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# IDENTIFICATION AND OPTIMIZATION OF RESOURCES IN SOME MAJOR FARMING SYSTEMS IN SONITPUR DISTRICT OF ASSAM

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ABSTRACT

In the present study attempt has been made to identify different types of farming systems in Sonitpur district and optimise the resource use among different size groups of farms using deterministic linear programming technique. Capital appeared to be an important resource constraint while the supply of human and bullock labour were in surplus. Optimization led to better utilization of resources, increase in gross cropped area and higher net returns. However, the optimal plans can be made effective only when the constraints in resource availability like timely supply and liberalization of credit, creation of irrigation potentialities and supply of other farm inputs are eliminated.

Agriculture is a diversified field which encompasses a number of activities, viz., crops, animal activities and activities in the homestead. Every rational farmer tries to improve his farm income not only from a single activity but from the whole farm business through selection of proper enterprise mix and judicious allocation of scarce farm resources. Farming system varies from farm to farm, place to place and region to region depending on agroclimatic conditions, resource position of the farmers, need and preferences of the farm families and religious and social taboos.

Before allocating every unit of scarce resources to any activity, the decision maker would like to know the profitability or remunerativeness of each activity included in a farming system. It is therefore, important to identify different types of farming systems in vogue in any area among different size groups of farms and analyse the economics of each type.

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The present study is an attempt to identify different types of farming systems in Sonitpur district and optimise the resource use among different size classes of farms.

## Methodology

Of the two subdivisions of Sonitpur district, Biswanath subdivision was randomly selected. To select the ultimate unit of a sample i.e., farmers, stratified multistage random sampling technique was adopted. In total 120 farmers, of which 60 were small, 38 medium and 22 large, were selected from 12 villages of the 3 blocks of the subdivision based on their operational holding, viz., small (upto 2 ha), medium (2-3 ha) and large (above large 3 ha). The data on existing farming system and resource position, amount of resource use for different enterprises and output produced on the farms, area under different crops, availability and utilization of capital, etc. were obtained through personal interview with the help of a pretested schedule. The data pertained to the year 1988-89.

*Analytical Tool* : Tabular as well as deterministic linear programming technique was used for the study.

The Model :

Max $Z = Cx$

subject to,

$$Ax \lessgtr b \qquad \text{and } x \geqslant 0$$

where,

Z — Total net returns

C — Vector of objective function coefficients for crop and animal activities

X — Vector of crop and animal activities

A — Matrix of input-output coefficients

b — Vector of resource constraints

Quarterly availability of land, human labour, bullock labour, capital, fodder and manure along with appropriate borrowing/hiring/purchasing activities constituted the deterministic linear programming model formulated for the study. After identification of the existing farming systems the important (major) systems were considered and syn-

thetic plans for these situations were prepared and optimum plans were developed for each one of them under the situation of (i) existing resources and (ii) incorporating borrowing, hiring and purchasing activities. The objective function as well as the constraint equations were accordingly altered deleting or adding appropriate co-efficients depending on the above two situations.

**Results and Discussion**

Analysis of data revealed that the farmers in general laid emphasis on both crops and livestock activities in the area under study. The main crop activities identified in the study area were rice, wheat, sesamum, rape and mustard, sugarcane, pulses, and summer and winter vegetables. Rice is the dominant crop in the area.

*Farming Systems*

Farming systems were identified based on mainly crop and animal activities. Homestead activities were found to be more or less similar in all the size groups of farms, hence were not considered while determining the farming systems. The type of farming system identified varied from 14 in small size group to 10 in large size group of farms. Out of 21 farming systems identified, 4 were common in all the size group of farms and 6 in 2 groups. Details of the types of farming system identified for the different size group of farms and the major systems are given in Table 1. Among the farming systems, only four systems on small farms and two each on medium and large farms were practised by most of the farmers in respective size groups. Other systems in vogue in respective size groups were practised by very few farmers. Hence, in the present study only the major and largely practised systems on small, medium and large farms have been considered for optimization and to see their effect on labour employment, capital utilization and net returns.

