Integrated Livestock and Poultry Farming System for Augmenting Socio-economic Status of Hill Farmers in Uttarakhand

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Abstract: Integrated farming system (IFS) comprising of crop and livestock has been sustainable over centuries. This study has shown the possible integrated farming systems with their benefits comparatively to traditional cropping systems. The study has also provided the information about the land holding, cropping pattern and livestock inventory based on the field level information from the state of Uttarakhand. The annual income from agriculture, livestock and service sectors was calculated. It has been found that the annual average family income from livestock production differed among the different categories of size of land holdings and it increased with increase in the size of land holdings. The annual average family income from livestock production also differed significantly among the different livestock production sub-system in both the regions. It was higher in LPS-1 (Rs. 6793) which was based on buffalo alone in Kumaon region but it was higher under LPS-6 (Rs. 9207), which was based on Buffalo + cow + poultry in Garhwal region. Therefore, LPS-6, the livestock production sub-system, based on Buffalo + cow + poultry should be promoted and advised to the farmers of Kumaon region for increasing the average family income from livestock production.

Key Words: *IFS, income, livestock, LPS, poultry*

Integrated Farming System (IFS) could be able to meet food needs of the ever-increasing population. Integrated farming systems seems to be the possible solution to meet the continuous increase in demand for food, stability of income and diverse requirements of food grains, vegetables, milk, egg, meat etc., thereby improving the nutrition of the small-scale farmers with limited resources. Integration of different agriculturally related enterprises with crops provides ways to recycle products and by-products of one component as input through another linked component and reduce the cost of production and thus raises the total income of the farm. For human need, the livestock provide food, fiber, skin, traction, fertilizer and fuel. Livestock also constitute a 'living bank' providing flexible financial reserves in times of emergency and serve as 'insurance' against crop failure for survival. The Integrated Farming System (IFS) has revolutionized conventional farming of livestock, aquaculture, horticulture, agro-industry and allied activities in some countries, especially in tropical and subtropical regions which are not arid. The Integrated Farming System can remove all these constraints by solving most of the existing economic and even ecological problems along with providing the needed means of production such as fuel, fertilizer and feed, besides increasing productivity many-fold. It can turn all those existing disastrous farming systems, especially in the poorest countries, into economically viable and ecologically balanced systems that will not only

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alleviate poverty, but can even eradicate this scourge completely.

The farming followed by the hill farmers is unscientific and the income generated through such farming is hardly sufficient to meet livelihood. However, using the existing resources the farming system can be made viable, sustainable and income generating with great opportunities of employment potential. Since Uttarakhand state is dominated by the marginal and small holding, different modules have been structured to utilize and recycle the available resources to level out their socio-economic status. Therefore, the study was conducted in the Uttarakhand state having reported area about 5.672 million ha whereas more than 85 per cent area is hilly and rest of the area is plain. The hill region has become a distinct socio-economic region on account of its topography peculiar geographical feature as compared to the plain. Economically the hill region is quite backward. Though the whole economy of the region is based on agriculture, the total cultivable land is only 14 per cent of the total reported area. About 67 per cent of the total working population is engaged in agriculture and more than 78 per cent of the population depends upon the agriculture for its livelihood. Paddy, wheat, maize and coarse cereals are major crops grown in the hill area.

Under the changing farm economy, food crop production even in best circumstances is marginally profitable enterprise. There is thus, need to look for ways by which farmers can make more effective use of their land, labour and capital. Usually this can be done by diversification of the production system. Depending upon skills and resources farmer may opt for more than one enterprise. In farming system research we need to determine the relative proportion of different agriculture enterprises for a particular area. In the hill area farmer's resource base is very low. Usually there are short of cash and labour availability for new enterprises. The importance of dairy animal in the area could be judged from the fact that about 15 per cent of the total cultivable area is allocated for fodder production. In view of the role played by livestock and poultry in the study area, it is essential that the farming system approach be applied in studying the contribution of livestock and developing alternative strategies for optimal production of livestock and poultry in the study area. The specific objectives were: (a) to work out the cropping pattern in the study area; (b) to categorize the existing livestock and poultry production sub-system under integrating farming system in the study area, and (c) to assess the income from various sources under different categories and livestock production system prevalent in the study area.

