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System Synergy of Farming System and Common Property Resources in Mountain Regions: A Case Study of Himachal Pradesh

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Abstract

The study conducted in the hilly region of Himachal Pradesh has revealed that the average size of operational holding in the region is small (0.69 ha) and therefore the common property resources (CPRs) assume significant importance for sustaining the livelihood of people. The '*kuhls*' emanating water of CPRs are the main sources of irrigation. The consumption of different products from CPR lands has been found to increase with decrease in the size of landholdings, which underlines the need to increase the productivity of CPR lands. The analysis of linkages between different farm sectors has revealed strong forward linkages of CPRs with livestock and agriculture and weak backward linkages with other sectors. The farm forestry and CPR lands have depicted weak linkage, but strong indirect linkages. The gravity water irrigation k*uhls* (channels) have also revealed strong linkages with agriculture and livestock. The analysis of linkages has suggested that there is a need to strengthen the backward linkages of agriculture, livestock and farm forestry with CPRs. The study has suggested to strengthen the management and conservation of CPRs.

Introduction

Agriculture is the mainstay of the state of Himachal Pradesh. Its importance in the economy of this hill state is apparent from the fact that it is by far the largest single industry and the main occupation of the people. In the hill agriculture, common property resources (CPRs) play an important role, directly or indirectly, in enhancing and stabilizing income, employment and sustenance of the village community by providing multiple goods and services to support farming systems (Vashist and Pathania, 1999; Jodha, 1997). The rural households in the state use CPRs for grazing of livestock and collecting of fuel, fodder, timber, NTFP and mining materials. But due to increasing biotic pressure there is a heavy exploitation of natural resources. Overgrazing has done permanent damage to the vegetative cover, leading to massive soil erosion and rise in barren land. The factors effecting decline in these resources are: land reforms, development programmes, encroachments and commercialization of agriculture (Jodha, 1985, 1986; Iyengar, 1989; Beck, 1994).

In a farm production system, some resources are managed within a farm unit, while others are contributed by the external sources. Both ecological and economical linkages of common property resources (CPRs) exist with other sectors. The CPRs provide direct income to the stakeholders and intermediate inputs to the agricultural and livestock sectors of the economy (Chopra and Dasgupta, 2002). The *kuhls* emanating from CPR water sources are used for irrigation (Chand *et al*., 1991). These resources generate income for almost all the households in one or the other form. Therefore, it is pertinent to analyze the existence of linkages between different farm sectors and CPRs.. In most of the earlier studies, in-depth analysis of the contribution of the CPRs towards the sustenance of

different farming systems has not been done. Considering the importance of CPRs towards the economic development of Himachal Pradesh, the present investigation was undertaken with the following objectives:

- To analyze linkages between CPRs and different farm sectors, and
- To study the extent of dependence of households on CPRs.

Methodology

For the present study, two agro-climatic zones, viz. sub-mountain and low hills subtropical zone (< 650 m above mean sea level, Zone-I) and mid-hills sub-humid zone (650 -1500 m above mean sea level, Zone-II) in Himachal Pradesh were selected. These two zones account for the major part of cultivable land (80 %) and harbour around 85 per cent of the total population of human beings as well as livestock. There is a heavy pressure on land and CPRs in these zones. Therefore, these two zones were purposively selected for the present investigation.

The multistage stratified random sampling technique was used in the present study and the districts of Hamirpur (from Zone-I) and Kangra (from Zone –II) were selected. The Hamirpur district was selected because of more pressure on CPR lands due to high population and livestock density, and Kangra district was selected because of the larger irrigated area through *kuhls* (> 84 %). Badsar and Bhoranj blocks from Hamirpur and Nagrota and Baijnath blocks from Kangra district were selected. Two *Patwar* circles (revenue villages) were randomly selected from each of these blocks. Two villages were selected at random from each *Patwar* circle. The selected households were divided into two categories, viz, marginal (having landholdings up to 0.76 ha) and small (having landholdings more than 0.76 ha) by using cube root frequency method. In total, 200 sample households belonging to the marginal (126) and small (74) categories were selected through probability proportional allocation method. The primary data were collected through well-designed pre-tested schedules and the secondary data from various sources.

