OPTIMUM FARM PLANS FOR SUSTAINABLE RURAL DEVELOPMENT IN CHAMBA DISTRICT (Himachal Pradesh)

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Abstract

In the hilly regions, the area under plough is always a cause of serious concern and it is impossible to bring more area under cultivation due to colossal costs involved. Thus, an attempt has been made in the present study to evaluate the farming systems of various regions by taking Chamba district as the study area. Chamba district is miniature Himachal Pradesh which has all the four agro-climatic zones of Himachal Pradesh. Also, Chamba district is listed as one of the backward districts in the baseline ranking of transformation of aspirational districts by NITI Aayog. Stratified two stage random sampling technique was employed for selecting the sample households. The study was based on primary data. Primary data were collected from 160 sample households. Further, the linear programming was employed to develop the optimum farm plans for the study area. Income approach was used for the identification of farming systems. Four farming systems were identified in the study area; cereals based farming system (FS-I), vegetables based farming system (FS-II), livestock based farming system (FS-III) and fruits based farming system (FS-IV). In the optimum plan of FS-I, Returns to Fixed Farm Resources (RFFR) were increased by Rs. 98,637 with borrowing capital limit of Rs. 11,583 and labour employment was found to be 571.31 man days. In FS-II, RFFR were increased by Rs. 89,711 with borrowing capital limit of Rs. 4,263 and labour employment was found to be 558.40 man days. In FS-III, RFFR were increased by Rs. 1,42,471 having borrowing limit of Rs. 51,281 and labour employment was found to be 1140.08 man days. In the optimum production plan of fruits based farming system (FS-IV) the RFFR were increased by Rs. 80,394 having

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borrowing capital limit of Rs. 6,561 and labour employment was found to be 523.50 man days.

Keywords: *plough, hilly regions, aspirational, farming, labour, system*

Introduction

Agriculture is the main occupation of the people of Himachal Pradesh. The net sown area in the state is about 550 thousand hectares (Anonymous 2018a). About 69 per cent of the main workers are engaged in agricultural pursuits but, the contribution of agriculture and allied sector is only 9.7 per cent in GSDP during 2017-18 (Anonymous 2018b). The agriculture in the state is beset with the disadvantage of small holdings. In the hilly regions, the area under plough is always a cause of serious concern and it is impossible to bring more area under cultivation due to colossal costs involved (Kumar 2011). Thus, an attempt has been made in the present study to evaluate the optimum farm plans by taking Chamba district as the study area. Chamba district is miniature Himachal Pradesh which has all the four agro-climatic zones of Himachal Pradesh (Anonymous 1982). Also, it is one of the most backward districts and no study was conducted to examine the economic aspects of existing and optimum farming systems (Anonymous 2018c). As the optimum farm plans are identified for all the four agro-climatic zones, hence, the results could be extended to rest of the areas having similar agro-climatic conditions.

Materials and Methods

Stratified two stage random sampling technique was employed for selecting the sample households. Further, the optimum farm production plans were formulated employing linear programming technique. Linear Discrete Optimizer (LINDO, 6.10 versions) software was used for analysis of linear programming. In linear programming analysis, a linear function of a number of variables (activities) was to be maximized subject to a number of constraints in the form of linear equalities and in-equalities. In mathematical form of one year, the linear programming model is formulated in the following way.

$$\text{Maximize } Z = \sum_{j=1}^{n} C_j X_j$$

Subject to the following resource constraints:

$$\sum_{j=1}^{n} a_{ij}X_j \leq bi \text{ (Resource restrictions)}$$
$(i=1, 2, 3\ldots..m)$

$\sum X_j \geq 0$ (Non-negativity restriction)
$(j=1, 2\ldots..n)$

where,

Z = Returns to Fixed Farm Resources (RFFR) from all the activities (₹/ha)

C_j = Returns over cash variable expenses or RFFR per unit of j^{th} activity

X_j = Level of the j^{th} activity (crops, livestock, fruits, fodder, hiring, borrowing, etc.)

b_i = Total availability of i^{th} resource on the farm

a_{ij} = Total quantity/amount of i^{th} resource per input required per unit of j^{th} activity

n = Number of activities used in the model

The C_j was calculated as below:

C_j (RFFR) = (value of main product)- (total cash variable expenses)

The objective function of the model was maximization of the annual Returns to Fixed Farm Resources (RFFR).

