(19)

ECONOMIC ANALYSIS OF SUSTAINABILITY OF FARMING SYSTEMS IN HILLY ZONE OF KARNATAKA*

V. R. KIRESUR[1], G. M. GADDI[2], K. C. GUMMAGOLMATH[3], PRASHANTKUMAR HIREMATH[4] AND V. S. KULKARNI[5]

[1]ICRISAT, Hyderabad-502324, [2]Deptt. of Agril. Econ., College of Agriculture, Hassan-573 225, [3]N.I.A.M., Bambala, Pratapnagar, Jaipur-303 906, [4 AND 5]Project Planning and Monitoring Cell, U.A.S., Dharwad - 580 005

The present study was undertaken in Hilly Zone of Karnataka to assess the sustainability of Different Farming Systems (FS) using the primary data collected from the 60 farmers selected using the multistage random sampling technique during the year 2001-02. Results of the study indicated that farmers incurred a total cost of Rs.1,07,677 under FS-I (Field crops+Dairy animals+Draught animals) as a whole and realized a net return of Rs.68,388. The total cost comprised of variable cost to the tune of Rs.84,226 and fixed cost to the tune of Rs.23,450. Milk production (1.74) activity was found to be more remunerative than the crop production (1.62). In the case of FS-IV (Horticultural crops+Dairy animals) farmers realized a net return of Rs.8,23,023 over total costs (Rs.3,22,015). In total costs, variable costs, fixed costs and apportioned establishment cost amounted to Rs.2,25,350, Rs.74,523 and Rs.22,143. Returns per rupee of investment (3.56) under FS-IV were very high than under FS-I (1.64). Production function analysis revealed that bullock labour, seed and FYM were the important variables influencing paddy production whereas plant nutrients as an input was the most significant variable in cotton production. In the zone, milk production was very much influenced by the use of concentrates and green fodder. Human labour coefficient was also found to significant. The Sustainability Value Index (SVI) was higher under FS-IV (0.34) than FS-I (0.01), due to very remunerative nature of horticultural crops under FS-IV. Thus, the farming system involving horticulture component was more sustainable than the one involving field crops. Hence, of late, horticulture is gaining lot of importance from farmers; but, it is not drawing matching attention by the policy makers and financial institutions in terms of providing enough support for the overall development of the horticultural sector.

INTRODUCTION

The ever increasing demand for crucial inputs like fertilizers, irrigation, credit, labour and farm mechanization has to be viewed in the long-term perspective of its consequence on sustainability of agriculture. On the one hand, country needs to be self-sufficient in food, fibre, meat, fish and livestock production through intensive agriculture and biochemical farming. On the other, the natural resource base of the country, which is being gradually eroded by the modern methods of farming, must be protected from irreversible degradation. In this direction, the adoption of appropriate farming system technologies deserves special emphasis. Farming system, a holistic approach advocating enterprise diversification, encompasses two facets of diversification,

*Funds provided by the National Agricultural Technology Project for this study is duly acknowledged.

namely, intra-enterprise [within an enterprise-crop/livestock] and inter-enterprise [across enterprises and activities-crop, livestock, wage labour and non-farm work] diversification.

Sustainable agriculture or farming is one that contributes to the overall objective of sustainable development, i.e., to meet the present needs without compromising the ability of the future generations to meet their own food needs and related demands from the land. Sustainability could be viewed in two facets; one, preservation of the health of land and water resources and secondly, production of technically feasible and viable crop and livestock enterprises through efficient land and water use, thus conserving environmentally friendly situations in the ecosystem.

Indian farming is dominated by small and marginal farms, accounting for about 75 per cent of the total holdings commanding only about 26 per cent of the cultivated area. The land acquired by those tiny farmers is so meager that it provides very low income and limited family employment. Further, due to continuous and intensive cultivation of land for meeting the objective of food security, natural resources have drastically degraded over time. Many a times, this process is irreversible. Hence, such an alarming loss/degradation of natural resources must be prevented in future at all costs, otherwise the costs of recovery would be too high to imagine if left unattended. In this context, there is utmost urgency to develop location specific optimum farming systems, which will be helpful to raise the standard of living of these farm families by ensuring enough employment opportunities.

