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RISK MANAGEMENT AND RURAL EMPLOYMENT IN HILL FARMING - A STUDY OF MANDI DISTRICT OF HIMACHAL PRADESH

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ABSTRACT

The study was carried out in Mandi district of Himachal Pradesh during 2002-03 to examine the labour employment in hill agriculture under risk. Stratified two stage random sampling technique was adopted to select the sample. A total of 150 households were selected from different sub-ecological regions viz. Low Hills, Mid Hills and High Hills. The risk efficient farm plans were developed using the Minimisation of Total Absolute Deviation (MOTAD) Model. The plans were existing resources with existing technology,(Plan I) and existing technology with augmented resources (Plan IV). In addition, two plans in between these two were developed. The study revealed that the per farm as well as per hectare labour use was higher during kharif season as compared to rabi season, as more labour intensive crops (paddy and vegetables) were grown during kharif season. With the introduction of dairy, the human labour employment increased by 59 per cent in plan-I whereas in plan-IV, it increased by 60 per cent in low hill region. In mid hills, this increase was estimated as high as 162 and 148 per cent. The corresponding figures in high hills were to the extent of 74 and 58 per cent. This clearly indicates that crops + dairy farming provided higher farm labour employment than crops enterprise alone. It was important to examine that the dairy activity with crops enterprise also reduced the risk. Thus, to increase the employment and minimise the risk in hill agriculture, emphasis needs to be given to encourage mixed farming. The crossbred cows were found to be the best dairy animals in the study area in terms of profitability as well as employment generation. Vegetables were found to be important in the cropping pattern particularly in plan IV. Thus, there is a need to popularise cultivation of vegetable crops in which the role of the Department of Agriculture is crucial in promoting scientific cultivation and orderly marketing to reduce risk.

Introduction

Generation of adequate and sustained employment opportunities has become the focus of attention of the development paradigm since the inception of planning era. Ever since the introduction of economic reforms in 1991, there has been an immense debate on the impact of economic reforms on employment, poverty and well-being of the poor in India, especially in the rural areas. In hilly regions, there is little scope for

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employment generation outside agriculture due to lack of non-farm avenues of employment as well as abundance of unskilled labour force crowding in farm sector.

It is trite observation that the production process itself is extremely susceptible to the caprices of the weather. The weather uncertainties in terms of paucity/ superabundance of rainfall, its lack of proper correspondence with the various stages of production, technological uncertainties in terms of failure of new varieties, non-availability of plant protection measures for diseases/insect pests, etc., contribute greatly to an uncertain production. In Himachal Pradesh, farming is fraught with risk and uncertainty where the performance of the monsoon directly governs the economy of about 83 per cent of cropped land. Owing to low, erratic and uncertain rainfall, crop yields in rainfed areas are low and highly variable and risky (Mruthyunjaya and Sirohi, 1979). Risk and uncertainty in production have also been recognised as important constraints in the process of rapid adoption of the high-yielding variety (HYV) technology in agriculture (Sasmal, 1993 and Saha, 2001).

Add to this the fact that product prices at the end of the cropping season vary significantly from what they were at the sowing time. All these reasons result into a considerable amount of revenue uncertainty. In addition to this, labour employment in agriculture particularly family labour, is seriously affected. In the absence of well-developed insurance and capital market in less developed agriculture, producers often use diverse mechanisms to mitigate the impact of this revenue uncertainty through various alternatives including crop and employment diversification. Of course, the extent to which the farmer can do so effectively will also depend on the uncertainty attaching to labour market employment. This is particularly true in hill agriculture.

Within agriculture also, it needs to be diversified by incorporating land-based and allied enterprises to enhance the employment avenues and reduce income variability, especially in hilly areas having fragile agro-eco-systems. Risk analysis showed that there is scope to enhance employment and minimise risk at farm level by enterprise-mix incorporating judicious-mix of crops and livestock enterprises (Sekar and Palanisami, 2000). The crop farming alone has been proved much risky under severe resource restrictions while crop-cum-livestock combination has been found to enhance the buffering capacity of the farm by reducing risk and increasing land-labour productivity in agriculture (Singh and Sharma 1988). Even under irrigated conditions, vegetable plus dairy was the most appropriate choice for the farmers as the pure vegetable farming was found to be more risky and less remunerative (Kumar et al., 2002).