The identified resource constraints were:

R_1 = Kharif land
R_2 = Rabi land
R_3 = Fruits land
R_4 = Minimum area for home consumption
R_5 = Human labour available
R_6 = Bullock labour available
R_7 = Farm yard manure available in quintals
R_8 = Purchase of urea added in working capital
R_9 = Purchase of NPK mixture added in working capital
R_{10} = Working capital availability in rupees
R_{11} = Dry fodder available in quintals
R_{12} = Green fodder available in quintals

R_{13} = Minimum number of local cows
R_{14} = Minimum number of cross bred cows
R_{15} = Minimum number of buffaloes
R_{16} = Minimum number of sheep
R_{17} = Minimum number of goat
R_{18} = Maximum poultry birds
R_{19} = Maximum flock size for rearing sheep/goat by nomadic population
R_{20} = Minimum mushroom bags

Results and Discussion

Identification of existing farming systems

In the present investigation, income approach was used for the identification of farming systems. The nomenclature of the farming system derived its name from the farming component that contributed maximum share to the farm family income. For this purpose gross income from different farm components was taken into account. Farming systems components in all blocks of the district were examined for cereals, pulses, millets, oilseeds, vegetables, livestock, poultry and horticulture (Table 1). During the pilot survey, it was found that in Bhattiyat block maximum (50.08 %) income was from cereals followed by livestock (24.53%), vegetables (17.09%), oilseeds (3.13%), pulses (2.09%), fruits (1.97%) and poultry (1.11%). In Chamba block, the contribution of various farm components to the total family farm income has been presented in Table 2 and found that vegetables were contributing maximum (53.49%) followed by fruits (21.55 %) whereas, the contribution of mushroom and poultry was 1.03 and 0.55 per cent, respectively. On an overview, Tissa block was dominated by livestock, fruits and cereals. In this block livestock contributed maximum (31.26 %) in gross farm income followed by fruits (28.73 %) and cereals (18.66%). The economy in Bharmaur block was mainly agriculture based with only single cropping season and also sheep and goats husbandry were the main occupation of the sample farmers along with agriculture. As such the sample households of Bharmaur block derived 54.66 per cent income from fruits followed by livestock (33.50 %) and pulses (6.12 %). On an overall basis, in Chamba district maximum (26.73 %) income was from fruits followed by livestock (25.12%), vegetables (23.06 %), cereals (19.36 %) and pulses (3.55 %).

Table 1. Average gross income from various farm components in different blocks

(Percent)

Blocks	Cereals	Pulses	Millets& pseudo cereals	Oilseeds	Vegetables	Livestock	Poultry	Mushrooms	Fruits	Average gross income (₹/farm/annum)
Bhattiyat	50.08	2.09	-	3.13	17.09	24.53	1.11	-	1.97	78871
Chamba	8.56	3.00	-	0.63	53.49	11.19	0.55	1.03	21.55	144407
Tissa	18.66	2.99	-	1.21	17.03	31.26	0.12	-	28.73	90454
Bharmaur	1.75	6.12	0.74	0.15	3.01	33.50	0.07	-	54.66	153929
Overall	19.36	3.55	0.18	1.28	23.06	25.12	0.46	0.26	26.73	116915