A farming system is a complex, interrelated matrix of soils, plants, animals, power, implements, labour, capital and other inputs controlled in the past by farming families and influenced to varying degrees by political, economical, institutional and social forces that operate at any levels. Research with a farming systems perspective has various objectives ranging from increasing the body of knowledge about farming systems to solving problems in different farming systems. Norman (1978) opined that farming systems in general are location-specific. Ruthenberg (1971) also opined that the type of farming system differs from place to place. Farming systems concept, after tracing the evolution of general systems theory, is a system referring to crop combination or enterprise mix in which the products and/or the by-products of one enterprise were used as inputs for the production of other enterprises (Maji, 1991). The whole farming rather than the individual crops/enterprises need to be considered in the decision making under the farming systems approach. Different types of cropping systems require different types of developmental programmes for effective changes in agriculture (Norman, 1978).

So far, studies conducted on farming systems have been few and far between. Farming systems approach in analyzing the

problems of agriculture is gaining lot of importance in recent years. Such a study would throw light on the problems associated with different farming systems and enable the academicians and policy makers to formulate and implement appropriate policies for a balanced and integrated agricultural development. The present paper attempts to examine the prevailing farming systems in the Hilly Zone of Northern Karnataka for their economic viability and sustainability.

METHODOLOGY

For the purpose of the study, Hilly Zone was selected in Northern Karnataka. Uttar Kannada district was selected in the zone based on the highest number of taluks covered by the zone. In the next stage, two taluks were selected from the district at random. In the third stage, two villages from each taluk were randomly selected. In each village, 15 farmers at the rate of five belonging to different farm size categories, namely, small, medium and large were selected at random. Thus in all, 60 respondents were selected and were post classified into various categories belonging to different farming systems (FS), viz., FS-I (Field Crops + Dairy animals + Draught animal) and FS-IV (Horticultural Crops + Dairy animals). Primary data collected from the farmers through personal interview method using pre-tested schedules designed for the purpose pertained to the agricultural year 2001-02. Then data were analysed using tabular analysis to know the input use pattern, cost of production, gross returns and net returns in different crops and farming systems. Ratios, averages and per centages were calculated to arrive at meaningful results.

Production Function Analysis :

Production function technique was used to examine the effect of different factors, namely, human labour, bullock labour, seed, farm yard manure, plant nutrients and plant protection chemicals on crop production. Cobb-Douglas type of production function, of the following form, was fitted to the data.

$$Y = a\ H^{b1}\ B^{b2}\ S^{b3}\ F^{b4}\ N^{b5}\ P^{b6}\ u \quad \ldots\ldots (3)$$

Where,

Y = Main product yield (q/ha)
H = Human labour (Man days)
B = Bullock labour (Pair days)
S = Seeds (Kg/ha)
F = Farm Yard Manure (Tones/ha)
N = Plant nutrients (Kg/ha)
P = Plant Protection Chemical (Rs/ha)
u = Random error term
a = Intercept
bj = Regression coefficient or production elasticity of jth input (j=1,2...6)
Σbj = Returns to scale (j=1,2...6)

Similarly to examine the effect of different factors, viz., green fodder, dry fodder, concentrates, labour and capital on milk production following Cobb-Douglas type of production function was fitted to the data.

$$Y = a\ G^{b1}\ D^{b2}\ C^{b3}\ K^{b4}\ H^{b5}\ u \ldots\ldots\ldots (2)$$

Where,

Y = Milk production in litres/animal/annum

G = Green fodder (q/animal/year)
D = Dry fodder (q/animal/year)
C = Concentrates (Kg/animal/year)
K = Capital Expenditure (Rs./year)
H = Human Labour (Man days/animal/year)
U = Random error term
a = Intercept
bj = Regression coefficient or production elasticity of jth input (j=1,2...5)
Σbj = Returns to scale (j=1,2...5)

