sugandhi) 100 plants	1.0					
Cashew (200 plants)	0.8	1.80	0.50	1.30	180	8.05
Pine apple (20,000 plants)	0.8	6.00	3.00	3.00	200	26.85
Depreciation cost of infrastructure and rental value of land			0.50			
Total	2.6	22.4	10.6	11.7	880	

* 17 year old Kulagar system. Arecanut value is ₹ 200/kg raw arecanut. Pepper yield is 2.0 kg dry pepper/plant, the value of dry Pepper is ₹ 600/kg. In 1.0 ha Kulagar system 100 nutmeg plants are found. Nutmeg yield is 2.0 kg nutmeg/plant. One kg nutmeg is sold at ₹ 400/kg, Nutmeg mace (red colour flower) is sold at ₹ 1000/kg. Infrastructure: For irrigation setup ₹ 0.60 lakh/acre-sprinkler system, Panting material: 1.5 lakh/ha and planting cost: ₹ 1.0 lakh. Depreciation cost is taken as ₹ 0.50 lakh/ha/year and for 5 years to get reasonably good economic yield is ₹ 2.50 lakh/-. Similarly rental value of land is ₹ 0.12 lakh/ha and for 5 years it is ₹ 0.60 lakh. All together for 1.0 ha kulagar system the Fixed cost comes to around ₹ 3.10 lakh.

have linked the dairy with biogas plant for meeting the family requirement of fuel (biogas). It was observed that biogas production helped in meeting the family requirement of fuel throughout the year. It is needed that the IFS should be linked to biogas production. This will help in producing valuable biogas slurry as very good form of manure. This manure can help in reclamation of the lateritic soil in the plantation crops along with the crop residues. Policy support for establishing the dairy enterprise is also very conducive. Besides, support price of cashew, arecanut and coconut is also remunerative for sustaining the system. Overall, such system is remunerative with higher level of income and generating adequate employment and also supporting the livelihood. Some of the IFS can be converted to agro-tourism in the way converting to aqua-culture based IFS and integrated fish with duck and making it more attractive for tourist.

Indigenous Kulagar -based Farming Systems (IKFS)

IKFS has been the age old and indigenous system of the coastal ecology more specifically in the Goa state. This system has been time tested and more climate resilient. Kulagar can be a best strategy for mitigation and adaptation to climate change. Due to optimal combination of varieties of crops and trees, such system results in inbuilt genetic/bio-diversity which is an important component of sustainability. Such systems also generate a higher level of income. In our studies, a net income and employment of ₹ 11.6 lakh and 1105 man days from 1.0 ha area; ₹ 3.83 lakh and 475 man days and ₹ 3.04 lakh and 475 man days from 2.0 ha area, and ₹ 12.25 and 880 man days were generated from 2.6 ha, which shows that Kulagar system is not only a sound system from ecological and climate resilience point of view, but also it has potential to generate adequate income and employment, and enhance the livelihood of small and marginal farmers. In the recent years, the Kulagar systems are linked to agro-eco tourism attracting tourist and in the process farmers are able to earn more money and employment for rural youth. This system generates new hope for the rural youth. However, such systems face various challenges, and eroding gradually.

Conclusion

The IFS and IKFS system have been the mainstay of economy and livelihood of farmers in Goa state. Both the systems have attracted the rural youth due to its income and employment generating potential. Overall, it is revealed that IFS and IKFS are very important to generate adequate income and employment for the livelihood improvement of the farmers. Besides, both systems are climate resilient and proved potential for adaptation and mitigation to climate change. IFS and IKFS may be promoted in large scale in coastal agro-ecosystem in other parts of the country as an important strategy for enhancing livelihood and climate resilience in agriculture.

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