Classification of farmers in different farming systems

The farmers were classified according to contribution of different farm components in gross income. A specialized farm is one on which 50 per cent or more receipts are derived from one enterprise (Dhondyal 1985). The farmers who derived more than 50 per cent income from cereals were categorized under FS-I (Cereals based FS), similarly, from vegetables were put under FS-II (Vegetables based FS), from livestock were grouped under FS-III (Livestock based FS) and from fruits were named as FS-IV (Fruits based FS). A sample of 40 households from each block was drawn during the field survey. By porting all the sample households it was revealed that in cereals based FS there were 46 households, out of which about 87 per cent were from Bhattiyat block and 13 per cent were from Tissa block. In case of vegetables based FS all the farmers (40) were from Chamba block. In livestock based FS, total farmers were 18, out of which maximum (89 %) households were from Tissa block and 11 per cent were from Bharmaur block. Similarly, in case of fruits based FS, out of total farmers (56), about 68 per cent farmers were from Bharmaur block and 32 per cent were from Tissa block. Thus, the overall sample size consisted of 160 households (Table 3).

Table 3 Distribution of sample households across farming systems

(Number)

Agro climatic zones	Blocks	Cereals based farming system (FS –I)	Vegetables based farming system (FS-II)	Livestock based farming system (FS-III)	Fruits based farming system (FS-IV)	Total
Zone-I	Bhattiyat	40 (86.96)	-	-	-	40 (25.00)
Zone-II	Chamba	-	40 (100.00)	-	-	40 (25.00)
Zone-III	Tissa	6 (13.04)	-	16 (88.89)	18 (32.14)	40 (25.00)
Zone-IV	Bharmaur	-	-	2 (11.11)	38 (67.86)	40 (25.00)
Overall		46 (100.00)	40 (100.00)	18 (100.00)	56 (100.00)	160 (100.00)

Note: Figures in parentheses show percentages to total households in each category of farms

Type of family and demographic features

The family structure and size are important indicators determining the social and economic well-being of the family and play a vital role in decision-making process in running the farm business. It is so because most of the farm activities are performed by members of family only. The distribution of sample households according to family structure and size is presented in Table 4. Majority of households in FS-I (54.35%) were having joint family structure where they had more than 5 members. In FS-II, 50 per cent families each were nuclear (1-4 members) and joint (> 4 members). In FS-III, about 44.44 per cent families were nuclear and 56.56 per cent were joint families and in FS-IV, maximum families were joint (53.57 %).

Table 4. Average family size and family structure of sample households

Sr.No.	Particulars	FS-I		FS-II		FS-III		FS-IV	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1	Family members								
i)	Males per household	3.02	51.62	2.63	55.60	2.39	51.90	2.66	54.78
ii)	Females per household	2.83	48.38	2.53	44.40	2.17	48.10	2.45	45.22
2	Average family size	5.85	100.00	5.15	100.00	4.56	100.00	5.11	100.00
3	Sex- ratio*	935	0.94	962	0.80	907	0.90	919	0.82
i)	Nuclear	21	45.65	20	50.00	10	55.56	26	46.43
ii)	Joint	25	54.35	20	50.00	8	44.44	30	53.57
iii)	Total	46	100.00	40	100.00	18	100.00	56	100.00

**Number of females per thousand males*

The average family size of sample households was 6 persons with a sex- ratio of 935 females per 1000 males in FS-I. Whereas in FS-II, the average family size was 5 persons and gender ratio was 962. FS-III had the average family size of about 5 persons having sex- ratio of 907 females per 1000 males. Finally in FS-IV, the average size holding was 5 persons and gender ratio was 919.

Optimum enterprise combination for different farming system

In the optimum plan of FS-I, (Table 5) the per cent area under paddy, wheat, maize, black gram, shorghum & bajra, berseem, makhan grass, tomato, brinjal and mango increased in total cropped area. The number of buffalo was 0.04 in existing plan but after optimization, the number was increased to one. In the existing plan the number of goat and sheep was 0.06 and 0.05 but after optimization number was increased to 8 and 7, respectively. The number of poultry birds in existing plan was 1.96 but to 28 in the optimized plan. In the optimum plan, RFFR were increased by ₹ 98637 in cereals based farming system (FS-I) with borrowing capital limit of ₹11583 and labour employment was found to be 571.31 man days.