Sustainability Value Index (SVI) :

To know the sustainability of prevailing farming systems in the zone Sustainability Value Index (SVI) was calculated using the following formula,

$$SVI = \frac{ANI-(1.96 * SD)}{MNI} \quad \text{.....(3)}$$

$$CV = \frac{SD}{ANI} \times 100 \quad \text{.....(4)}$$

Where,
SVI = Sustainability Value Index
ANI = Average Net Income
MNI = Maximum Net Income
SD = Standard Deviation
CV = Coefficient of variation

RESULTS AND DISCUSSION

Costs and Returns Profile of Different Farming Systems :

Farming System-I

Components of variable costs include expenditure on seeds, FYM, human labour, bullock labour, plant nutrients, plant protection chemicals and interest on working capital for crops, while, expenditure on green fodder, dry fodder, concentrates, human labour and other expenses for milk production. Similarly land revenue, land rent, depreciation on farm machinery and implements and interest on fixed capital were included under fixed costs for crops, while depreciation on farm utensils and animals for milk production. Major crops of the zone include paddy and sorghum among cereals; greengram, blackgram and tur among pulses; groundnut among oilseeds and cotton and sugarcane among commercial crops.

Per farm cost and returns from different crops and dairy enterprises (FS-I) are given in Table-1. It could be observed from the table that proportion of total cost incurred on crops was generally high for crops than dairy enterprises. Across the categories of farms, crops constituted about 85 per cent of total cost and milk production activity (dairy enterprise) constituted for remaining 15 per cent of total cost. However, it is interesting to note that among the various categories of farms, relatively higher proportion of cost was utilized for dairy enterprises in the case of small farms (about 40 per cent) as compared to medium (18 per cent) and large farms (11 per cent). Similarly, net income from milk production constituted for higher proportion (40.24 per cent) on small farms than on medium (19.73 per cent) and large farms (12.40per cent). This shows the reliance of small farms on dairy enterprise in combination of field crops for sustaining the higher income.

Due to small size of farms and complimentary nature of theses enterprises, small category farmers were more concentrated on diversifying their activity. However, returns per rupee of investment were on higher side for medium (1.79) category of farms than on large (1.76) and small farms (1.67). It is also interesting to note that on overall category of farms, returns per rupee of investment were higher for dairy enterprise (1.74) than crops (1.62). Due to sufficient availability of grazing land, the annual maintenance cost of milch animals was less, as they did not go for stall-feeding. The category wise profitability ratio for crop production showed that medium category of farmers (1.71) realized comparatively higher returns than small (1.68) and large (1.67) farms.

The crop wise analysis presented in the Table-3 revealed that due to more suitability of soil and climatic conditions, paddy grown during rabi season found to be the most profitable crop as indicated by the highest returns per rupee of investment (1:2.47) followed by paddy in kharif (2.23), sorghum (1.84) and horse gram (1.82). Per farm share of different crops in the total cost and returns under farming system-I presented in the Table-4 revealed that across the categories of farms, cotton constituted for the highest proportion of the total cost (48.40 per cent) followed by kharif paddy (25.79 per cent) and rabi horse gram (14.03), while share of rest of the crops was very meagre. However among different categories of farms, paddy grown in kharif season constituted for the highest proportion in the case of small farms (48.41 per cent), where as cotton constituted for the highest proportion of total cost in the case of medium farms (49.62 per cent) and large farms (51.33 per cent).