Hilly regions are characterised by small, scattered, fragmented and rainfed landholdings, weak market infrastructure, traditional production practices, etc. More than 70 per cent of the population of hills earn their livelihoods directly from farming business. Due to low level of education and skill, the movement of labour force from land based activities (farming) to urban oriented activities (industrial production) is low. All these factors affect the economy and livelihoods of hill people under some mountain specificities which separate the hilly region from other areas (Jodha, 1996). Thus, there is a need to study the labour employment under existing situation and explore possibilities for enhancing gainful employment through alternative farm plans. These plans would be more useful if studied under varying degrees of risk so that farmers can choose the plan as per their risk bearing capability. Keeping this in view, the present study was undertaken with the following specific objectives.

1. To examine the existing employment pattern for different farm situations in Mandi district of Himachal Pradesh
2. To study the changing pattern of employment under risk efficient farm plans for different farm situations in the study area
3. To suggest suitable policy measures for enhancing employment in agriculture.

Methodology

Mandi district of Himachal Pradesh was purposively selected where 74 per cent of total population is directly or indirectly dependent upon agriculture. The district has been divided into three distinct sub-ecological regions viz. (i) Foot hills areas (ii) Mid hills areas (iii) High hills areas (Anonymous, 1981). Stratified two stage random sampling technique was adopted to select the sample for the study considering sub-ecological regions as strata. In the first stage of sampling, five villages were selected randomly from each sub-ecological region. In the second stage, a complete list of all the farm households in each of the selected villages was compiled and 50 farm households from each sub-ecological region were proportionally allocated in the selected villages. Thus in all, a sample of 150 farm households of different sub-ecological regions was selected. Both cross section and time series data for the present study were collected through personal visit to the households. Commensurate with the set objectives of the study, cross sectional data collected during 2002-03 and time series data (1998-99 to 2002-03) were collected on area, production and prices of different crops and number and production of livestock from households. To study the employment pattern under risk, risk efficient farm plans were developed for different sub-ecological regions using Minimisation of Total Absolute Deviation (MOTAD) Model. The model used was of the following form;

$$\text{Minimise } Z = \sum_{h=1}^{s} Y^{h-} \qquad \text{(Objective Function)}$$

$$\sum_{j=1}^{n} (C_{hj} - g_j)\, x_j\, Y^{h-} \geq 0 \qquad \text{(Linearity constraints)}$$

$$\sum_{j=1}^{n} f_j x_j = ? \qquad \text{(Parametric constraints)}$$

$$\sum_{j=1}^{n} a_{ij} x_j \leq b_i \qquad \text{(Resource constraints viz, land, peak labour use, capital)}$$

$$\sum_{j=1}^{n} a_{ij} x_j \geq b_i \qquad \text{(Minima constraints)}$$

$$x_j, \text{ and } Y^{h-} \geq 0 \qquad \text{(Non-negativity constraint)}$$

Where,

Z = Sum of the absolute values of deviations of the returns of various enterprises from their mean values

Y^{h-} = Absolute values of the negative total returns deviation of various enterprises in the hth year from their mean (h = 1, 2……..,s)

C_{hj} = Returns of jth farm activity in the h^{th} year

g_j = Mean value of the returns of the j^{th} farm activity

x_j = Level of j^{th} farm activity

f_j = The expected returns per ha of the j^{th} activity

λ = Parameter showing total Returns to Fixed Farm Resources (RFFR) from all the farm activities. Parameter to start from

minimum prescribed income (λl) under restricted supply to maximum (λm) attainable income under unrestricted supply of resources

a_{ij} = Technical requirement of the jth activity for the ith resource

b_i = The constraint level of the ith resource

s = Number of time-series observations

n = Number of farm activities

The risk efficient farm production plans were obtained under the following two situations :