In the optimum plan of FS-II, (Table 6) area of maize, wheat, sorghum & bajra, berseem, kidney beans, cauliflower and apple increased in total cropped area. In livestock enterprise, the number of local cow and cross-bred cow was 0.08 and 0.30 in existing plan but after optimization, only the number of cross-bred cow increased to one. In this farming system (FS-II), the number of goat and sheep was 0.05 and 0.03 in existing plan but after optimization number was increased to 6 and 5, respectively. The number of poultry birds in existing plan was 1.58 but by the optimization the number was increased to 32. In case of mushroom 78 bags are found in optimum plan to maximize the profit. The Returns to Fixed Farm Resources (RFFR) were increased by 89711 in the optimum production plan of FS-II. In the optimum production plan the borrowing capital limit was observed 4263 and labour employment was found to 558.40 man days.

In the optimum plan of FS-III, (Table 7) the percentage of area under maize, wheat, clover, oats, kidney beans, peas and potatoes increased. In existing plan, area under apple was 0.018 ha which increased to 0.027 ha in optimum plan. The number of local cow, cross bred cow and buffalo was 0.46, 0.30 and 0.28 in existing plan but after the process of optimization, the numbers was increased to one in cross bred cow and buffalo, respectively. In the existing plan the number of goat and sheep was 0.84 and 0.73 but after optimization number was increased to 5 in each category. The number of poultry birds in existing plan was 0.37 but after the optimization the number was increased to 35. In the optimum production plan the flock size of rearing sheep and goats by nomads was increased to 86 sheep and goats. In the optimum plan, RFFR were increased by 142471. Further, the borrowing capital limit was observed to ⊠ 51281 and labour employment was found to 1140.08 man days in the optimum production plan of livestock based farming system (FS-III).

In the optimum plan of FS-IV, (Table 8) the area share of kidney beans, wheat, clover, potato and apple increased. The number of local cow and cross-bred cow was 0.38 and 0.28 in existing plan but by the process of optimization, the number of only cross-bred cow increased to one. In the existing plan the number of goat and sheep was 3.00 and 2.91 but after optimization number was increased to 8 and 7, respectively. The number of poultry birds in existing plan was 0.78 but after optimization the number

was increased to 22. In the optimum production plan of fruits based farming system (FS-IV) the RFFR were increased by 80394. In the optimum production plan the borrowing capital limit was observed 6561 and labour employment was found to 523.50 man days.

Table 5 Production plans for cereals based farming system (FS-I)

Sr.No.	Farm enterprises	Existing plan		Optimum plan					
		Area/number		Area/number		RFFR		Total employment	
I	Field crops (ha)	Particulars	Per cent	Particulars	Per cent	₹	Per cent	Mandays	Per cent
	*Kharif*season	0.700	58.33	0.699	58.54	-	-	-	-
1	Cereals								
i)	Maize	0.216	18.00	0.231	19.35	5831	3.94	20.56	3.6
ii)	Paddy	0.310	25.80	0.360	30.15	6024	4.07	30.60	5.36
2	Pulses								
i)	Black gram	0.019	1.60	0.021	1.76	735	0.5	1.37	0.24
ii)	Kidney beans	0.008	0.70	-	-		-		-
iii)	Horse gram	0.010	0.80	-	-		-		-
iv)	Soybean	0.011	0.90	-	-		-		-
3	Fodder crops								
i)	Sorghum and bajra	0.054	4.50	0.060	5.03		-	3.42	0.6
ii)	Clover	0.010	0.80	-	-		-		-
4	Vegetables						-		-
i)	Tomato	0.007	0.62	0.014	1.17	1734	1.17	0.98	0.17
ii)	Capsicum	0.011	0.90	-	-		-		-
iii)	Brinjal	0.005	0.44	0.013	1.09	1521	1.03	0.87	0.15
iv)	Ginger	0.002	0.17	-	-		-		-