The foregoing discussion revealed that medium and large categories of farms concentrated more on commercial crops like cotton, while small farms concentrated on food crops and also allocated substantial proportion of total cost to commercial crops. But it is interesting to know that, despite spending more on cotton crop, medium and large categories of farmers were able to realize only about 37 per cent of returns as against almost half of the total cost being spent on it. This may be attributed to the fact that cotton required more of high priced purchased inputs. Moreover due to indiscriminate and high dose of pesticides and plant nutrients resulted in high cost structure. This fact is also supported by the higher returns per rupee of investment generated by the paddy crop unlike that of cotton crop. The B:C Ratio is more than two for paddy crop, while it was only 1:1.27 for cotton crop. With better yield, price advantage and relatively less cost of production, paddy was able to constitute higher proportion of gross returns as against expenses made on it.

Farming System-IV :

Farming System-IV includes rearing of dairy animals in combination with the horticulture crops. The major plantation and fruit crops of the zone include coconut, mango,

guava, sapota and banana. Per farm cost and returns structure as well as relative share of different enterprises in the total cost and returns are given in the Table-2. It is revealed from the table that the share of milk production activity despite constituting for about five per cent of the total cost, in the total income was very meagre (1.46per cent). Due to remunerative earnings, horticulture crops constituted for the bulk proportion of income. Returns per rupee of investment from horticultural enterprise were very high (3.65) as against 1.74 in the case of milk production. This indicated that, under this farming system in this zone, dairy was a purely subsidiary enterprise and farmers maintained nearly two (1.70 to 2.10) dairy animal in order to meet the milk requirement of the family. The horticultural crops were mostly grown as mixed crops and were rarely grown as sole crop like banana. The crop wise profitability analysis (Table-3) revealed that the ratio was the highest in the case of areca + banana (4.27) followed by areca + pepper (3.66), areca + betel vine (3.63) and banana sole crop (2.70).

The share of different horticultural crops in the total costs and returns are presented in Table-4. It is apparent from the table that areca + betel vine constituted for the highest proportion of the total cost (41.15per cent) followed by area + banana (25.86 per cent), areca + pepper (20.45 per cent) and banana sole crop (12.54 per cent). Similar trend was observed with respect to gross returns, wherein areca + betel vine accounted for the highest proportion of the total returns (41.38per cent) followed by area + banana (25.79per cent), areca + pepper (23.52per cent) and banana sole crop (9.31per cent).

Sustainability of Selected Farming Systems

Production Function Analysis :

Efficiency is an important concept in production economics when resources are meagre and opportunities for developing and adopting better technologies are competitive. Indiscriminate use of resources at the farm level builds a high cost structure into the production process. It is difficult to assess the level of efficiency of a farmer unless one is sure of the conditions in which he operates. It is possible to raise the productivity of farms by improving the level of efficiency without actually increasing the resource use. Estimates on the extent of inefficiency could also help to decide whether to improve efficiency or to develop new technologies to raise the farm productivity. The crop wise production functions estimated are presented in Table-5. The functions were estimated for those crops, which have sufficient number of sample observations. Functions were not estimated for horticultural crops due to insufficiency of sample farms.

Crop Production :

It could be observed from Table-5 that in the case of paddy, among different inputs, coefficient of seed (0.6754), bullock labour (0.4046) and farmyard manure (0.1564) have

significantly contributed towards the output and thus revealed that still there is a scope to utilize higher level of these inputs to reach optimum level of production. However, human labour was excessively used than the requirement, while nutrients and plant protection chemicals fail to exert any significant influence on the output. Returns to scale was unitary indicating optimum returns for the inputs utilized in the paddy production. However co-coefficient of multiple determination could only capture the variation in production to the extent of 64 per cent. On the other hand results on regression analysis in the case of cotton indicated that only plant nutrients (0.5129) and human labour were found to have significant influence on cotton output. While bullock labour was excessively (-0.7351) used and rest of the inputs had positive but non-significant influence on output of cotton. The co-efficient of multiple determination was low and six independent variables included in the production function were able to capture 65 per cent of variation in the cotton production. So climate, rainfall, soil characteristics and other socio economic features of the sample farmers, which are not included in the model, were responsible for the lower yield levels on the farmers' fields.