Cropping intensity in the existing cropping pattern varied from 150 to 163 per cent in small size group and 120 to 122 per cent in large size group.

**Optimal Plans**

Table 2 to 4 revealed the composition of existing plans as well as the optimum plans of all the major farming systems of small, medium and large groups of farms in Sonitpur district.

**Table 1. Identification of different Farming systems**

| Sl. No. | Types of farming system identified | Number of farmers | | |
|---|---|---|---|---|
| | | Small | Medium | Large |
| 1. | Crop+dairy cow+goat+pigeon+duckery | 22 (M)* | 18 (M) | 6 (M) |
| 2. | Crop+dairy cow+pigeon+duckery | 13 (M) | 6 (M) | 5 (M) |
| 3. | Crop+goat+pigeon+duckery+poultry | 6 (M) | — | — |
| 4. | Crop+dairy cow+buffalo+pigeon+poultry+duckery | 4 (M) | — | — |
| 5. | Crop+goat+dairy | 3 | — | 1 |
| 6. | Crop+pigeon+duckery | 2 | — | — |
| 7. | Crop+dairy cow+goat+pigeon+duckery+fishery | 2 | 2 | — |
| 8. | Crop+dairy cow+buffallo+goat | 1 | — | — |
| 9. | Crop+goat+pigeon+duckery | 1 | 1 | 1 |
| 10. | Crop+dairy cow+pigeon+duckery+poultry | 2 | — | 1 |
| 11. | Crop+dairy cow+poultry | 1 | 2 | — |
| 12. | Crop+dairy cow+poultry+fishery | 1 | — | — |
| 13. | Crop+goat+duckery | 1 | — | — |
| 14. | Crop+dairy cow | 1 | 1 | 1 |
| 15. | Crop+dairy+buffallo+pigeon+duckery | — | 2 | 2 |
| 16. | Crop+dairy+buffallo+goat+pigeon+duckery | — | 2 | 1 |
| 17. | Crop+dairy+goat | — | 1 | — |
| 18. | Crop+dairy+pigeon+duckery+fishery | — | 2 | — |
| 19. | Crop+goat+pigeon+fishery | — | 1 | — |
| 20. | Crop+dairy+buffallo+pigeon+duckery+fishery | — | — | 3 |
| 21. | Crop+dairy+goat+poultry | — | — | 1 |
| | Total number of Farmers | 60 | 38 | 22 |

* M indicates major farming systems

## Table 2. Existing Plan vs. Optimal Plans for Small Size Group

| Particulars | Unit | Existing plan* F91 P01 | F92 P02 | F93 P03 | F94 P04 |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| *Summer* | | | | | |
| 1. Autumn Rice (Local) | Ha | 0.045 (02.37) | 0.040 (02.05) | 0.045 (02.32) | 0.050 (02.59) |
| 2. Autumn Rice (HYU) | Ha | 0.090 (04.74) | 0.100 (05.13) | 0.095 (04.90) | 0.085 (04.40) |
| 3. Sum. Veg. | Ha | 0.191 (10.05) | 0.205 (10.51) | 0.215 (11.08) | 0.205 (10.65) |
| 4. Jute | Ha | 0.004 (0.210) | 0.005 (0.257) | 0.005 (0.260) | 0.006 (0.310) |
| *Kharif* | | | | | |
| 1. Winter Rice (Local) | Ha | 0.210 (11.05) | 0.190 (09.74) | 0.185 (09.54) | 0.190 (09.85) |
| 2. Winter Rice (HYV) | Ha | 0.420 (22.10) | 0.430 (22.05) | 0.440 (22.68) | 0.435 (22.54) |
| 3. Sesamum | Ha | 0.083 (04.30) | 0.090 (04.62) | 0.080 (04.20) | 0.085 (04.40) |
| *Rabi* | | | | | |
| 1. Mustard | Ha | 0.196 (10.31) | 0.185 (09.49) | 0.180 (09.28) | 0.200 (10.36) |
| 2. Wheat | Ha | 0.065 (03.42) | 0.075 (03.85) | 0.065 (03.35) | 0.060 (03.11) |
| 3. Potato | Ha | 0.075 (03.94) | 0.085 (04.66) | 0.085 (04.38) | 0.075 (03.89) |
| 4. Vegetables | Ha | 0 299 (15.74) | 0.305 (15.64) | 0.310 (15.98) | 0.300 (15.54) |
| 5. Pulses | Ha | 0.125 (06.57) | 0.135 (06.92) | 0.130 (06.75) | 0.130 (06.74) |
| 6. Summer Rice (Local) | Ha | 0.013 (00.65) | 0.013 (00.67) | 0.013 (00.68) | 0.012 (0.650) |
| 7. Summer Rice (HYV) | Ha | 0.088 (04.63) | 0.090 (04.62) | 0.090 (04.65) | 0.095 (04.92) |
| Gross cropped area | Ha | 1.900 (100.0) | 1.950 (100.0) | 1.940 (100.0) | 1.930 (100.0) |
| Net cropped area | Ha | 1.253 | 1.300 | 1.245 | 1.180 |
| Cropping intensity % | | 151.63% | 150.00% | 155.32% | 163.55% |