1. Situation-I: Crop enterprises

2. Situation-II: Crop-cum-dairy enterprises

Four risk efficient farm plans were developed at different levels of farm income (determined under above two situations for each sub-ecological region). To determine the extent of employment, labour hiring was included in all these plans. These farm plans are as follows:

P1: Risk efficient farm plan minimum (λl) level of income

P2: Risk efficient farm plan for $\lambda l + \alpha$ level of income

P3: Risk efficient farm plan for $\lambda l + 2\alpha$ level of income

P4: Risk efficient farm plan for $\lambda l + 3\alpha$ level of income

Where, α, 2α and 3α are the additional income levels in the successive plans at varying degrees of risk and α is computed as;

$$\alpha = \frac{\text{Optimised income with augmented resources } (\lambda m) - \text{Optimised income with restricted resources } (\lambda l)}{3}$$

Results and Discussion

Occupation Pattern : Occupational pattern of working population has been presented in Table 1. It was observed that 76 per cent of the total working persons were engaged in agriculture in the study area as majority of the family workers did not prefer to leave their homes in search of off-farm avenues of employment. Dependence on agriculture was found to be higher in high hills (93 per cent) as compared to other two regions, which can be attributed to the reason that the high hills were less developed and majority of the population had poor access to education and other infrastructural facilities. Service including daily paid labour was next to agriculture in employment generation. Similar results were found by Singh and Singh (1999). It is interesting to note that all the females were engaged in agriculture except in low hills where 3 to 4 per cent were in government services.

Existing Labour Use : The human labour is the crucial input in farming, especially in those regions where farm mechanisation has not taken place. The existing use of labour employment in different regions of Mandi district is depicted in Table 2. Results of the study showed that the use of total human labour employment on the farm was observed to be higher (31.03 mandays) during *kharif* season as compared to *rabi* season (22.45 mandays). Similar trend was noticed in different hills which were mainly due to the fact that *kharif* crops like maize, paddy and vegetables required more labour for inter-cultural practices. Further, it is interesting to note that existing use of human labour was 121 and 51 per cent higher in low and high hills over mid hills. Such results might be due to cultivation of more vegetable crops in low and high hills as compared to mid hills. Lowest exiting use of human labour was found in mid hills due to the small landholdings of the respondent farmers as well as less area under

Table 1 : Occupational Pattern of Working Persons (16-60 years) in Different Regions (per cent)

(Per cent)

Occupation	Low Hills			Mid Hills			High Hills			Overall		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Agriculture	35.72	96.51	66.47	34.43	100.00	68.50	85.02	100.00	93.20	51.85	98.68	75.90
Service	29.76	3.49	16.47	27.87	0.00	13.39	2.82	0.00	1.36	20.37	1.32	10.59
Business*	9.52	0.00	4.71	16.39	0.00	7.87	4.22	0.00	2.04	9.72	0.00	4.23
DPL	25.00	0.00	12.35	21.31	0.00	10.24	7.04	0.00	3.40	18.06	0.00	8.78
Total	100	100	100	100	100	100	100	100	100	100	100	100
	(89)	(86)	(175)	(70)	(66)	(136)	(72)	(76)	(148)	(231)	(228)	(459)

* Business including cottage industries.

Figures in parentheses show total working population.

Source: Field Survey, 2002-03.

labour intensive vegetable crops. As far as per hectare labour use is concerned, it was found highest in low hills followed by mid and high hills in both *kharif* as well as *rabi* seasons.

Table 2 : Existing Labour Use in Different Regions of Mandi District

(Mandays/farm)

Particulars	Low Hills	Mid Hills	High Hills	Overall
Kharif season	40.55(50.13)	19.30(43.65)	32.96(43.49)	31.03(46.25)
Rabi season	34.33(42.79)	14.57(32.78)	18.35(28.12)	22.45(35.46)
Total	74.89(46.48)	33.87(38.20)	51.31(36.38)	53.48(41.01)

Figures in parentheses show per hectare labour use.

Source : Field Survey, 2002-03.