Milk Production :

The results on the production function analysis in milk production are also presented in Table-5. It could be observed from the table that Cobb-Douglas production function was found to be the good fit to the data as revealed by the high values of F (25.05). Variables like green fodder (0.3533), concentrates (0.4440) were highly significant at one per cent probability level, while human labour (0.2998) found to be significant at five per cent probability level. Thus these three inputs have significant influence on milk production, while capital input contributed negatively towards milk production. Even though the dry fodder coefficient was positive but failed to exert any significant influence on milk production in the zone. Despite lower value of R2 (0.6988), the regression equation was a good fit as revealed by the significant F value at one per cent level of probability. Returns to scale was more than unity indicating increasing returns from the dairy enterprise.

Sustainability Value Indices :

To keep the pace of agricultural production for the growing population and at the same time to maintain natural resources for the future generations, sustainability approach deserves important place in the policy decisions. In this regard, an attempt has been made to assess the sustainability of existing farming systems in Hilly zone. Table-6 gives the details of the Average Net Income (ANI), Co-efficient of Variation (CV) and Sustainability Value Indices (SVI) for different farming systems.

Under FS-I, medium farmers possess higher SVI (0.39) closely followed by large (0.38) and small (0.13) farmers. On the other hand large farmers had higher SVI (0.45) under FS-IV followed by medium (0.35) and small

farmers (0.28). This trend was noticed mainly due to larger area of horticulture in combination with dairy enterprises was taken up by large farmers, which was responsible for stabilizing income. The higher SVI was noticed in the case of FS-IV (0.34) compared to FS-I (0.01). The system wise comparison of SVI indicated that horticulture in combination with dairy enterprises (FS-IV) was more stable than crops with dairy enterprise (FS-I).

Some Marketing Issues :

Farmers opined that there was no parity between input prices and output prices. Hence, there was a need to maintain parity by the government intervention in the market with appropriate price policy. Suitable policies were also needed to encourage the use of bio-pesticides and bio-fertilizers to substitute poor quality of agro-chemicals as expressed by majority of the farmers in the study area. Supply of quality seeds and agro-chemicals was another issue which needed enough attention. Farmers were also worried about the severe price fluctuations in their markets. Market regulation in vogue needs a revisit. In the livestock sector, problem of marketing of milk also surfaced the discussion. High cost of feed material, defective marketing system, non availability of high yielding breeds, absence of AI facility and pasture land for grazing milch animals were the severe constraints.

SUMMARY AND CONCLUSIONS

It could be concluded from the above results that under FS-I milk production (1.74) activity turned out to be good subsidiary income generating activity with higher profitability ratio than crop production (1.62), besides acting as a good complementary enterprise with crop enterprise. Farmers under FS-IV realized a net returns of Rs.8,23,023 with higher returns per rupee of investment (3.56) than under FS-I (1.64). Production function analysis revealed that bullock labour, seed, plant nutrients and FYM were the important variables influencing crop production, while in milk production, concentrates, green fodder and human labour were the important variables conditioning level of output Thus, FS-IV (0.34) was found to be more sustainable than FS-I (0.01) due to inclusion of very remunerative horticultural crops. Thus, the farming system involving horticulture component was more sustainable than the one involving field crops. Hence, of late, horticulture is gaining lot of importance from farmers; but, it is not drawing matching attention by the policy makers and financial institutions in terms of providing enough support for the overall development of the horticultural sector.

REFERENCES

Maji, C.C., 1991, Farming systems in the post green revolution belt. Indian Journal of Agricultural Economics, 46(3): 403-411.

Norman, D.W., 1978, Farming systems research to improve the livelihood of small farmers. American Journal of Agricultural Economics, 60(5) : 813-818.

