INTEGRATION OF LIVESTOCK IN THE FARMING SYSTEM AND VIABILITY OF RAIN-FED FARMING SYSTEM

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Abstract: Integrated farming system comprising of crop and livestock has been sustainable over centuries. Integrated farming system research project consist of following components viz., crop production (0.55 ha), horticulture (0.40 ha), livestock (0.03 ha.), dairy farming (1 milking buffalo), poultry farming (100 birds/batch) and goat rearing (20 goats). Farm shed, buffalo shed, poultry house and farm pond on an area of 0.03 ha. Border plantation (0.02 ha.)The entire project is laid on an area of 1.00 ha. the present experiment is planned at Mulegaon research farm, Zonal Agricultural research Station, Solapur with the objectives to generate the integrated farming system model for efficient use of resources, to study the integrated farming system model in respect of employment generation, to study the integration of livestock in the farming system research and to study the economics and viability of rain-fed farming system.

The results of on farm Integrated farming system model conducted at Mulegaon research farm shows that expenditure, income, net profit and B:C ratio was found to be Rs. 75398, Rs. 117332, Rs. 41934 and 1.55, respectively. Net profit received from on farm integrated farming system was Rs.20035.

Keywords: Livestock, sustainable, farming system, horticulture, border plantation

Introduction: Integrated farming system comprising of crop and livestock has been sustainable over centuries. The system could be able to meet food needs of the ever-increasing population. In this system, animals are raised on agricultural waste and reared for milk and meat purpose and voids are used as manure and fuel. With this view, the present experiment is planned at Mulegaon research farm, Zonal Agricultural research Station, Solapur with the objectives to generate the integrated farming system model for efficient use of resources, to study the impact assessment of integrated farming system model in respect of employment generation, recycling of energy and increasing the income flow, to study the integration of livestock in the farming system research and to study the economics and viability of rain-fed farming system.

Experimental details of the study was Integrated farming system research includes crop component, horticulture and livestock components. The animal component was maintained on byproduct obtained from the crop production. The recommended technologies were followed while growing the scheduled cropping system. Considering the practical feasibility and agro climatic situation during the cropping season the change in scheduled cropping pattern and acreage was made.

The data on cost of cultivation of farming system was recorded by day to day observation taken during the period. The detailed information on livestock maintenance was recorded and maintenance cost worked out. Based on this information, the cost of cultivation productivity and economic returns were estimated and presented.

Integrated farming system research project consist of following components viz., crop production (0.55 ha), horticulture (0.40 ha), livestock (0.03 ha.), dairy farming (1 milking buffalo), poultry farming (100 birds/batch) and goat rearing (20 goats). Farm shed, buffalo shed, poultry house and farm pond on an area of 0.03 ha. Border plantation (0.02 ha.)The entire project is laid on an area of 1.00 ha.

Results: Economics of all the four components viz; crop production, horticulture, livestock (animal, goat and poultry) and border plantation during the year 2009-10 to 2013-14 was worked out separately and presented in this study. The detailed componentwise distribution of area and its allocation is presented in the Table 1.

Table 1 Componentise area and its percent allocation

Sr. No.	Component	Area (ha)	Area allotted (%)
1.	Crop production	0.55	55.00
2.	Horticulture	0.40	40.00
3.	Livestock	0.03	3.00
4.	Border plantation	0.02	2.00
	Total	**1.00**	**100.00**

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Cropping programme followed in the integrated farming system: The detailed cropping programme followed during the 2009-10 to 2013-14 for the integrated farming system was given in Table 2.

Table 2 Cropping programme followed during 2009-10 to 2013-14

Sr. No.	Summer		*Kharif*		*Rabi*	
	Crop	**Area (ha)**	**Crop**	**Area (ha)**	Crop	**Area(ha)**
1.	Anola	0.40	Anola	0.40	Anola	0.40
2.	Fallow	(0.40)	Intercropping of (Pigeonpea+Pearlmillet)	(0.40)	Fallow	(0.40)
3.	Fallow	(0.30)	Cowpea	0.30	*Rabi* sorghum	0.30
4.	Fallow	(0.10)	Maize fodder	0.10	Sorghum fodder	0.10
5.	Fallow	(0.15)	Fallow	0.15	Gram	0.15
	Total	**0.95**		**0.95**		**0.95**

Net cropped area : 0.95 ha.
Gross cropped area : 1.75 ha.
Cropping intensity : 184 %

While implementing cropping programme on dry region of integrated farming system, all the available resources were utilized at its extreme and hence, the cropping intensity was 184 per cent.