MATERIALS AND METHODS

The state of Uttarakhand comprises of two divisions i.e. Kumaon and Garhwal and 13 districts. Out of which Almora district from Kumaon region and Tehri Garhwal district from Garhwal region were selected purposively. Tarikhet and Narendranagar block was selected randomly from Almora and Tehri Garhwal respectively. The selection of villages within block was based on the marketable surplus of milk, its accessibility and vicinity to the market place. The broad general information about the potential villages was collected using rapid appraisal technique. A list of all the revenue villages was prepared with the help of respective block headquarter. 17 villages were taken from each selected block, thus a total number of 34 villages were selected randomly from both the region. These farmers were then categorized under three size group i.e. small (up to 0.5 ha), medium (0.5 to 1 ha) and large (above 1 ha). Then the sample of 612 farmers (473 small, 111 medium and 28 large) from Tarikhet block in Kumaon region and 601 (408 small, 165 medium and 28 large) from Narendranagar block in Garhwal region were selected randomly. Thus, the total 1213 sample farmers were selected randomly for the present study.

The data were pertained to the year 2009-10. The primary data on land holding pattern, cropping pattern, livestock and poultry inventory and annual returns from different enterprises like agriculture, livestock, poultry etc were collected through personnel interview with the help of pre-tested schedule. The information on employment generation from various production systems were also taken from farmers.

RESULTS AND DISCUSSION

Human and livestock population density

The human and livestock population density is presented in Table 1. Table reveals that the human population density per hectare of geographical area was slightly higher in Kumaon region than the Garhwal region (4.04 v/s 3.83) Similarly average livestock density per unit of geographical area was higher in Kumaon region than Garhwal region (2.27 v/s 1.72) the human livestock ratio observed was around 2.

Table 1
Human and livestock population density

S. No.	Particulars	Kumaon region	Garhwal region	Overall
1.	Human density/ha geographical area	4.04	3.83	3.93
2.	Livestock density/ha geographical area	2.27	1.72	1.99
3.	Human: livestock ratio	1.78	2.23	2.00

Categorization of land holding

It may be seen from Table 2 that the small, medium and large size land holdings (77.29, 18.14 and 4.58 per cent respectively) of the total sample farms in Kumaon region was slightly lower than the Garhwal region i.e. 67.89, 27.45 and 4.66 percent. It may also be seen these the average size of land holding by small, medium and large sized farm was 0.27, 0.74 and 1.57 ha in Kumaon region, and 0.25, 0.71 and 1.33 ha in Garhwal region while overall land holding by farmer in Garhwal region (0.43 ha) was slightly higher than the Kumaon region (0.41 ha). Thus, the small, medium and large sized farmers owned 44.80, 39.23 and 15.97 per cent of the total land in the overall area. It is further show that the small and large size farmer constituted 50.03 and 17.48 per cent of total land was also higher in Kumaon region than the 39.69 and 14.50 per cent respectably in the Garhwal region. While the medium size of farmer constituted 45.81 per cent of total land in Garhwal region was much higher than the Kumaon region (32.50 per cent).

Cropping pattern

The per farm area under different crop in Kumaon and Garhwal region are presented in Table 3. Table reveals that the wheat was the principal grain crop occupying the largest percentage of the cropped area in all the categories of farms in both regions. The average value for grain crops in Kumaon and Garhwal region being 92.45 and 95.89 per cent, respectively. On an overall basis in Kumaon region, wheat (32.08%) was followed by minor millets (30.19 %) and paddy (24.53 %) and in Garhwal region wheat (34.25 %) was followed by paddy (23.29 %) and minor millet (23.81 %). Vegetable occupied about 6.35% in the overall area, with Kumaon region having a higher area covered compared to Garhwal region (7.55 v/s 4.11).