Ruthenberg, H., 1971, Farming systems in the tropics. Clavendon Press, Oxford:1-6.

TABLE - 1

Per Farm Cost and Returns Structure under FS-I in Hilly Zone

(Rupees)

SN	Particulars	Small	Medium	Large	Overall
I	**All crops**				
	Area (Ha)	**2.15**	**4.80**	**10.04**	**7.08**
1	Total Variable Costs (TVC)	18228 [52.77]	49796 [77.63]	106108 [86.05]	68273 [81.06]
2	Total Fixed Cost (TFC)	6015 [95.17]	16589 [98.83]	34650 [99.00]	23167 [98.79]
3	Total Cost (TC)	24243 [59.33]	66385 [82.02]	140758 [88.92]	91440 [84.92]
4	Gross Returns	40843 [59.50]	113401 [81.29]	235147 [88.38]	147798 [83.94]
5	Net Returns Over TC	16600 [59.76]	47016 [80.27]	94389 [87.60]	56358 [82.41]
6	**BC Ratio over TC**	**1.68**	**1.71**	**1.67**	**1.62**
II	**Dairy**				
	Herd size	**2.10**	**1.70**	**2.00**	**1.93**
1	Total Variable Costs (TVC)	16314 [47.23]	14352 [22.37]	17196 [13.95]	15954 [18.94]
2	Total Fixed Cost (TFC)	305 [4.83]	197 [1.17]	349 [1.00]	284 [1.21]
3	Total Cost (TC)	16619 [40.67]	14549 [17.98]	17545 [11.08]	16237 [15.08]
4	Gross Returns	27795 [40.50]	26102 [18.71]	30909 [11.62]	28268 [16.06]
5	Net Returns Over TC	11176 [40.24]	11553 [19.73]	13361 [12.40]	12030 [17.59]
6	**BC ratio over TC**	**1.67**	**1.79**	**1.76**	**1.74**
III	**Total (Crops + dairy)**				
1	Total Variable Costs (TVC)	34541 [100.00]	64148 [100.00]	123304 [100.00]	84227 [100.00]
2	Total Fixed Cost (TFC)	6320 [100.00]	16786 [100.00]	34999 [100.00]	23451 [100.00]
3	Total Cost (TC)	40862 [100.00]	80934 [100.00]	158303 [100.00]	107677 [100.00]
4	Gross Returns	68638 [100.00]	139503 [100.00]	266053 [100.00]	176066 [100.00]
5	Net Returns Over TC	27776 [100.00]	58569 [100.00]	107750 [100.00]	68388 [100.00]
6	BC Ratio over TC	1.68	1.72	1.68	1.64

Note: Figures in the parentheses indicates per cent to the total (Crops + Livestock)

TABLE - 2

Per Farm Cost and Returns Structure under FS-I in Hilly Zone

(Rupees)