v)	Chilli	0.010	0.81	-	-		-		-
vii)	Okra	0.011	0.90	-	-		-		-
viii)	Beans	0.006	0.53	-	-		-		-
xiv)	Other vegetables	0.011	0.90	-	-		-		-
	Rabi season	0.500	41.67	0.495	41.46		-		-
1	Cereals			-	-		-		-
i)	Wheat	0.257	21.39	0.322	26.97	3662	2.48	28.34	4.96
ii)	Barley	0.031	2.60	-	-		-		-
2	Oilseed						-		-
i)	Mustard	0.056	4.70	-	-		-		-
ii)	Toria	0.011	0.90	-	-		-		-
3	Fodder crops						-		-
i)	Oats	0.032	2.70	-	-		-		-
ii)	*Berseem*	0.043	3.60	0.099	8.29		-	6.04	1.06
iii)	Other fodder (*makhan* grass, etc.)	0.011	0.90	0.031	2.6		-	2.32	0.41
4	Vegetables								
i)	Cabbage	0.002	0.15	-	-		-		-
ii)	Cauliflower	0.011	0.90	0.025	2.09	2932	1.98	1.90	0.33
iii)	Peas	0.011	0.90	0.018	1.51	2211	1.49	1.35	0.24
iv)	Potato	0.015	1.35	-	-		-		-
v)	Onion	0.010	0.80	-	-		-		-
vi)	Garlic	0.002	0.14	-	-		-		-
vii)	Radish	0.005	0.40	-	-		-		-
viii)	Other vegetables	0.002	0.20	-	-		-		-
	Total cropped area (ha)	1.200	100.00	1.194	100.00		-		-
II	**Fruits (ha)**								
i)	Mango	0.010	52.36	0.020	100.00	1580	1.07	1.56	0.27
ii)	Litchi	0.005	20.80	-	-		-		-
iii)	Citrus	0.004	20.00	-	-		-		-
iv)	Walnut	0.001	6.84	-	-		-		-
	Total area under fruit crops	0.020	100.00	0.020	100.00		-		-
III	**Livestock (no.)**						-		-
i)	Local cow	0.08	-	-	-		-		-
ii)	Improved cow	0.10	-	-	-		-		-
iii)	Buffalo	0.04	-	1	-	76584	51.76	232.00	40.61
iv)	Goat	0.06	-	8	-	17288	11.69	102.00	17.85
v)	Sheep	0.05	-	7	-	13482	9.11	96.00	16.8
IV	**Poultry (no.)**	1.96	-	28	-	14364	9.71	42.00	7.35
V	**Total**	-	-	-	-	147948	100	571.31	100.00
VI	**Borrowing capital limit (₹)**	-	-	-	-	11583	-	-	-

VII	Labour hiring (man-days)	-	-	-	-	-	-	-	-

Existing RFFR=49311

Labour employed in existing plan= 173 man days

Labour available in existing farm=730 man days

Sr.No.	Farm enterprises	Existing plan		Optimal plan					
		Area/number		Area/number		RFFR		Total employment	
I	Field crops (ha)	Particulars	Per cent	Particulars	Percent	₹	Percent	Mandays	Percent
	*Kharif*season	0.570	57.58	0.503	57.49	-	-	-	-
1	Cereals								
i)	Maize	0.150	15.19	0.195	22.29	4263	2.48	14.24	2.55
ii)	Paddy	0.04	4.04	0.100	11.43	641	0.37	9.8	1.76
2	Pulses								
i)	Black gram	0.010	1.02	-	-	-	-	-	-
ii)	Kidney beans	0.040	5.25	0.101	11.54	5693	3.31	6.46	1.16
iii)	Horse gram	0.020	2.63	-	-	-	-	-	-
3	Fodder crops								
i)	Sorghum and bajra	0.043	4.31	0.107	12.23	-	-	5.67	1.02
4	Vegetables								
i)	Tomato	0.040	4.04	-	-	-	-	-	-
ii)	Capsicum	0.030	3.02	-	-	-	-	-	-
iii)	Brinjal	0.030	3.03	-	-	-	-	-	-
iv)	Ginger	0.020	2.01	-	-	-	-	-	-
v)	Chilli	0.010	1.00	-	-	-	-	-	-
vi)	Okra	0.047	4.70	-	-	-	-	-	-
vii)	Beans	0.040	4.02	-	-	-	-	-	-
viii)	Other vegetables	0.030	3.03	-	-	-	-	-	-
	Rabi season	0.42	42.42	0.372	42.51	-	-	-	-
1	Cereals								
i)	Wheat	0.101	10.27	0.175	20.00	2137	1.24	14.35	2.57
ii)	Barley	0.030	3.03	-	-	-	-	-	-
2	Oilseed								-
i)	Mustard	0.030	3.03	-	-	-	-	-	-
3	Fodder crops								
i)	Oats	0.020	2.02	-	-	-	-	-	-
ii)	*Berseem*	0.030	3.00	0.073	8.34	-	-	4.31	0.77
iii)	Other fodder (*makhan*grass, etc.)	0.010	1.01	0.022	2.51	-	-	1.58	0.28