Table 2– Contd.

| Optimlan'* | | | | Optimal plan without hiring and borrowing*** | | | |
|---|---|---|---|---|---|---|---|
| F91 P11 | F92 P12 | F93 P13 | F94 P14 | F91 P21 | F92 P22 | F93 P23 | F94 P24 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 0.030 (00.93) | 0.025 (00.78) | 0.025 (00.75) | 0.030 (00.94) | 0.030 (01.18) | 0.025 (01.04) | 0.025 (01.20) | 0.030 (01.21) |
| 0.070 (02.18) | 0.075 (02.34) | 0.075 (02.24) | 0.080 (02.50) | 0.070 (02.72) | 0.075 (03.11) | 0.075 (03.61) | 0.080 (03.23) |
| 0.910 (28.38) | 0.900 (28.12) | 0.950 (28.36) | 0.890 (27.81) | 0.625 (24.32) | 0.552 (22.90) | 0.576 (27.69) | 0.687 (27.70) |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 0.200 (06.24) | 0.150 (04.69) | 0.150 (04.48) | 0.250 (07.81) | 0.200 (07.78) | 0.150 (06.22) | 0.150 (07.22) | 0.150 (06.05) |
| 0.898 (28.00) | 0.950 ( 29.69) | 1.000 (29.85) | 0.850 (26.56) | 0.856 (22.80) | 0.621 (25.77) | 0.504 (24.23) | 0.571 (23.02) |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 0.120 (03.75) | 0.050 (01.56) | 0.050 (01.49) | 0.100 (03.14) | 0.120 (04.67) | 0.050 (02.07) | 0.050 (02.40) | 0.070 (02.90) |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 0.890 (27.76) | 0.950 (29.69) | 1.000 (29.85) | 0.900 (28.12) | 0.890 (34.53) | 0.940 (39.00) | 0.700 (33.65) | 0.890 (35.89) |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — |
| 0.088 (02.74) | 0.100 (03.12) | 0.100 (02.98) | 0.100 (03.12) | 0.048 (01.87) | — — | — — | — — |
| 3.206 (100.0) | 3.200 (100.0) | 3.350 (100.0) | 3.200 (100.0) | 2.570 (100.0) | 2.410 (100.0) | 2.080 (100.0) | 2.480 (100.0) |
| 1.253 | 1.300 | 1.245 | 1.180 | 1.253 | 1.300 | 1.245 | 1.180 |
| 255.80% | 246.15% | 269.00% | 271.20% | 205.00% | 185.60% | 167.06% | 210.20% |