SN	Particulars	Small	Medium	Large	Overall
I	**Horticultural crops**				
	Area (Ha)	2.90	7.95	17.14	7.77
1	Total Variable Costs (TVC)	138170 [89.44]	138917 [90.88]	220801 [94.82]	209396 [92.96]
2	Total Fixed Cost (TFC)	47124 [99.36]	52412 [99.63]	64982 [99.63]	74239 [99.62]
3	Apportioned Establishment Cost	14412 [100.00]	15186 [100.00]	18892 [100.00]	22143 [100.00]
4	Total Cost (TC)	199705 [92.32]	206515 [93.54]	256428 [95.67]	305778 [94.98]
5	Gross Returns	718708 [96.28]	781440 [96.77]	989292 [97.92]	1116771 [97.53]
6	Net Returns Over TC	519003 [97.89]	574925 [98.02]	732864 [98.76]	810993 [98.54]
7	B:C Ratio	3.60	3.78	3.86	3.65
II	**Dairy**				
	Herd size	2.10	1.70	2.35	2.05
1	Total Variable Costs (TVC)	16314 [10.56]	14352 [9.12]	17196 [5.18]	15954 [7.04]
2	Total Fixed Cost (TFC)	305 [0.64]	197 [0.37]	349 [0.37	284 [0.38]
3	Apportioned Establishment Cost	-	-	-	-
4	Total Cost (TC)	16619 [7.68]	145489 [6.46]	17545 [4.43]	16237 [5.02]
5	Gross Returns	27795 [3.72]	26102 [3.23]	30906 [2.08]	28268 [2.47]
6	Net Returns Over TC	11176 [2.11]	11553 [1.98]	13361 [1.24]	12030 [1.46]
7	B:C Ratio	1.67	1.79	1.76	1.74
III	**Crops + Dairy**				
1	Total Variable Costs (TVC)	154484 [100.00]	153268 [100.00]	237997 [100.00]	225350 [100.00]
2	Total Fixed Cost (TFC)	47429 [100.00]	52609 [100.00]	65330 [100.00]	74523 [100.00]
3	Apportioned Establishment Cost	14412 [100.00]	15186 [100.00]	18899 [100.00]	22143 [100.00]
4	Total Cost (TC)	216324 [100.00]	221064 [100.00]	273973 [100.00]	322015 [100.00]
5	Gross Returns	746503 [100.00]	807542 [100.00]	1020197 [100.00]	1145038 [100.00]
6	Net Returns Over TC	530179 [100.00]	586479 [100.00]	746225 [100.00]	823023 [100.00]
7	B:C Ratio	3.45	3.65	3.72	3.56

Note: Figures in the parentheses indicates per cent to the total (Crops + Livestock)

TABLE - 3

Per Farm Benefit-Cost Ratio in Production of Various Crops under Different Farming Systems in Hilly Zone

SN	Particulars	Small	Medium	Large	Overall
I	**Farming System-I**				
1	Cotton	1.33	1.21	1.31	1.27
2	Greengram	-	-	1.27	1.27
3	Paddy-Kharif	1.97	2.54	2.20	2.23
4	Blackgram	1.41	1.54	1.60	1.51
5	Fodder crop	1.16	-	-	1.16
6	Horsegram	1.56	1.68	2.05	1.82
7	Paddy-Rabi/Summer	2.47	-	-	2.47
8	Sorghum	-	-	1.84	1.84
II	**Farming System-IV**				
1	Banana	2.77	2.60	2.66	2.70
2	Areca+Betelvine	3.50	3.69	3.56	3.63
3	Areca+Banana	4.07	4.48	4.45	4.27
4	Areca+Pepper	3.66	--	-	3.66

TABLE - 4

Per Farm Shares of Various Crops in Cost and Returns under Different Farming Systems in Hilly Zone

(Rupees)