Table 2
Land holding pattern on sample farm

Particulars	Kumaon region				Garhwal region				Total/ Overall			
	Small	Medium	Large	Total	Small	Medium	Large	Total	Small	Medium	Large	Total
No of sample farms	473 (77.29)	111 (18.14)	28 (4.58)	612 (100)	408 (67.89)	165 (27.45)	28 (4.66)	601 (100)	881 (72.63)	276 (22.75)	56 (4.62)	1213 (100)
Cultivated area (ha)	125.96 (50.03)	81.82 (32.50)	44 (17.48)	251.78 (100)	102.2 (39.69)	117.96 (45.81)	37.34 (14.50)	257.5 (100)	228.16 (44.80)	199.78 (39.23)	81.34 (15.97)	509.28 (100)
Average size of holding (ha)	0.27	0.74	1.57	0.41	0.25	0.71	1.33	0.43	0.26	0.72	1.45	0.42

Note: Figures in parenthesis are percentage of their total

Table 3
Cropping pattern on sample farm (ha)

S. No.	Crops	Kumaon region	Garhwal region	Average
1.	Total Grain crops	0.49 (92.45)	0.70 (95.89)	0.59 (93.65)
(i)	Wheat	0.17 (32.08)	0.25 (34.25)	0.21 (33.33)
(ii)	Minor millet	0.16 (30.19)	0.14 (19.18)	0.15 (23.81)
(iii)	Paddy	0.13 (24.53)	0.17 (23.29)	0.15 (23.81)
(iv)	Others	0.02 (3.77)	0.13 (17.81)	0.08 (12.70)
2.	Total vegetable crops	0.04 (7.55)	0.03 (4.11)	0.04 (6.35)
3.	Gross Cropped area	0.53	0.73	0.63
4.	Cultivable area	0.41	0.43	0.42
5.	Cropping intensity	129.46	169.98	149.54

Figures in parentheses are in percent to gross cropped area

Problem in crop production

The lack of irrigation facility in the study area is one of the major problems in crop production. The non-availability of appropriate technologies, use of poor fermented organic manure, use of seed of un-improved crop varieties, insects particularly white grub, pests, crop damage by wild animals etc. are among the other problem faced by the farmers in the study area. The crop yields are therefore, low leading to insufficient grain production to feed the local population. The farmers are skeptical about the use of land for production of off-season vegetables, fruit and other crops may be partly because of different terrain, non-availability of marketing infrastructure including fruits and vegetables processing industry. Wherever, infrastructures particularly in the form of roads have been developed, the farmers had been tried to opt vegetable production.

Livestock & poultry inventory on sample farm

The average number of cattle and buffalo owned by farmers in Kumaon & Garhwal region were 2.08 & 0.65 and 1.23 & 1.72, respectively (Table 4) indicating that the cows in Garhwal region may not be preferred milch animal. The third major livestock was goat (26.08%) of the total livestock in the study area. The ship was practically absent from Kumaon region and constituted less than 1% in Garhwal region. The poultry constituted about 7.71% of the total livestock and poultry production in the study area.

Table 4
Livestock and poultry inventory on sample farm (No)

S. No.	Livestock & Poultry	Kumaon region	Garhwal region	Total /Overall
1.	Cattle	2.08 (43.15)	0.65 (16.21)	1.37 (31.07)
2.	Buffalo	1.23 (25.52)	1.72 (42.89)	1.47 (33.33)
3.	Sheep	-	0.03 (0.75)	0.01 (0.23)
4.	Goat	0.98 (20.33)	1.34 (33.42)	1.15 (26.08)
5.	Others	0.04 (0.83)	-	0.02 (0.45)
6.	Draft animal	0.04 (0.83)	0.05 (1.25)	0.05 (1.13)
7.	Total livestock	4.37 (90.66)	3.79 (94.51)	4.07 (92.29)
8.	Poultry	0.45 (9.34)	0.22 (5.49)	0.34 (7.71)
9.	Total livestock & Poultry	4.82	4.01	4.41

Figures in parentheses are in percent to total livestock & poultry

Livestock production sub system

Characterization of livestock production sub system (LPS) is presented in Table 5.