Analytical Framework

Input-output Model

Static input-output model was used to study the inter-linkages between different farm components and the related sectors. The inter-linkages were worked out using the micro level data for six sectors, viz. agriculture, livestock, farm forestry, common property resources, *kuhls* and market (Thakur, 1996). In this model, the household sector was taken as the focal point controlling all the contributing sectors for the inputs required and outputs generated from various farm components under different farming systems. The basic form of the input-output model is given by Equation (1) :

$$X_i = X_{ij} + F_i \quad \ldots(1)$$

where, X_i represents the value of output from the ith sector, and X_{ij} and F_i are the amounts of X_i used in the household (F_i) and other sectors of the system (j = 1, 2…., n).

$$X_i - \Sigma X_{ij} = F_i \quad \ldots(2)$$

Equation (1) can be expressed as the transaction matrix and shows the value of inputs that flows form one sector to other. In this way, the contribution of all the sectors can be expressed as the total cost of production for the sector and associated net income from that particular sector. The co-efficient, thus, obtained can be expressed as input-output co-efficient denoted by Equation (3):

$$X_{ij} = a_{ij} X_j \quad \ldots(3)$$

Where, a_{ij} gives the worth of the produce (in Rs) of the ith sector required per unit value output of the jth sector.

$$X_i - \Sigma a_{ij} . X_i = F_i \quad \ldots(4)$$

This represents the relationship that exists between the household sector and output of X_i and the relationship between the intermediate sectors, a_{ij} in the term.

Results and Discussions

Land-use pattern

Land-use pattern shows the availability of culturable land and the land put to different uses.

The land- use pattern of sample farmers has been shown in Table 1. The average landholding was worked out to be 1.14 ha, in which the net sown area was 60.5 per cent. The pasture/*ghasni* accounted for about 23 per cent of the total holdings. A comparison across the marginal and small categories of farm households revealed that the average size of holding on marginal farms was 0.5 ha as against 2.2 ha on small farms. The proportion of operational holding was found higher (80 %) on marginal than small (53 %) farms. The size of holding was found low (1.05 ha) in Zone-I than Zone-II (1.23 ha). The per cent net sown area to total holding was higher (62 %) in Zone-I than Zone-II (59 %).

The study on source of irrigation (Table 2) has revealed that lift irrigation in Zone-I and *kuhl* CPR resources in Zone-II were the main sources of irrigation. It was found that in Zone-I, marginal farmers were benefited more by the lift irrigation scheme compared to small farmers. While, in Zone-II, the marginal and small farmers were equally benefited through *kuhl* irrigation. On an average, only 13.5 per cent farm households used lift irrigation scheme and 50 per cent farm households used *kuhl*s. It was also noted that with the availability of water from lift irrigation in Zone-I, the farmers had diversified their cropping system and were growing some vegetable crops also.

Livestock Production

Table 3 depicts the average livestock inventory for different categories of households. It was found that average size of cattle holding (ACU) was lower (3.76/farm) in Zone-I than Zone II (6.50/farm). The number was higher of buffaloes and bullocks in Zone-I and of sheep and goats in Zone-II. The average number of cattle (ACU) was higher on small than marginal farms. The livestock population, converted into standard cattle unit by using the conversion factor suggested by Kumbhare *et al.* (1983) was found maximum on small farms in Zone-II. It was due to the large number of goats and sheep kept by these households.