SN	Particulars	Small	per cent	Medium	per cent	Large	per cent	Overall	per cent
I	**Farming System-I**								
A	**Costs**								
1	Cotton	5958	23.09	32941	49.62	71825	51.33	44619	48.40
2	Greengram	-	-	-	-	2246	1.60	2246	2.44
3	Paddy-Kharif	12492	48.41	20650	31.11	39048	27.90	23776	25.79
4	Blackgram	1443	5.59	1756	2.65	6750	4.82	3261	3.54
5	Fodder crop	1449	5.61	-	-	-	-	1448	1.57
6	Horsegram	2902	11.25	11037	16.63	17729	12.67	12929	14.03
7	Paddy-Rabi/ Summer	1562	6.05	-	-	-	-	1562	1.69
8	Sorghum	-	-	-	-	2342	1.67	2342	2.54
B	**Returns**								
1	Cotton	7948	17.78	39759	35.06	93939	39.95	56672	37.37
2	Greengram	-	-	-	-	3881	1.65	3881	2.56
3	Paddy-Kharif	24643	55.14	52442	46.24	85843	36.51	52851	34.85
4	Blackgram	2030	4.54	2700	2.38	10800	4.59	4943	3.26
5	Fodder crop	1680	3.76	-	-	-	-	1680	1.11
6	Horsegram	4541	10.16	18500	16.31	36363	15.46	23451	15.46
7	Paddy-Rabi/ Summer	3853	8.62	-	-	-	-	3853	2.54
8	Sorghum	-	-	-	-	4320	1.84	4320	2.85
II	**Farming System-IV**								
A	**Costs**								
1	Banana	20363	27.78	49972	23.72	23597	6.09	38502	12.54
2	Areca+Betelvine	-	-	-	-	126397	32.62	126397	41.15
3	Areca+Banana	27064	36.92	63304	30.05	123390	31.85	79423	25.86
4	Areca+Pepper	25880	35.30	97407	46.23	114042	29.44	62804	20.45
B	**Returns**								
1	Banana	56337	21.96	129871	16.62	62831	4.33	103956	9.31
2	Areca+Betelvine	-	-	-	-	462175	31.84	462175	41.38
3	Areca+Banana	94764	36.94	233582	29.89	439627	30.29	288003	25.79
4	Areca+Pepper	105432	41.10	417987	53.49	486834	33.54	262636	23.52

TABLE - 5

Production Function Estimates for Selected Crops and Milk Production in Hilly Zone

SN	Particulars	Parameter	Paddy	Cotton	Milk Production
1	Number of observations	N	30	20	60
2	Intercept	A	0.7459	-3.8941	-1.9386**
			(1.0444)	(1.8329)	[0.7750]
3	Human labour	H	-0.2442**	0.9759*	0.2998**
			(0.1075)	(0.5016)	[0.1042]
4	Bullock labour	B	0.4046**	-0.7351***	-
			(0.2025)	(0.2437)***	
5	Seed	S	0.6754***	0.0800	-
			(0.1780)	(0.2149)	
6	Farm Yard Manure	F	0.1564**	0.0218	-
			(0.0622)	(0.1104)	
7	Plant Nutrients	N	0.0061	0.5129***	-
			(0.1052)	(0.1879)	
8	Plant Protection Chemicals	P	0.0311	0.2857	
			(0.0471)	(0.2113)	
9	Green fodder	G	-	-	0.3533***
					[0.1241]
10	Dry fodder	D	-	-	0.1206
					[0.1394]
11	Concentrates	C	-	-	0.4440***
					[0.0823]
13	Capital	K	-	-	-0.1123
					[0.0866]
14	R^2	R^2	0.64	1.65	0.6988
15	Adjusted R^2	$\bar{R}^2$	0.55	0.49	0.6709
16	Returns to Scale	Σb_i	1.03	1.08	1.1055
17	F Value	F	6.86	3.98	25.05***

Note: ***, ** and * indicate significance at one, five and ten per cent probability levels, respectively.
Figures in parentheses indicate standard errors.

TABLE - 6

Sustainability Value Indices for Different Farming Systems in Hilly Zone

SN	Particulars	Small	Medium	Large	Overall
I	**Farming system-I**				
1	ANI (Rs.)	40396	58500	108086	68994
2	MNI (Rs.)	74076	76849	143208	143208
3	SD	15723	14466	27378	34946
4	CV (per cent)	39	25	25	51
5	**SVI**	**0.13**	**0.39**	**0.38**	**0.01**
II	**Farming system-IV**				
1	ANI (Rs.)	73352	85798	89967	82800
2	MNI (Rs.)	104979	122280	115742	115742
3	SD	22494	22159	19482	21920
4	CV (per cent)	31	26	22	26
5	**SVI**	**0.28**	**0.35**	**0.45**	**0.34**

Note: ANI= Average Net Income, MNI= Maximum Net Income, SD= Standard Deviation, CV= Coefficient of Variation, SVI= Sustainability Value Index.