Table 5
Number of farm under different livestock and poultry production sub-systems on sample farm

S. No.	livestock production system (LPS)	Kumaon region	Garhwal region
1.	LPS-1 (Buffalo alone)	204 (33.33)	319 (53.07)
2.	LPS-2 (Cattle alone)	137 (22.38)	9 (1.50)
3.	LPS-3 (Buffalo+Cattle)	116 (18.95)	104 (17.30)
4.	LPS-4 (Buffalo+Goat)	56 (9.15)	62 (10.32)
5.	LPS-5 (Buffalo+Cattle+Goat)	34 (5.56)	35 (5.82)
6.	LPS-6 (Buffalo+Cattle+Poultry)	10 (1.60)	5 (0.83)
7.	Others	55 (9.03)	67 (11.16)
	Total	612	601

Figures in parentheses are in percentage to total

A total of six classes of livestock and poultry farming were identified as common sub classes in both the region which were designated as Buffalo based (LPS-1), Cattle based (LPS-2), Buffalo+Cattle based (LPS-3), Buffalo+Goat based (LPS-4), Buffalo+Cattle+Goat based (LPS-5) and Buffalo+Cattle+Poultry based (LPS-6) sub systems. However four major sub systems dominated in both the region. These sub systems revealed that in Garhwal region, most of farmers (53.07%) were rearing only buffaloes along with buffalo based (LPS-3) was identified as another dominate livestock production sub system LPS-3 (17.30%) followed by LPS-4 (10.32%), LPS-5 (5.82%), LPS-2 (1.5%) and LPS-6 (0.83%) and rest 11.16% families were rearing other different combination of livestock along with grain crop and horticultural crops. In Kumaon region, most prevalent livestock sub system was also LPS-1 (33.33%) followed by LPS-2 (22.38%), LPS-3 (18.95%), LPS-4 (9.15%), LPS-5 (5.56%) and LPS-6 (1.60%). The remaining 9.03% of the farmers were rearing other than the above combination of livestock along with grain and horticultural crops which could not be considered as major sub system in either of the region. Further, it was also revealed that in Garhwal region buffalo was (1) the most favored animal/livestock (53.07%) while cattle were most popular in Kumaon region (22.38%).

Income on sample farm

Per farm income from crops, livestock and other sources in various categories of land holdings and livestock production sub system in Kumaon and Garhwal region are presented in Table 6 and 7, respectively.

Income from crop production:

To calculate gross income from crops and vegetable production the output was multiplied by prevailing price of the commodities in the market. Annual average family income from crop production in Kumaon region was estimated about Rs 3036 which was 4.88% of total annual family average income. Income from crop also differed among various livestock production sub-systems. The average annual family income from crops sub-sector was higher in LPS-1 (Rs. 4217) followed by LPS-4 (Rs. 3592), LPS-5 (Rs. 2947), LPS-3 (Rs. 2597), LPS-6 (Rs. 2326) and LPS-2 (Rs. 2158). It was observed that farmers rearing only buffaloes had higher income from the crops (2). The average annual family income form crops sub-sector in Garhwal region was Rs. 3437, which constituted 5.57 per cent of the total annual average family income. The income from crops under different livestock production sub-systems also differed and it was highest under the LPS-1 (Rs. 4077), which was based on buffalo alone. It was followed by LPS-4 (Rs. 3583), LPS-5 (Rs. 3125),

LPS-3 (Rs. 2560), LPS-6 (Rs. 2114) and LPS-2 (Rs. 2094). Further the trends in annual average family incomes from crop production under different livestock production system in Kumaon and Garhwal region were almost similar and indicated that farmers rearing only buffaloes had higher income from the crops in both areas. This may be because of buffaloes are generally reared under stall fed system and buffalo dung is collected throughout the year and used as manure in the crop production, while cow and goat are left loose for grazing in the forest, thus their dung goes as waste. Further, the regular income from the sale of the milk of buffalo also facilitates the farmer to buy fertilizer and other inputs add to the crop productivity.

Income from livestock production

To calculate annual livestock income, monthly/ annual income from sale of milk and livestock animals was added. Home consumed milk was also given weightage while calculating annual income. The average annual income from livestock production in Kumaon region was estimated as Rs. 6316. The income from livestock production in Kumaon region was differed among the categories of the size of the holding. It was higher in families with large land holding than small and medium size

land holding, which could be because of the more land resources available with farmers having large land holdings for rearing buffaloes under stall fed system. Same pattern was observed in Kumaon region. The annual average income from livestock production in Kumaon region differed among different livestock production sub system and it was higher in LPS-1 (Rs. 6793), which was based on buffaloes alone. This was followed by LPS-5(Rs 4347), LPS-6 (Rs 3966), LPS-4 (Rs. 2886), LPS-3 (Rs. 3768) and LPS-2 (Rs. 2441) including that farmers rearing only buffaloes had higher income than rearing cattle or any other combination of livestock (3).