Labour Employment Under Different Farm Plans : The peak season-wise human labour utilisation under different plans in low, mid and high hills has been shown through Table 3 to Table 5. While estimating peak seasons labour availability, family labour (male and female) was converted into mandays. A period of eight hours of work was considered as one manday.In the present study four human labour peak periods were identified during the year as Peak-1 (April 15-30), Peak-2 (July 1-15), Peak-3 (Sept. 15-30) and Peak-4 (Oct. 15-31). The labour use was estimated by using peak period labour constraints through MOTAD model.

It is evident from the Tables that there was shortage of human labour in all the peak periods under all the plans in situation-II (crops + dairy farming) in all the three regions. Human labour utilisation increased successively from plan-I to plan-IV in all the peak periods in both the situations. These Tables further revealed that except peak period-1, there was surplus human labour under all the plans in situation-I in mid and high hills. There was marginal increase in the human labour employment during different peak periods under different farm plans. As far as total labour use per farm is concerned, in situation-I it varied from 83.07 to 89.88 mandays in low hills, 33.69 to 36.64 mandays in mid hills and 56.76 to 72.28 mandays in high hills in plan-I to plan-IV. With the introduction of dairy the human labour employment per farm increased by 59 per cent in plan-I whereas in plan-IV, it increased by 60 per cent in low hills. In mid hills, the increase in situation-II over situation-I for plan-I and plan-IV was estimated at 162 and 148 per cent. The corresponding figures for high hills were 74 and 58 per cent. This indicated that crop + dairy farming was more labour intensive than crop enterprises. Further, it can be inferred from the results that dairy activity with crop enterprise reduced the risk which was clearly shown by the comparison of respective coefficients of variation in situation-I and situation-II. This implied that the combination of crop and dairy was most useful in stabilising farm income and reducing associated risk. Results of the study further indicated that human labour employment for different risk efficient plans increased with the increase in the risk under different plans. Utilisation of human labour in peak period -1 was higher as compared to peak period -2, peak period -3 and peak period -4 in both the situations. Peak period -1 was found to be the most critical peak period for land preparation for sowing of vegetables that took more time of labour and sowing of other *kharif* crops and harvesting of *rabi* crops in the study area hills. There was marginal increase in the human labour employment

Table 3 : Human Labour Utilisation Under Different Farm Plans in Low Hills (Mandays/Farm)

Situations	Particulars	Availability	P I		P II		P III		P IV	
			Used	Additional	Used	Additional	Used	Additional	Used	Additional
I Crop	Peak-1	14.46	34.24	19.78	35.62	21.16	36.29	21.83	36.97	22.51
Enterprises	Peak-2	14.46	14.59	0.13	15.21	0.75	15.57	1.11	15.94	1.48
	Peak-3	14.46	14.59	0.13	15.21	0.75	15.57	1.11	15.94	1.48
	Peak-4	14.46	19.65	5.19	20.41	5.95	20.72	6.26	21.03	6.57
	Total	57.84	83.07	25.23	86.45	28.61	88.15	30.31	89.88	32.04
	Risk		9.63		14.42		19.94		25.19	
II	Peak-1	14.46	54.46	40.00	58.47	44.01	59.1	44.64	59.24	44.78
Crop + Dairy	Peak-2	14.46	36.39	21.93	36.91	22.45	37.24	22.78	37.63	23.17
Enterprises	Peak-3	14.46	36.39	21.93	36.91	22.45	37.24	22.78	37.63	23.17
	Peak-4	14.46	41.1	26.64	44.6	30.14	44.89	30.43	44.63	30.17
	Total	57.84	168.34	110.50	176.89	119.05	178.47	120.63	179.13	121.29
	Risk		7.19		12.35		18.46		23.19	

Table 4 : Human Labour Utilisation Under Different Farm Plans in High Hills (Mandays/Farm)