4	Vegetables								
i)	Cabbage	0.030	3.10	-	-	-	-	-	-
ii)	Cauliflower	0.069	4.26	0.102	11.66	18924	11.02	11.93	2.14
iii)	Peas	0.030	3.02	-	-	-	-	-	-
iv)	Potato	0.030	3.03	-	-	-	-	-	-
v)	Onion	0.020	2.02	-	-	-	-	-	-
vi)	Garlic	0.010	1.01	-	-	-	-	-	-
vi)	Radish	0.010	1.00	-	-	-	-	-	-
viii)	Other vegetables	0.020	2.04	-	-	-	-	-	-
	Total cropped area	0.990	100.00	0.875	100	-	-	-	-
II	**Fruits (ha)**								
i)	Aonla	0.012	19.22	-	-	-	-	-	-
ii)	Citrus	0.024	40.78	-	-	-	-	-	-
iii)	Apple	0.015	24.52	0.060	100.00	22500	13.10	6.06	1.09
iv)	Walnut	0.009	15.48	-	-	-	-	-	-
	Total area under fruit crops	0.060	100.00	0.060	100.00	-	-	-	-
III	**Livestock (no.)**								
i)	Local cow	0.08	-	-	-	-	-	-	-
ii)	Improved cow	0.30	-	1	-	64232	37.4	217	38.86
iii)	Goat	0.05	-	6	-	8885	5.17	104	18.62
iv)	Sheep	0.03	-	5	-	7830	4.56	97	17.37
IV	**Poultry (no.)**	1.58	-	32	-	16288	9.48	35	6.27
V	**Mushroom (bags)**	1.25	-	78	-	20358	11.85	31	5.55
VI	**RFFR (₹)**	-	-	-	-	171751	100.00	558.40	100.00
VII	**Borrowing capital limit (₹)**	-	-		-	4263	-	-	-
VIII	**Labour hiring (man-days)**	-	-		-	-	-	-	-

Existing RFFR=₹82040
Labour employed in existing plan =186 man days
Labour available in existing farm= 644 man days

Table 7 Production plans for livestock based farming system (FS-III)