Similarly in Garhwal region, the annual average family income from livestock production was estimated as Rs. 5471.63. The income form livestock production also differed among the various livestock production sub-systems and it was observed that income from livestock sub sector was highest in LPS-6 (Rs. 9207) followed by LPS-5 (Rs. 8126), LPS-1 (Rs. 7376), LPS-4 (Rs. 6210), LPS-2 (Rs. 2521) and LPS-3 (Rs. 2499). Since, LPS-6 and LPS-5 was adopted by a very small number of the farmers thus LPS-1 which has been adopted by majority of the families (53 per cent) emerged as the most important livestock production sub-system in Garhwal region. This also indicated that farmers

Table 6
Income from various sources under different categories in Kumaon region of Uttarakhand

(Rs. / farm)

Parameter	Crop income	Livestock income	Agriculture income (Crop + livestock)	Service income	Annual income
Pooled (612)	3036 (4.88)	6316 (10.15)	9352 (15.03)	52876 (84.97)	62228
Categories					
Small (473)	2640 (4.53)	6190 (10.63)	8830 (15.17)	49396 (84.83)	58226
Medium (111)	3915 (5.49)	5834 (8.18)	9749 (13.67)	61589 (86.33)	71338
Large (28)	6236 (6.60)	10425 (11.03)	16661 (17.63)	77832 (82.37)	94493
LPS Systems					
LPS-1	4217 (7.04)	6793 (11.35)	11010 (18.39)	48853 (81.61)	59863
LPS-2	2158 (3.34)	2441 (3.78)	4599 (7.12)	59963 (92.88)	64562
LPS-3	2597 (4.07)	3768 (5.90)	6365 (9.97)	57461 (90.03)	63826
LPS-4	3592 (5.61)	3886 (6.07)	7478 (11.69)	56503 (88.31)	63981
LPS-5	2497 (3.99)	4347 (6.95)	6844 (10.94)	55735 (89.06)	62579
LPS-6	2326 (4.91)	3966 (8.37)	6292 (13.28)	41085 (86.72)	47377

Figures in parentheses are in percent to annual income

Table 7
Income from various sources under different categories in Garhwal region of Uttarakhand

(Rs. / farm)

Parameter	Crops income	Livestock income	Agriculture income (Crop + livestock	Service income	Annual income
Pooled (601)	3437 (5.57)	5472 (8.87)	8909 (14.45)	52757 (85.55)	61666
Categories					
Small (408)	2554 (4.39)	4879 (8.39)	7433 (12.78)	50707 (87.22)	58140
Medium (165)	4052 (5.33)	5977 (7.87)	10029 (13.20)	65947 (86.80)	75976
Large (28)	7889 (8.75)	7200 (7.98)	15089 (16.73)	75090 (83.27)	90179
LPS Systems					
LPS-1	4077 (6.53)	7375 (11.82)	11452 (18.35	50942 (81.65)	62394
LPS-2	2094 (3.61)	2521 (4.34)	4615 (7.95)	53430 (92.05)	58045
LPS-3	2560 (4.39)	2499 (4.28)	5059 (8.67)	53276 (91.33)	58335
LPS-4	3583 (5.68)	6210 (9.85)	9793 (15.53)	53280 (84.47)	63073
LPS-5	3125 (4.85)	8126 (12.61)	11251 (17.46)	53183 (82.54)	64433
LPS-6	2114 (3.90)	9207 (16.98)	11321 (20.88)	42890 (79.12)	54211

Figures in parentheses are in percent to annual income

rearing only buffaloes alone or in combination of other livestock have higher income from livestock production sub-sector in both regions. In the light of the above results it emerges that farmers should be advised and encouraged to follow LPS-6. Rearing of cows and poultry with buffaloes will increased income from livestock production (4) and hence, will increase overall agriculture income of the farmer.

Crop production v/s livestock production

Total annual average family incomes were always higher from livestock production than from crop production sub-sector in both the region. This highlights the importance of livestock production in hills. The income from both crop and livestock production generally increased with the increase in the size of land holdings in both the region. Among various livestock production sub-systems, the income from crops sub-sector were highest in LPS-1, which was based on buffalo rearing alone in both the region than any other livestock production sub-system (5).