Grain yield obtained from crop production component in IFS (2009-10 to 2013-14): The grain yield received from all the crops of the crop component and average of five years from 2009-10 to 2013-14 was calculated and are presented in Table 3.

Table 3 Grain yield obtained from crop production component in IFS (2009-10 to 2013-14).

Sr. No	Crop/variety	Area (ha)	Grain yield (qt)					
			2009-10	2010-11	2011-12	2012-13	2013-14	Average
1	Pearlmillet (Shanti)	0.26	0.00	4.00	4.50	3.00	2.00	3.38
2	Pigeonpea(Vipula)	0.14	1.00	0.72	1.50	0.50	1.30	1.00
3	Cowpea(Phule pandhari)	0.30	0.00	2.00	1.25	0.00	1.00	1.42
4	*Rabi* Sorghum(Chitra)	0.30	1.08	2.50	1.50	0.00	0.75	1.46
5	Gram (Digvijay)	0.15	1.50	1.30	1.00	1.00	0.50	1.06
6	Fodder crops (MaizeAT)	0.10	-	-	-	-	-	-
7	Sorghum fodder (Phule Amruta)	0.10	-	-	-	-	-	-

Average grain yield for the crops viz; pearlmillet, pigeonpea, cowpea, *rabi* sorghum and gram was 3.38, 1.00, 1.42, 1.46, and 1.06 quintals, respectively.

Fodder yield obtained from crop production component in IFS (2009-10 to 2013-14): The fodder yield received from all the crops of the crop component and average of five years from 2009-10 to 2013-14 was worked out and are presented in Table 4.

Table 4 Fodder yield obtained from crop cultivation component in IFS (2009-10 to 2013-14)

Sr. No	Crop/variety	Area (ha)	Fodder yield (qt)					
			2009-10	2010-11	2011-12	2012-13	2013-14	Average
1	Pearlmillet (Shanti)	0.26	0.45	10.00	10.0	7.00	8.00	7.09
2	Pigeonpea (Vipula)	0.14	0.50	1.50	5.00	2.00	0.50	1.90
3	Cowpea(Phule pandhari)	0.30	10.00	4.50	5.00	30.00	15.00	12.90
4	Rabi Sorghum(Chitra)	0.30	6.25	6.00	10.00	7.00	3.00	6.45
5	Gram (Digvijay)	0.15	0.75	1.75	1.75	0.75	1.00	1.20
6	Fodder crops (Maize)	0.10	12.00	35.00	80.00	27.00	20.00	34.80
7	Sorghum fodder	0.10	--	15.00	20.00	22.00	19.00	19.00

Average fodder yield for the crops viz; pearlmillet, pigeonpea, cowpea, rabi sorghum, gram, maize fodder and sorghum fodder was 7.09, 1.90, 12.90, 6.45, 1.20, 34.80 and 19.00 quintals, respectively.

Overall economics of integrated farming system: While, summing up of the integrated farming system, overall economics of all the components of IFS was worked out and feasibility of the on station farming system was tested

Cost of production of integrated farming system: Cost incurred for all the components of farming system was worked out and presented in Table 5.

Table 5 Cost of production of integrated farming system (2009-10 to 2013-14)

Sr. No.	Crop	Area (ha)	Cost of production (Rs.)					
			2009-10	2010-11	2011-12	2012-13	2013-14	Average
1.	Crop production	0.55	10705	17035	23262	19083	17299	17476
2.	Horticulture	0.40	5570	3732	4000	3232	4579	4223
3.	Dairy farming	0.03	12321	0	18987	43656	28286	20650
4.	Poultry farming		7532	10967	9422	9463	9747	9427
5.	Goat rearing		18164	33263	14180	25877	21114	22520
6.	Border plantation	0.02	900	1260	1200	1300	850	1102
Total		**1.00**	**55192**	**66257**	**71051**	**102611**	**81875**	**75398**

It has been observed that from the one hectare of area the cost incurred for production all the six components was Rs.75398, of that major items of cost was goat rearing (Rs.22520) followed by dairy farming (Rs.20650) and crop production (Rs.17476) components. The minimum cost was incurred for border plantation (Rs.1102).