Dependence on CPR Lands

The dependence of farm households on CPR lands, given in Table 4, revealed that households of both the zones collect fodder and mining material from these lands. In Zone-I, 56-88 per cent of the sample households use CPR lands for collection of leaves for litter, grazing of animals and fuel wood in the overall farm situation. The farm implements material, fencing material, soil collection, timber and NTFP were collected by 15-33 per cent households from CPRs. In the case of Zone-II, 64-84 per cent of households used the CPR lands for collection of leaves for litter, grazing of animal, wood for farm

Table 1. Land-use pattern of farm households

(in per cent)

Particulars	Zone-I			Zone-II			All farms		
	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall
Net sown area	77.40	55.91	62.16	81.60	50.82	59.08	79.58	53.12	60.50
Pasture/ *Ghasni*	17.74	36.36	30.95	12.71	16.48	15.47	15.13	25.48	22.59
Orchard	4.86	7.73	6.90	5.69	32.70	25.45	5.29	21.40	16.91
Average holding size (ha)	0.52	1.82	1.05	0.49	2.73	1.23	0.50	2.22	1.14

Table 2. Sources of irrigation and proportion of beneficiary farm households

(in per cent)

Farm size	Marginal		Small		Overall	
	Lift irrigation	*Kuhl*	Lift irrigation	*Kuhl*	Lift irrigation	*Kuhl*
Zone-I	30.00	-	21.95	-	27.00	-
Zone-II	-	100	-	100	-	100
All farms	14.28	53.18	12.16	44.60	13.50	50.00

Table 3. Per farm inventory of livestock on farm households

(No./farm)

Particulars	Cow	Buffalo	Bullock	Young stock	Goat	Sheep	ACU
			Zone-I				
Marginal	0.17	1.49	-	0.44	-	-	3.30
Small	0.34	1.98	0.61	0.63	0.05	-	4.40
Overall	0.30	1.69	0.54	0. 52	0.06	0.11	3.76
			Zone-II				
Marginal	1.15	0.4	1.16	0.58	2.22	2.03	4.10
Small	1.54	0.75	1.79	0.66	11.73	19.12	11.13
Overall	1.28	0.52	1.37	0.34	5.36	7.67	6.50
			Overall				
Marginal	0.73	0.91	0.82	0.52	1.21	1.17	3.82
Small	0.34	1.43	1.14	0.47	5.26	8.53	7.42
Overall	0.80	1.12	0.94	0.57	2.71	3.89	5.18

Table 4. Dependence of households on CPRs

(in per cent)

Particulars	Zone-I			Zone-II			All farms		
	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall
Fodder	100	100	100	100	100	100	100	100	100
Grazing	69.49	65.85	68.00	68.66	66.67	68.00	69.05	66.22	68.00
Leaves for litter	59.32	51.22	56.00	65.67	60.61	64.00	62.70	55.41	60.00
Fuel wood	88.14	87.80	88.00	85.07	81.82	84.00	86.51	85.14	86.00
Farm implements	16.95	12.20	15.00	74.63	69.70	73.00	47.62	37.84	44.00
Stacking material	10.45	8.30	9.59	20.90	12.12	18.00	16.00	7.01	11.52
Fencing	30.51	17.07	25.00	20.90	15.15	19.00	25.40	16.22	22.00
Soil collection	30.51	36.59	33.00	-	-	-	14.29	20.27	16.5
Mining	100	100	100	100	100	100	100	100	100
NTFP	25.42	19.51	23.00	23.88	18.18	22.00	24.60	18.92	22.5
Timber	33.00	24.40	29.47	36.25	27.60	33.40	34.62	26.00	30.32

implements and fuelwood in the overall farm situation and 18-34 per cent of households use these lands for stacking, fencing, timber and non- timber products. Almost similar pattern has been observed in both the farm categories of Zone-I and Zone-II. The consumption of different products from CPR lands has been found higher by marginal farms than small-size farms. The study has revealed that there is a demand for CPR resources/products in the sample villages. However, due to encroachment of CPR lands, plantation of pine trees and infestation of these lands by lantana, the production of several products including grasses has decreased. Therefore, to sustain the rising demand of rising human and livestock population, productivity of CPR lands need to be increased by proper management (Sekar, 2001).