Situations	Particulars	Availability	P I		P II		P III		P IV	
			Used	Additional	Used	Additional	Used	Additional	Used	Additional
I	Peak-1	11.07	13.64	2.57	14.19	3.12	14.73	3.66	14.97	3.90
Crop	Peak-2	11.07	6.40	-4.67	6.40	-4.67	6.43	-4.64	6.70	-4.37
Enterprises	Peak-3	11.07	6.40	-4.67	6.40	-4.67	6.43	-4.64	6.70	-4.37
	Peak-4	11.07	7.25	-.82	7.79	-3.28	8.27	-2.80	8.27	-2.80
	Total	44.28	33.69	-10.59	34.78	-9.50	35.86	-8.42	36.64	-7.64
	Risk		21.02		23.07		25.21		35.96	
II	Peak-1	11.07	35.76	24.69	36.14	25.07	36.52	25.45	36.84	25.77
Crop + Dairy	Peak-2	11.07	28.51	17.44	28.51	17.44	28.51	17.44	28.57	17.50
Enterprises	Peak-3	11.07	28.51	17.44	28.51	17.44	28.51	17.44	28.57	17.50
	Peak-4	11.07	29.37	18.30	29.75	18.68	30.12	19.05	30.38	19.31
	Total	44.28	122.15	77.30	122.91	78.63	123.66	79.38	124.36	80.08
	Risk		19.50		20.60		21.75		23.47	

Note: Peak period for labour use; Peak-1 (April 15-30), Peak-2 (July 1-15), Peak-3 (Sept. 15-30) and Peak-4 (Oct. 15-31).

Table 5 : Human Labour Utilisation Under Different Farm Plans in High Hills (Mandays/Farm)

Situations	Particulars	Availability	P I		P II		P III		P IV	
			Used	Additional	Used	Additional	Used	Additional	Used	Additional
I	Peak-1	18.27	23.15	4.88	25.74	7.47	28.33	10.06	30.6	12.33
Crop	Peak-2	18.27	10.46	-7.81	10.46	-7.81	10.46	-7.81	11.07	-7.20
Enterprises	Peak-3	18.27	10.46	-7.81	10.46	-7.81	10.46	-7.81	11.07	-7.20
	Peak-4	18.27	12.69	-5.58	15.28	-2.99	17.86	-0.41	19.54	1.27
	Total	73.08	56.76	-16.32	61.94	-11.14	67.11	-5.97	72.28	-0.80
	Risk		21.28		23.66		25.86		29.12	
II	Peak-1	18.27	40.38	22.11	43.09	24.82	45.79	27.52	48.49	30.22
Crop + Dairy	Peak-2	18.27	31.80	13.53	31.80	13.53	31.80	13.53	31.80	13.53
Enterprises	Peak-3	18.27	31.80	13.53	31.80	13.53	31.80	13.53	31.80	13.53
	Peak-4	18.27	29.92	11.65	32.62	14.35	35.32	17.05	38.03	19.76
	Total	73.08	133.9	60.82	139.31	66.23	144.71	71.63	150.12	77.04
	Risk		18.52		19.42		20.92		22.66	

Note: Peak period for labour use; Peak-1 (April 15-30), Peak-2 (July 1-15), Peak-3 (Sept. 15-30) and Peak-4 (Oct. 15-31).

during different peak periods under different farm plans. As far as total labour use per farm is concerned, in situation-I it varied from 83.07 to 89.88 mandays in low hills, 33.69 to 36.64 mandays in mid hills and 56.76 to 72.28 mandays in high hills in plan-I to plan-IV. With the introduction of dairy, the human labour employment per farm increased by 59 per cent in plan-I whereas in plan-IV, it increased by 60 per cent in low hills. In mid hills, the increase in situation-II over situation-I for plan-I and plan-IV was estimated at 162 and 148 per cent. The corresponding figures for high hills were 74 and 58 per cent. This indicated that crop + dairy farming was more labour intensive than crop enterprises. Further, it can be inferred from the results that dairy activity with crop enterprise reduced the risk which was clearly shown by the comparison of respective coefficients of variation in situation-I and situation-II. This implied that the combination of crop and dairy was most useful in stabilising farm income and reducing associated risk. Results of the study further indicated that human labour employment for different risk efficient plans increased with the increase in the risk under different plans. Utilisation of human labour in peak period -1 was higher as compared to peak period -2, peak period -3 and peak period -4 in both the situations. Peak period -1 was found to be the most critical peak period for land preparation for sowing of vegetables that took more time of labour and sowing of other kharif crops and harvesting of rabi crops in the study area.