Gross income from integrated farming system: Gross income received through all the components of farming system i.e. crop production, horticulture, dairy farming, poultry farming, goat rearing and border plantation was presented in Table 6.

Table 6 Gross income from integrated farming system.(2009-10 to 2013-14)

Sr. No.	Crop	Area (ha)	Gross income (Rs.)					
			2009-10	2010-11	2011-12	2012-13	2013-14	Average
1.	Crop production	0.55	16985	34249	45900	26197	23675	29400
2.	Horticulture	0.40	7493	6375	7500	2306	4600	5655
3.	Dairy farming	0.03	10112	0	37192	53500	59572	32075
4.	Poultry farming		9810	16969	15740	17944	21400	16373
5.	Goat Rearing		15225	58570	28871	32210	24569	31889
6.	Border plantation	0.02	1250	1750	1800	2400	2500	1940
Total		**1.00**	**60875**	**117913**	**137003**	**134557**	**136316**	**117332**

At the end of integrated farming system the gross income received from all the components of integrated farming system was Rs.115982 of which, maximum gross income received through dairy farming (Rs.32075) followed by goat rearing (Rs.31889) and crop production (Rs.29400).

Net income from integrated farming system: Net income received through all the components of farming system i.e. crop production, horticulture, dairy farming, poultry farming, goat rearing and border plantation was presented in Table 7.

Table 7 Net income from integrated farming system.(2009-10 to 2013-14)

Sr. No.	Crop	Area (ha)	Net income (Rs.)					
			2009-10	2010-11	2011-12	2012-13	2013-14	Average
1.	Crop production	0.55	6279	17214	22638	7117	6376	11924
2.	Horticulture	0.40	1923	2643	3500	-926	0021	1432
3.	Dairy farming	0.03	-2209	0	18205	9844	31286	11425
4.	Poultry farming		2278	6002	6318	8481	11653	6946
5.	Goat Rearing		-2939	25307	14691	6333	3455	9369

6.	Border plantation	0.02	0350	490	600	1100	1650	838
Total		**1.00**	**5683**	**51656**	**65952**	**31949**	**54441**	**41934**

After deduction of gross income from the cost of cultivation the profitability or net income received through the integrated farming system was Rs.40584 from the one hectare of area. The maximum net returns received from crop production Rs.11924 followed by dairy farming Rs.11425.

Benefit cost ratio of integrated farming system: Overall profitability of any firm has been decided through the benefit cost ratio, if the ratio more than one it means that the enterprise become profitable. The benefit cost ratio of integrated farming system after completion of five years has been worked out and presented in Table 8.

Table 8 Benefit cost ratio of integrated farming system.(2009-10 to 2013-14)

Sr. No.	Crop	Area (ha)	B:C ratio					
			2009-10	2010-11	2011-12	2012-13	2013-14	Average
1.	Crop production	0.55	1.58	2.01	1.97	1.37	1.37	1.68
2.	Horticulture	0.40	1.35	1.70	1.87	0.71	1.00	1.34
3.	Dairy farming	0.03	0.82	0	1.95	1.22	2.10	1.55
4.	Poultry farming		1.30	1.54	1.67	1.89	2.19	1.41
5.	Goat Rearing		0.84	1.76	2.03	1.24	1.16	1.42
6.	Border plantation	0.02	1.38	1.39	1.50	1.86	2.94	1.76
Total		**1.00**	**1.21**	**1.40**	**1.55**	**1.38**	**1.79**	**1.55**

At the end of project average benefit cost ratio from all the components of farming system was 1.54 which indicates that the on farm integrated farming system model was profitable, the maximum B:C ratio was observed in border plantation (1.76) this is because of no additional expenditure incurred on this component while in major components the maximum B:C ratio was of crop production component i.e. 1.68 followed by dairy farming (1.55).

Employment generation in integrated farming system: At the time of implementation of farming system, from each component various labours were utilized and employment was generated. The employment generated at various time and the net income received through the integrated farming system was worked out and presented in Table 9.