Table 2—Contd.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| *Other activities* | | | | | |
| 1. Dairy (Local) | Nos | 1.000 | 1.000 | 1.000 | 1.000 |
| 2. Dairy (Improved) | Nos | 1.000 | 1.000 | 1.000 | 1.000 |
| 3. Goat | Nos | 2.000 | 2.000 | 2.000 | — |
| 4. Duckery | Nos | 4.000 | 5.000 | 6.000 | 5.000 |
| 5. Pigeon | Nos | 3.000 | 3.000 | 3.000 | 4.000 |
| 6. Buffalo | Nos | 0.100 | 0.100 | 0.100 | 0.100 |
| 7. Poultry | Nos | 0.150 | 0.200 | 0.150 | 0.250 |
| 8. Human Labour | MD | 203 | 210 | 212 | 217 |
| 9. Bullock Labour | PD | 55 | 58 | 63 | 65 |
| 10. Working Capital | Rs | 6760.00 | 6550.00 | 6500.00 | 6900.00 |
| 11. Net Returns | Rs | 11516.00 | 10244.00 | 9060.00 | 13535.00 |

Figures within brackets indicate percentage
$PO_1$—$PO_4$—Existing plans;
$P1_1$—$P1_4$—Optimal plans with hiring and borrowing;
$P2_1$—$P2_4$—Optimal plans without hiring and borrowing.

## Effect of Optimization of Existing Situation

*Optimization without hiring, borrowing and purchasing activities*

(I) *Cropping pattern*

Optimization of the existing plan have resulted in increased gross cropped area on farms of all size groups.

*Small Farms*

The cropping intensity had increased from 147.2, 150.0, 155.67 and 163.55 to 205.0, 185.6, 167.06 and 210.2 per cent, respectively, in FS1, FS2, FS3 and FS4. Rice, which is one of the dominant crops in the existing plan, showed a decrease in its area in the optimal plans in all the identified farming systems. The decrease was noted to be 47 per cent to about 34 per cent in FS1 and 46 per cent to 33 per cent in farming

| 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — |
| 1.000 | 1.000 | — | 0.50 | — | — | — | — |
| 0.250 | — | 0.250 | — | — | — | — | — |
| 0.230 | 0.250 | 0.250 | 0.250 | — | — | — | — |
| 0.500 | 0.500 | 0.500 | 0.250 | — | — | — | — |
| — | — | — | 0.500 | — | — | — | — |
| — | — | 0.250 | 0.250 | — | — | — | — |
| 350 | 350 | 295 | 349 | 203 | 194 | 185 | 204 |
| 106.5 | 105 | 113 | 108 | 85 | 78 | 75 | 85 |
| 9345.75 | 8199.25 | 11132.25 | 9036.00 | 6760.00 | 6550.00 | 6550.00 | 6900.00 |
| 24009.15 | 22253.30 | 23141.90 | 22477.30 | 18480.00 | 16477.40 | 16893.05 | 18138.80 |

* Dairy unit shows no. of dairy cows, Goat unit shows no. of goats, Duckery unit shows no. of ducks, Pigeon unit shows pairs of pigeon, Buffalo unit shows no. of she buffalo and Poultry unit shows no. of poultry birds.

system FS4. Vegetables being highly remunerative crops, their area increased in the optimal plans of all the farming systems. Mustard is the other crop which appeared in the optimum plans but with reduced area.

None of the livestock activities appeared in any of the identified farming systems in the optimum plans as they were less remunerative as compared to crop activities.

*Medium Farms*

The cropping intensity increased from 131 to 148 per cent and 131 155 per cent in both the identified farming systems The area under rice decreased from about 58 to 39 per cent in FS1 and 57 to 30 per cent in FS2. As in the case of small farms, the area under summer and winter vegetables increased from 12.6 to 51.5 per cent and 12.75 to 50.5 per cent,

respectively, in both the identified farming systems. Among other activities, sesamum and mustard were included but with less area.

Livestock activities did not appear in the optimum plans for the reasons cited in case of small farms.

*Large Farms*

The cropping intensity increased from 120.15 to 149.80 per cent and 122.70 to 147.27 per cent in FS1 and FS2, respectively. Rice being a less remunerative crop, its area decreased from about 67 to about 34 per cent in FS1 and about 65 to 34 per cent in FS2. The relative areas under vegetables increased while that of mustard decreased. Pulses also appeared in the optimum plans with increased area, the increase being from 5.92 per cent to 12.92 per cent in FS1 and 5.69 per cent to 12.60 per cent in FS2.