Increase in Human Labour Employment Under Different Farm Plans: The increase in human labour employment under subsequent farm plans in low, mid and high hills has been analysed and presented in Table 6. It is clear from this Table that increase in human labour employment over plan-I was 8.20 per cent in low hills, 8.76 per cent in mid hills and 27.34 per cent in high hills in plan-IV under situation-I. In situation-II, the corresponding figures were worked out to be 6.41, 1.82 and 12.11 per cent. The results indicated that the human labour employment increased even under risk efficient farm plans. The maximum increase in human labour employment was found in high hills in both the situations due to introduction of more labour intensive crops (garlic) in cropping pattern.

Table 6 : Human Labour Employment Per Farm Under Different Farm Plans in Low, Mid and High Hills of Mandi District

Situations	Particulars	Farm Plans			
		PI	PII	PIII	PIV
(1) (2)		(3)	(4)	(5)	(6)
Low Hills					
I	Human labour requirements	83.07	86.45	88.15	89.88
Crop	(MD)				
Enterprises	Increase over plan-I (%)	-	4.07	6.12	8.20
	Increase over plan-II (%)	-	-	1.97	3.97
	Increase over plan-III (%)	-	-	-	1.96

(Contd..)

Table 6: *(Contd..)*

(1)	(2)		(3)	(4)	(5)	(6)
	II	Human labour requirements	168.34	176.89	178.47	179.13
	Crop + Dairy	(MD)				
	Enterprises	Increase over plan-I (%)	-	5.08	6.02	6.41
		Increase over plan-II (%)	-	-	0.89	1.27
		Increase over plan-III (%)	-	-	-	0.34
Mid Hills						
	I	Human labour requirements	33.69	34.78	35.86	36.64
	Crop	(MD)				
	Enterprises	Increase over plan-I (%)	-	3.24	6.44	8.76
		Increase over plan-II (%)	-	-	3.11	5.35
		Increase over plan-III (%)	-	-	-	2.18
	II	Human labour requirements	122.15	122.91	123.66	124.36
	Crop + Dairy	(MD)				
	Enterprises	Increase over plan-I (%)	-	0.62	1.24	1.82
		Increase over plan-II (%)	-	-	0.61	1.18
		Increase over plan-III (%)	-	-	-	0.57
High Hills						
	I	Human labour requirements	56.76	61.94	67.11	72.28
	Crop	(MD)				
	Enterprises	Increase over plan-I (%)	-	9.13	18.23	27.34
		Increase over plan-II (%)	-	-	8.35	16.69
		Increase over plan-III (%)	-	-	-	7.70
	II	Human labour requirements	133.90	139.31	144.71	150.12
	Crop + Dairy	(MD)				
	Enterprises	Increase over plan-I (%)	-	4.04	8.07	12.11
		Increase over plan-II (%)	-	-	3.87	7.76
		Increase over plan-III (%)	-	-	-	3.74

Conclusion

Agriculture was found to be the main occupation absorbing more than two-thirds of the working population in all the three regions. The risk efficient farm plans formulated on different hill situations with crop and crop + dairy farming revealed that dairy activity created additional employment opportunities in all the three regions. The introduction of dairy activity reduced the coefficient of variation associated with each level of income (RFFR) thereby indicating its role in stabilising farm income. Thus to increase the employment and minimise the risk in hill agriculture, different risk efficient farm plans need to be adopted by farmers by incorporating judicious-mix of crops and dairy activities with prudent guidance from the extension officials of department of agriculture. Emphasis needs to be given to maintain cross-bred cows for generating additional employment to the farmers. During survey it was observed that there is fodder scarcity in the area. For this, there is need to establish fodder storage for adequate supply. In addition to this, introduction of green fodder trees as well as exotic grass species will also help in fodder availability.

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