Sr.No.	Farm enterprises	Existing plan		Optimum plan					
		Area/number		Area/number		RFFR		Total employment	
I	Field crops (ha)	Particulars	Percent	Particulars	Percent	₹	Percent	Mandays	Percent
	*Kharif*season	0.421	56.26	0.450	56.15	-	-	-	-
1	Cereals								
i)	Maize	0.212	28.03	0.301	40.24	6374	2.86	28.6	2.51
2	Pulses								
i)	Black gram	0.002	0.25	-					
ii)	Kidney beans	0.040	5.25	0.051	7.24	4389	1.97	4.45	0.39
iii)	Horse gram	0.020	2.63	-	-	-	-	-	-
3	Fodder crops								
i)	Sorghum and bajra	0.020	2.62	-	-	-	-	-	-
ii)	Clover	0.070	9.50	0.073	9.76	-	-	1.22	0.11
4	Vegetables								
i)	Tomato	0.018	2.49	-	-	-	-	-	-
ii)	Brinjal	0.013	1.84	0.025	3.34	1553	0.7	1.48	0.13
iii)	Beans	0.012	1.58	-	-	-	-	-	-
iv)	Other vegetables	0.014	1.84	-	-	-	-	-	-
	Rabi season	0.332	43.74	0.328	43.85	-	-	-	-
1	Cereals								-
i)	Wheat	0.150	19.69	0.175	23.40	873	0.39	14	1.23
ii)	Barley	0.020	2.63	-	-		-	-	-
2	Oilseed								
i)	Mustard	0.020	2.63	-	-		-	-	-
3	Fodder crops								
i)	Oats	0.031	4.25	0.043	5.75		-		-
ii)	*Berseem*	0.005	0.69	-	-		-		-
iii)	Other fodder (*makhan* grass, etc.)	0.010	1.31	-	-		-		-
4	Vegetables								
i)	Cauliflower	0.018	2.36	-	-	-	-	-	-
ii)	Peas	0.020	2.63	0.039	5.21	4391	1.97	2.89	0.25
iii)	Potato	0.037	4.94	0.071	9.49	5240	2.35	10.15	0.89
iv)	Onion	0.010	1.31	-	-	-	-	-	-
v)	Garlic	0.006	0.84	-	-	-	-	-	-
vi)	Radish	0.005	0.69	-	-	-	-	-	-
vii)	Other vegetables	0.007	1.00	-	-	-	-	-	-
	Total cropped area	0.760	100.00	0.748	100	-	-	-	-
II	Fruits (ha)								
i)	Apple	0.018	60.64	0.027	100.00	11388	5.11	3.29	0.29
ii)	Walnut	0.009	29.36	-	-	-	-	-	-
iii)	Pear	0.003	10.00	-	-	-	-	-	-
	Total area under fruit crops	0.030	100.00	0.27	100.00	-	-	-	-

III	**Livestock (no.)**								
i)	Local cow	0.46	-	-	-		-	-	-
ii)	Improved cow	0.30	-	1	-	43186	19.37	232	20.35
iii)	Buffalo	0.28	-	1	-	70511	31.63	247	21.67
iv)	Goat	0.84	-	5	-	12885	5.78	102	8.95
v)	Sheep	0.73	-	5	-	7525	3.38	93	8.16
IV	**Poultry (no.)**	0.37	-	35	-	20790	9.33	40	3.51
V	**Sheep/goat (Nomadic)**	6.60	-	86	-	33798	15.16	360	31.58
VI	**Total**	-		-	-	222903	100.00	1140.08	100.00
VII	**Borrowing capital limit (₹)**	-	-	-	-	51281	-	-	-
VIII	**Labour hiring (man-days)**	-	-	-	-	-	-	213.08	-

Existing RFFR=₹80432

Labour employed in existing plan = 354 man days

Labour available in existing farm= 927man days

Table 8 Production plans for fruits based farming system (FS-IV)

Sr. No.	Farm enterprises	Existing plan		Optimum plan					
		Area/number		Area/number		RFFR		Total employment	
I	Field crops (ha)	Particulars	Per cent	Particulars	Per cent	₹	Per cent	Mandays	Per cent
	Kharifseason	0.371	77.29	0.369	78.34	-	-	-	-
1	Cereals								
i)	Maize	0.062	12.92	0.108	22.93	1930	0.95	5.89	1.13
2	Millets and pseudo cereals								
i)	Millets (Kodra)	0.014	2.92	0.019	4.03	819	0.4	0.93	0.18
ii)	Buckwheat	0.017	3.54	-	-	-	-	-	-
3	Pulses								
i)	Black gram	0.026	5.42	-	-		-	-	-
ii)	Kidney beans	0.104	21.67	0.151	32.06	12031	5.91	10.87	2.08
iii)	Horse gram	0.042	8.75	-	-	-	-	-	-
4	Oilseeds								
i)	Sesame	0.008	1.67	-	-	-	-	-	-
5	Fodder crops								0