Among the animal activities only 25 number of pigeons was suggested in the optimal plan. The study revealed that in all the size groups of farms as well as for the different identified farming systems the remunerative crops appeared with more areas and the less or non-remunerative crops were dropped altogether.

Regarding livestock, they were reared mostly under traditional methods and were less remunerative and did not appear in the optimum plan.

**Labour Employment**

Small Farms

Although the gross cropped area had increased, the employment of human labour showed an opposite trend. Its requirement decreased from 210 to 194 mandays in FS2, 212 to 185 in FS3 and 217 to 204 in FS4 whereas in FS1 it remained unchanged. This was probably on account of inclusion of less labour intensive crops in the optimum plan as well as elimination of most of the animal activities. However the requirement of bullock labour had increased due to increase in gross cropped area in all the farming systems, the increase being from 55 to 85 and 65 to 85 pair days in FS1 and FS4, respectively.

Medium Farms

The requirement of human labour had a direct relationship with the increase in gross cropped area. The increase in human labour was

## Table 3. Existing Plans Vs Optimal Plans for Medium Size Group

| Particulars | Unit ! | Existing plans* | | Optimal plans | | Optimal plans withoht hiring'** and borrowing | |
|---|---|---|---|---|---|---|---|
| | | FS1 P01 | FS2 P02 | FS1 P11 | FS2 P12 | FS1 P21 | FS2 P22 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *Summer* | | | | | | | |
| 1. Autumn Rice (Local) | Ha | 0.085 (02.59) | 0.080 (02.40) | 0.050 (00.73) | 0.040 (00.57) | 0.050 (01.35) | 0.040 (01.02) |
| 2. Autumn Rice (HYV) | Ha | 0.171 (05.22) | 0.175 (05.27) | 0.100 (01.46) | 0.120 (01.70) | 0.100 (02.70) | 0.120 (03.05) |
| 3. Vegetables | Ha | 0.243 (07.42) | 0.250 (07.52) | 1.700 (24.89) | 1.690 (23.67) | 1.010 (27.22) | 0.980 (24.94) |
| 4. Jute | Ha | 0.040 (01.22) | 0.050 (01.50) | 0.080 (01.17) | — — | — — | — — |
| 5. Sugarcane | Ha | 0.167 (05.10) | 0.155 (04.67) | — — | — — | — — | — — |
| *Kharif* | | | | | | | |
| 1. Winter Rice (Local) | Ha | 0.463 (14.13) | 0.500 (15.05) | 0.300 (04.39) | 0.250 (03.55) | 0.300 (08.08) | 0.250 (06.36) |
| 2. Winter Rice (HYV) | Ha | 0.926 (28.27) | 0.930 (28.00) | 2.190 (32.06) | 2.350 (33.33) | 1.100 (29.65) | 0.884 (22.49) |
| 3. Sesamum | Ha | 0.168 (5.13) | 0.165 (4.97) | — | — | 0.080 (2.16) | 0.500 (12.72) |

Table 3—Contd.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| *Rabi* | | | | | | | |
| 1. Mustard | Ha | 0.291 (8.88) | 0.285 (8.58) | 0.170 (2.50) | 0.150 (2.13) | 0.170 (4.58) | 0.150 (3.82) |
| 2. Wheat | Ha | 0.155 (4.73) | 0.160 (4.82) | — | — | — | — |
| 3. Potato | Ha | 0.057 (1.74) | 0.067 (2.02) | — | — | — | — |
| 4. Vegetables | Ha | 0.170 (5.200) | 0.175 (5.270) | 1.060 (15.52) | 1.100 (15.60) | 0.900 (24.27) | 1.010 (25.60) |
| 5. Pulses | Ha | 0.220 (6.710) | 0.210 (6.320) | 0.620 (9.08) | 0.600 (8.51) | — | — |
| 6. Summer Rice (Local) | Ha | 0.040 (1.220) | 0.030 (0.900) | — | — | — | — |
| 7. Summer Rice (HYV) | Ha | 0.800 (2.440) | 0.090 (2.710) | 0.560 (8.20) | 0.750 (10.64) | — | — |
| Gross Cropped Area | Ha | 3.276 (100.0) | 3.322 (100.0) | 6.830 (100.0) | 7.050 (100.0) | 3.710 (100.0) | 3.930 (100.0) |
| Net Cropped Area | Ha | 2.500 | 2.530 | 2.500 | 2.530 | 2.500 | 2.530 |
| Cropping Intensity | % | 131.04% | 131.30% | 273.20% | 278.60% | 148.40% | 155.50% |
| *Other activities* | | | | | | | |
| 1. Dairy (Local) | Nos. | 2.000 | 2.000 | 0.500 | 0.500 | — | — |
| 2. Dairy (Improved) | Nos. | 1.000 | 1.000 | 0.500 | 0.500 | — | — |
| 3. Goat | Nos. | 2.000 | 2.000 | 0.500 | — | — | — |