Agriculture income

The total income from crops and livestock production was considered as the agriculture income. The annual average family income from agriculture was estimated as Rs. 9352 and Rs. 8909 in Kumaon and Garhwal region, respectively. The total agriculture income increased with the increase in size of land holdings in both regions and among all the livestock production sub-systems. It was highest in the families following LPS-1 based on rearing of only buffaloes comparatively to other livestock production sub-system in both the regions.

Income from service

Income from service included the income from business, daily paid labour and regular employment from government/private sector etc, and it was observed that about 85 percent of the annual/gross average family income in both Kumaon and Garhwal region was from service and about 15 percent of total average family income was from agriculture sector. Service income differed significantly among various sizes of land holdings and it increased with increase in size of land holdings in both the region indicating that farmers with large size land holdings were having better jobs than small ones. This may be due to higher education opportunities available to their family members and their better economic conditions. However, no trends were observed for service

income among different livestock production sub-systems in both the regions of this study.

Annual gross family income

The annual gross average family income was estimated about Rs. 62,228 and Rs. 61,666 in Kumaon and Garhwal region respectively indicating slightly higher average family income. The annual gross family income increased with the increase in size of land holdings in both the region.

CONCUSSION

The human and livestock density per hectare of geographical area were slightly higher in Kumaon region than the Garhwal region i.e. 4.04 v/s 3.83 and 2.27 v/s 1.72, respectively. The small, medium and large size house hold constituted 77.29, 18.14 & 4.58 percent and 67.89, 27.24 & 4.66 percent in Kumaon and Garhwal region, respectively. The cultivable areas owned by small, medium and large size were 50.03, 32.50 & 17.48 percent in Kumaon and 39.69, 45.81 & 14.50 in Garhwal region. The wheat was the principal grain crop occupying the highest cultivated area in Kumaon (25.08%) and Garhwal (34.25%). Minor millet (30.19 & 19.18) and Paddy (24.53 & 23.29) were another important cereal crops. The lack of irrigation facilities in the study area is one of the major problem in crop production. The non availability of appropriate technologies, use of poorly fermented organic manure, use of unimproved seeds and insect- pests are faced by the farmer. The average number of cattle and buffalo owned by farmers in Kumaon & Garhwal region were 2.08 & 0.65 and 1.23 & 1.72, respectively indicating that the cows in Garhwal region may not be preferred milch animal. The third major livestock was goat (26.08%) of the total livestock in the study area. The ship was practically absent from Kumaon region and constituted less than 1% in Garhwal region. The poultry constituted about 7.71% of the total livestock and poultry production in the study area.

The animal feeding practices in both the areas were more or less similar. The buffaloes were stall-fed while cattle and other categories of livestock were sent out for grazing during day time. The practice of chaffing of green and dry fodder before feeding was practically absent. The use of complete mineral mixture and compound balanced concentrate mixture was also non-existent. Availability of green fodder in animal ration was higher in rainy season compared to summer and winter season while the availability of dry fodder and tree leaves was higher in winter season. The buffaloes are bred naturally in both the Kumaon and Garhwal regions. In case of cows 85.92% farmers followed natural service, 5.10% A.I., and rest 8.98% both A.I. and natural service. The poor availability of improved bull for natural service or A.I. facilities along with poor and imbalanced nutrition during large part of the year was responsible for delayed maturity leading to higher age at first calving and longer inter calving period. The animals were herded in a poorly ventilated unhygienic and dark house during night. The prophylactic measures, like vaccination, deworming etc. were also uncommon and most of the animals in the area are treated using indigenous preparations. The unhygienic condition in which most of the animals are kept give rise heavy calf mortality and other problems, particularly prolapsed of uterus, poor growth and low milk yield etc.

The annual average family income from livestock were estimated to be higher in Kumaon (Rs. 6316) than Garhwal region (Rs. 5472) which was because of larger proportion (53.07%) of farmers were rearing the buffaloes in Garhwal region than Kumaon region. Hence, farmers of Kumaon region may be advised and encouraged to rear the buffaloes to increase their income from livestock production.

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