System Synergy between CPRs and Farming Systems

It has been found that CPRs have both ecological and economical linkages with other sectors. In the economic terms, CPRs produce provides direct income to the stakeholders. In the agricultural sector, CPR lands provide inputs like stacking material, wood for farm implements and leaves for litter and compost. The agriculture sector does not have direct backward linkages with CPRs but does provide

fodder and concentrates to the livestock sector. With increase in the production of crops, the availability of fodder and concentrates increases, which reduces pressure on CPR lands for fodder. The CPR lands provide fodder and grazing fields to the livestock sector and thus, have strong forward linkages with it. The livestock sector provides droppings of animals to CPRs during grazing and has weak backward linkages. The livestock sector reduces pressure for firewood on CPR lands to a large extent, provided the households install biogas plants. The CPR lands provide income to almost all the households in one or the other form.

The CPR lands have indirect relationship with *ghasnies*. By increasing the productivity of *ghasnies* through growing improved grasses and tree plantations, pressure on CPR lands can be reduced to a great extent. The CPR lands affect environment and climate also. The properly-managed CPR lands protect soil erosion and help in regeneration of grasses and trees. These ecological linkages are important for sustainable development of CPR lands. The biomass in the CPR lands has been undergoing considerable change in terms of density as well as total production. The pine plantation and weeds infestation reduce the productivity of CPR lands. The management aspects and female participation (main users of CPRs) have weak linkages with CPR lands.

The linkages between crop lands and CPR lands are weak. The CPR lands in the state suffer from poor plantation, management rights, weed infestation, etc. The productivity of grasses on CPR lands is very poor due to weeds and pine tree plantations. It can be increased by planting improved grass species, broad-leaf tree plantation and discouraging pine tree plantations. The CPR lands have strong forward and weak backward linkages with livestock. The backward linkages can be improved by providing more input (FYM) from the livestock sector to CPR lands. This sector can also reduce pressure on CPR lands for fuel wood by providing dung as inputs to biogas plants, besides increasing the manurial value. The productivity of the CPR lands can also be increased by enhancing the productivity of crops and grasses on owned *ghasni* and field *bunds,* which have an indirect effect on CPR lands.

Almost all the households were found to depend on CPR lands (*Khads*) for mining materials. Their indiscriminate extractions has reduced the productivity of CPR lands and has caused soil erosion and degradation. Therefore, there is a need to have sound policy measures for its sustainable use and management. A proper management of CPR lands will protect soil erosion, increase regeneration and reduce losses due to fire. There is also a need to strengthen the process of plantation, weed management and benefit-sharing. The linkages between CPR lands and other sectors have been shown in Figure 1.

The *kuhls* with their economic and ecological benefits, have strong forward linkages with agriculture because they contribute towards increasing the income of households by enhancing the productivity of crops. The production and availability of fodder from general crops as well as from fodder crops like *barseem*, *chari* and oats also increase due to irrigation. This, in turn, reduces the pressure on CPR lands for fodder/ grasses. But, the backward linkages between *kuhls* and agriculture are weak and no income from crops is spent on their maintenance. The *kuhls* have strong forward and weak backward linkages with the livestock sector. They provide drinking and bathing water to livestock but no input is provided by the livestock to enhance the efficiency of the k*uhls*. By providing irrigation water to CPR lands, the productivity of grass lands can be increased. The linkage between *kuhls* and its management is weak. The households around a *kuhl* are polluting its water by throwing garbage and even directing flow of sewerage water in it. The linkages between *kuhls* and other sectors have been shown in Figure 2. The study has found a need to strengthen the management of *kuhls* to increase crop production and thereby reduce pressure on CPR lands.

Assessment of Inter-linkages of Farming Systems with CPRs

The linkages between different sub-sectors of the farming system, viz. agriculture, livestock, farm forestry, CPRs, *kuhl*s, market and labour for marginal and small households in the study area have been depicted in Table 5 for Zone-I, Table 6 for Zone-II and Table 7 for all farm households. A perusal of