i)	Sorghum and bajra	0.002	0.42	-	-	-	-	-	0
ii)	Clover	0.020	4.17	0.055	11.68	-	-	3.25	0.62
iii)	Oats	0.033	6.88	-	-	-	-	-	-
4	Vegetables								
i)	Tomato	0.003	0.63	-	-	-	-	-	-
iii)	Brinjal	0.002	0.42	-	-	-	-	-	-
iii)	Radish	0.002	0.42	-	-	-	-	-	-
iv)	Potato	0.021	4.38	0.036	7.64	2691	1.32	5.18	
v)	Cauliflower	0.001	0.21	-	-	-	-		-
vi)	Peas	0.003	0.63	-	-	-	-		-
vii)	Beans	0.004	0.83	-	-	-	-		-
viii)	Onion	0.003	0.63	-	-	-	-		-
ix)	Other vegetables	0.004	0.83	-	-	-	-		-
	Rabi season	0.109	22.71	0.102	21.66	-	-		-
1	Cereals								
i)	Wheat	0.055	11.46	0.070	14.86	358	0.18	5.11	0.98
ii)	Barley	0.028	5.83	-	-	-	-	-	-
2	Oilseed								
i)	Mustard	0.005	1.04	-	-	-	-	-	-
3	Fodder crops								
i)	Other fodder (makhan grass, etc.)	0.002	0.42	0.010	2.12	-	-	0.55	0.11
4	Vegetables								
i)	Peas	0.006	1.25	-	-	-	-	-	-
ii)	Potato	0.005	1.04	0.022	4.67	1644	0.81	3.17	0.61
iii)	Garlic	0.004	0.83	-	-	-	-	-	-
iv)	Other vegetables	0.004	0.83	-	-	-	-	-	-
	Total cropped area	**0.480**	**100.00**	**0.471**	**100.00**	-	-	-	-
II	**Fruits (ha)**								
i)	Apple	0.105	65.58	0.155	100.00	92203	45.27	21.55	4.12
ii)	Walnut	0.025	15.80	-	-	-	-	-	-

iii)	Pear	0.018	11.06	-	-	-	-	-	-
iv)	Apricot	0.012	7.56	-	-	-	-	-	-
	Total area under fruit crops	0.16	100.00	0.155	100.00	-	-	-	-
III	**Livestock (no.)**								
i)	Indigenous cow	0.38	-	-	-	-	-	-	-
ii)	Improved cow	0.28	-	1	-	44603	21.9	227	43.36
iii)	Goat	3.00	-	8	-	19705	9.67	111	21.2
iv)	Sheep	2.91	-	7	-	16480	8.09	94	17.96
IV	**Poultry (no.)**	**0.78**	-	**22**	-	**11220**	**5.51**	**35**	**6.69**
V	**Total**					**203684**	**100.00**	**523.50**	**100.00**
VI	**Borrowing capital limit (₹)**	-	-	-	-	**6561**	-	-	-
VII	**Labour hiring (man-days)**	-	-	-	-	-	-	-	-

Existing RFFR =₹123290

Labour employed in existing plan =249 man days

Labour available in existing farm =828 man days

Conclusions

Farming is an activity carried out by households on holdings that represent managerial units organized for the economic production of crops, livestock and related activities. Farming system is an approach that is being used increasingly to meet the need for greater food production and a better standard of living for farmers in developing countries. As the optimum farming systems are identified for all the four agro-climatic zones, hence, the results could be extended to rest of the areas having similar agro-climatic conditions. Increased number of backyard poultry in the optimum farm plans can be a potent tool for the up-liftment of the small and marginal farmers in the study area. Thus, incentives should be given for introducing backyard poultry in the study area so that the income of small and marginal

farmers is improved. The optimum farm plans indicated capital deficit among these farming systems. Hence, there is need to induct more capital in the study area.

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