Table 9 Net income and employment generation in IFS model (2009-10 to 2013-14)

Components	Net income						Employment generation					
	09-10	10-11	11-12	12-13	13-14	Total	09-10	10-11	11-12	12-13	13-14	Total
Crop production	6279	17214	22638	7117	6376	59624	158	158	158	158	160	792
Horticulture	1923	2643	3500	-926	0021	411	95	95	95	95	95	475
Dairy farming	-2209	00	18205	9844	31286	57126	65	-	65	65	65	260
Poultry farming	2278	6002	6318	8481	11653	34732	09	12	09	09	09	48
Goat rearing	-2939	25307	14691	6333	3455	46847	180	180	180	180	153	873
Border plantation	350	490	600	1100	1650	4190	15	-	-	-	-	15
Total	5683	51656	65952	31949	54441	202930	522	445	507	507	482	2463

Total employment generated from all the components of integrated farming system was 2463 and net income received was Rs. 202930. The more employment was generated in the goat rearing (873) while net income received was Rs.46847 followed by crop production component (792) and net income (Rs.59624). Very less net returns were received through horticulture component as employment generated was 475, this was because of dry spell at the time of flower initiation.

Comparison of on farm integrated farming system with the existing farming systems in the Solapur district of Maharashtra: The integrated farming system experiment was compared with the

study viz; Evaluation of existing farming systems in scarcity zone of Western Maharashtra conducted during 2009-10 the details are given below

While conducting the existing farming study the following methodology was adopted i.e. six farmers from each tahsils of Solapur district representing small (size group-I), medium (size group-II) and large (size group-III) size group of holdings with different types of farming systems were selected purposively. Thus, in all 66 sample cultivators were studied.

Overall economic of the IFS model: For comparison the overall results of on farm integrated farming system is presented in Table 10.

Table 10 Overall economic of the IFS model (2009-10 to 2013-14)

Sr. No	Components	Area (ha	Cost of prod (Rs)	Gross income (Rs)	Net income (Rs)	B:C ratio
1.	Crop production	0.55	17476	29400	11924	1.68
2.	Horticulture	0.40	4223	5655	1432	1.34
3.	Dairy farming	0.03	20650	32075	11425	1.55
4.	Poultry farming		9427	16373	6946	1.73
5.	Goat rearing		22520	31889	9369	1.41
6.	Border plantation	0.02	1102	1940	838	1.76
Total		**1.00**	**75398**	**117332**	**41934**	**1.55**

Cost of production of all the components of on farm farming system was Rs.75398, gross income received was Rs.117332 and net income received from the integrated farming system model was Rs.41934 and the B:C ratio was 1.55 means the integrated farming system model was profitable.

Conclusions:

1. For the crop production component total cost of production incurred was Rs.17476.The gross income of Rs.29400 and net income of Rs.11924 has been received with 1.68 B:C ratio.
2. From the horticulture component the gross income of Rs. 5654/- has been received. The total cost incurred thereon was Rs.4223 with net returns were Rs.1432.00 with 1.34 B:C ratio.
3. Among the animal components from the dairy farming, the gross income received was Rs. 32075. The total cost of production is required thereon is Rs.20650/- with giving net return of Rs.11425/- with 1.55 B:C ratio.
4. From the poultry farming, the gross income of Rs. 16373/- has been received. The total cost of production is required thereon is Rs.9427/- with giving net return of Rs.6946/-with B:C ratio 1.73.
5. From the goat rearing, the gross income of Rs. 31889/- has been received. The total cost of production is required thereon is Rs.22520/- with giving net return of Rs.9369/- with 1.41 B:C ratio.
6. While from the border plantation crops, the gross income of Rs.1940/- has been received. The total cost is incurred there on is Rs.1102/- with net returns of Rs.838 and the B:C ratio was 1.76.
7. On farmers field survey on existing farming systems in the Solapur district was revealed that on per hectare basis the expenditure, income, net profit and B:C ratio was found to be Rs. 50160, Rs. 70709, Rs. 20549 and 1.41, respectively.
8. The results of on farm Integrated farming system model conducted at Mulegaon research farm shows that expenditure, income, net profit and B:C ratio was found to be Rs. 75398, Rs. 117332, Rs. 41934 and 1.55, respectively.
9. Net profit received from on farm integrated farming system over farmer's field survey was Rs.20035, which was 97.50 per cent more, over the existing farming systems on farmer's field.

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