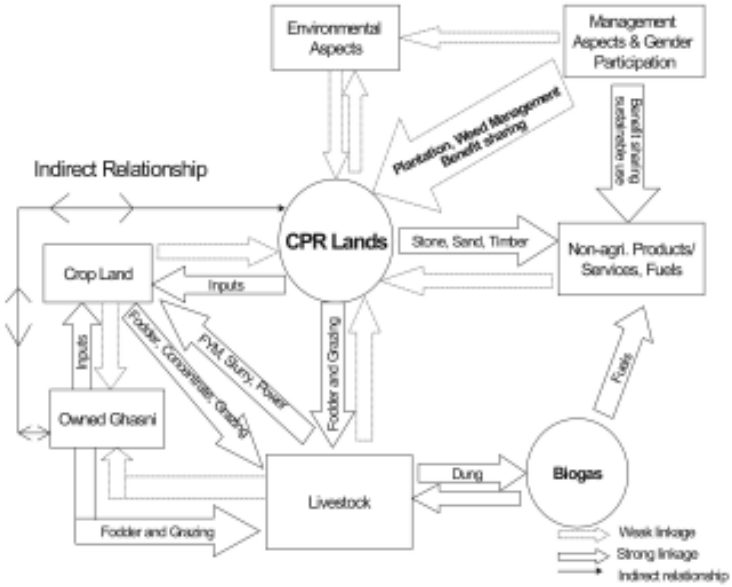

Fig. 1. The linkages between CPR lands and other sectors — A flow diagram

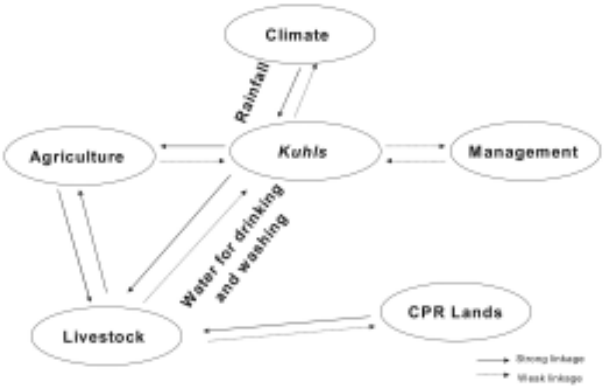

Fig. 2. The linkages of *kuhls* with other sectors

Table 5 revealed that in Zone-I, agriculture output was lower (Rs 9,508) on marginal than small (Rs 20,201) farm households. The sectoral requirements of inputs for marginal and small farm households respectively were Rs 3,109 and Rs 3,947 from livestock, Rs 1,990 and Rs 3,659 from its own output, while market-oriented input cost accounted for Rs 1,340 and Rs. 2,957, respectively. The contribution of farm forestry and CPRs to the agriculture sector varied form Rs 92 to Rs 748. The input-output co-efficient indicated that each rupee of agricultural production required inputs of which Re 0.20 were from agriculture, Re 0.32 from livestock, Re 0.01 from farm forestry, and Re 0.07 from CPRs under the marginal farms. A similar pattern was noted for the small farm households.

In the livestock sector, the per farm total production was estimated at Rs 23,515 and Rs 28,827 for marginal and small farms, respectively. In the case of marginal category, the annual production utilized the inputs worth Rs 2,714, Rs 4,541 and Rs 5,383 from agriculture, farm forestry and CPR, respectively. In terms of input-output co-efficient each rupee required inputs worth Re 0.11, Re 0.19, Re 0.23 and Re 0.18 from agriculture, farm forestry, CPRs and markets, respectively. A similar pattern was observed for the small category of households.

In Zone-II, the agriculture output was of Rs 14,573 and Rs 34,506 on marginal and small households, respectively. The inputs for marginal and small categories of households were estimated at Rs 4,069, Rs 4,367, Rs 6,640 and Rs 7,509 from its own output and livestock, respectively, while in Market-oriented inputs cost was Rs 2,594 and Rs 3,849, respectively. The contribution of farm forestry and CPRs to agriculture sector varied from Rs 205 to Rs 900 in both the categories of households. The contribution of CPRs was lower by small farms than marginal farms. The input-output coefficients indicated that each rupee of agriculture production required seed and other inputs which comprised Re 0.27 from agriculture, Re 0.30 from livestock, Re 0.01 from farm forestry sectors and Re 0.06 from CPRs under the marginal farms, and small farms this varied from Re 0.008 to Re 0.22 (Table 6).

Table 5. Linkages between different farming components of different farm households in Zone-I

(Rs/farm)

Producing sectors	Consuming sectors				Total production
	Agriculture	Livestock	Farm forestry	CPRs	
			Marginal farms		
Agriculture	1990 (0.20)	2714 (0.11)	-	-	9308
Livestock	3109 (0.32)	-	-	-	23515
Farm forestry (own *ghasni* + field bunds)	92 (0.01)	4541 (0.19)	-	-	6744
CPRs	748 (0.07)	5383 (0.23)	-	-	11534
*Kuhl*s	-	-	-	-	-
Market	1340 (0.14)	4263 (0.18)	150 (0.02)	-	15753
Labour	2169 (0.22)	8104 (0.34	2090 (0.31)	10852 (0.94)	12463
			Small farms		
Agriculture	3659 (0.18)	4454 (0.15)	-	-	20201
Livestock	3947 (0.19)	-	-	-	28827
Farm forestry (own *ghasni* + field bunds)	215 (0.01)	8689 (0.30)	-	-	13890
CPRs	720 (0.04)	3946 (0.13)	-	-	11976
*Kuhl*s	-	-	-	-	-
Market	2957 (0.15)	4674 (0.16)	130 (0.01)	-	7761
Labour	4886 (0.24)	8429 (0.29)	3955 (0.28)	9474 (0.79)	17370
			Overall		
Agriculture	3067 (0.23)	3457 (0.13)	-	-	13154
Livestock	3330 (0.25)	-	-	-	25840
Farm forestry (own *ghasni* + field bunds)	142 (0.01)	7147 (0.27)	-	-	8443
CPRs	765 (0.06)	4123 (0.15)	-	-	11675
*Kuhl*s	-	-	-	-	-
Market	2003 (0.15)	4432 (0.17)	142 (0.02)	-	6577
Labour	3342 (0.25)	8255 (0.31)	3208 (0.38)	10112 (0.86)	14905

Note: Figures within the brackets show the input-output co-efficients

Table 6. Linkage between different farming components of different farm households in Zone-II

(Rs/farm)

Producing sectors	Consuming sectors				Total production
	Agriculture	Livestock	Farm forestry	CPRs	
			Marginal farms		
Agriculture	4069	4150	-	-	14573
	(0.27)	(0.13)			
Livestock	4367	-	-	-	31887
	(0.30)				
Farm forestry (own	205	6792	-	-	8907
ghasni + field bunds)	(0.01)	(0.21)			
CPRs	900	13160	-	-	24887
	(0.06)	(0.41)			
*Kuhl*s	10109	-	-	-	10109
Market	2594	5585	170	-	8240
	(0.18)	(0.15)	(0.02)		
Labour	2312	8656	2897	21329	13865
	(0.16)	(0.26)	(0.33)	(0.85)	
			Small farms		
Agriculture	6640	8206	-	-	34506
	(0.19)	(0.20)			
Livestock	7509	-	-	-	39633
	(0.22)				
Farm forestry (own	299	14212	-	-	25699
ghasni + field bunds)	(0.008)	(0.35)			
CPRs	776	11483	-	-	23466
	(0.02)	(0.28)			
*Kuhl*s	29243	-	-	-	29243
Market	3849	6188	185	-	10422
	(0.11)	(0.15)	(0.004)		
Labour	5415	8751	5506	22044	19672
	(0.16)	(0.20)	(0.21)	(0.92)	
			Overall		
Agriculture	5155	5481	-	-	20513
	(0.25)	(0.15)			
Livestock	5404	-	-	-	35776
	(0.26)				
Farm forestry (own	236	9375	-	-	15841
ghasni + field bunds)	(0.01)	(0.26)			
CPRs	859	11854	-	-	24418
	(0.04)	(0.33)			
*Kuhl*s	16423	-	-	-	16423
Market	3008	5850	175	-	9033
	(0.15)	(0.16)	(0.01)		
Labour	3336	8687	3758	21522	15781
	(0.16)	(0.24)	(0.23)	(0.88)	

Note: Figures within the brackets show the input-output co-efficient

Table 7. Linkage between different farming components of farm households on average farm situations

(Rs/farm)

Producing sectors	Consuming sectors				Total production
	Agriculture	Livestock	Farm forestry	CPRs	
			Marginal farms		
Agriculture	3229	3323	-	-	12514
	(0.25)	(0.12)			
Livestock	3871	-	-	-	27649
	(0.31)				
Farm forestry (own *ghasni* + field bunds)	152	6138	-	-	7894
	(0.01)	(0.22)			
CPRs	829	8220	-	-	18039
	(0.07)	(0.29)			
*Kuhl*s	5375	-	-	-	5375
Market	1756	4966	161	-	7075
	(0.14)	(0.17)	(0.02)		
Labour	2292	8491	2519.12	16840	13208
	(0.18)	(0.30)	(0.32)	(0.93)	
			Small farms		
Agriculture	5037	6481	-	-	26580
	(0.19)	(0.18)			
Livestock	5410	-	-	-	34709
	(0.20)				
Farm forestry (own *ghasni* + field bunds)	252	11706	-	-	19972
	(0.009)	(0.33)			
CPRs	785	6869	-	-	16588
	(0.03)	(0.19)			
*Kuhl*s	13040	-	-	-	13040
Market	2463	5267	145	-	8947
	(0.09)	(0.15)	(0.07)		
Labour	5122	8573	4647	14761	18396
	(0.19)	(0.24)	(0.23)	(0.89)	
			Overall		
Agriculture	4261	4669	-	-	16834
	(0.25)	(0.14)			
Livestock	4467	-	-	-	27892
	(0.27)				
Farm forestry (own *ghasni* + field bunds)	189	8766	-	-	13142
	(0.01)	(0.27)			
CPRs	812	8261	-	-	16917
	(0.05)	(0.25)			
*Kuhl*s	9207	-	-	-	9207
Market	1427	5176	156	-	7805
	(0.08)	(0.16)	(0.02)		
Labour	3339	8521	3483	15240	15343
	(0.20)	(0.26)	(0.26)	(0.90)	

Note: Figures within the brackets show the input-output co-efficient

The production of livestock sector was estimated at Rs 31,887 and Rs 39,663 for the marginal and small farms, respectively. In the case of marginal category, the annual production utilized inputs worth Rs 4,150, Rs 6,792 and Rs 13,160 from agriculture, farm forestry and CPRs, respectively. In terms of input-output coefficients, each rupee required inputs worth Re 0.13, Re 0.21, Re 0.41 and Re 0.15 from agriculture, farm forestry, CPRs and market, respectively. A similar pattern was observed for the small households in the study area. The contribution of *kuhl*s to the agriculture sector amounted to Rs 10,109 and Rs 29,243 on marginal and small farms, respectively. The analysis showed weak linkages of farm forestry and CPRs with the agriculture sector in both the zones as well as farm categories. Almost a similar pattern was noticed under all farms situations (Table 7).

Conclusions

The study has revealed that the average size of operational holding in the region is small (0.69 ha), thereby showing importance of CPRs for sustaining livelihood of people. The '*kuhls*' emanating from CPRs water resources are the main source of irrigation in hills. The dependence on CPR products has been found more of marginal than small farms. The study on linkages between different sectors such as agriculture, livestock, farm forestry, CPRs, *kuhls*, market and labour has revealed strong forward linkage of CPRs with livestock, agriculture, while weak backward linkages was observed with these sectors. The gravity water irrigation *kuhls* (channels) have depicted strong linkages with agriculture and livestock. The analysis has suggested that there is a need to strengthen backward linkages of agriculture, livestock and farm forestry with CPRs.

Keeping in view the increasing biotic pressure on CPRs, the study has suggested that farmers should be educated to go in for improved breeds, which will increase their income and reduce pressure on CPRs. There is need to strengthen management of CPRs for their sustainability. Assured irrigation facilities, particularly for the middle and lower regions of *kuhls*, can be provided by storing the *kuhl* water during lean periods for its utilization during peak periods.

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