Table 3—Contd.

3. Goat Nos. 2.000 2.000

Table 3—Contd.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 4. Duckery | Nos. | 6.000 | 5.000 | 0.500 | 0.500 | — | — |
| 5. Pigeon | Nos. | 4.000 | 4.000 | 0.500 | 0.500 | — | — |
| 6. Buffalo | Nos. | 0.200 | 0.200 | — | — | — | — |
| 7. Poultry | Nos. | 0.250 | 0.200 | — | — | — | — |
| 8. Human Labour | MD | 325 | 337 | 636 | 695 | 498 | 506 |
| 9. Bullock Labour | PD | 105 | 103 | 213.5 | 220 | 128 | 159 |
| 10. Working Capital | Rs | 9650.00 | 10200.00 | 15943.00 | 16351.00 | 9650.00 | 9979.00 |
| 11. Net Returns | Rs | 17180.00 | 17350.00 | 42328.70 | 43403.45 | 23900.00 | 25387.50 |

Figures within brackets indicates percentage.

$P0_1$—$P0_3$—Existing Plan;

$P1_1$—$P1_2$—Optimal Plan with borrowing and hiring;

$P2_1$—$P2_2$—Optimal plan without hiring and borrowing.

! Dairy unit shows no. of dairy cows, Goat unit shows no. of goats, Duckery unit shows no. of ducks, Pigeon unit shows pairs of pigeon, Buffalo unit shows no. of she buffalo and Poultry unit shows no. of poultry birds.

from 325 to 498 mandays and 337 to 506 mandays in FS1 and FS2, respectively. The requirement of bullock labour also showed the same trend. It increased from 105 to 128 and 103 to 159 pairdays in FS1 and FS2, respectively.

Large Farms

The increase in human labour requirement as a result of the increase in gross cropped area was from 455 to 529 and 468 to 521 mandays in FS1 and FS2, respectively. The utilization of bullock labour increased from 170 to 217 pairdays in FS1 and 168 to 215 pairdays in FS2.

**Working Capital and Net Returns**

Small Farms

Since working capital was a constraint, the amount available was fully utilised in all the farming systems in this group. One of the objectives of optimization was to increase the net returns and this had been achieved. The net returns had increased in all the farming systems, the increase being from Rs. 11,516 to Rs. 18,480 in FS1 and from Rs. 13,535 to Rs. 18,138 in FS4.

Medium Farms

In this size group the utilization of working capital remained the same in FS1 whereas in FS2 it decreased from Rs. 10,200 to Rs. 9,979 in the optimum plan. The net returns had increased from Rs. 17,180 to Rs. 23,900 and from Rs. 17,350 to Rs. 25,387 in FS1 and FS2, respectively.

Large Farms

The requirement of working capital in the optimum plan showed a marginal decrease from Rs. 17,100 to Rs. 17,022 and from Rs. 17,200 to Rs. 16,979 in FS1 and FS2, respectively. Like the other groups, the net returns had also increased, the respective increase being from Rs. 24,805 to Rs. 40,806 and from Rs. 24,355 to Rs. 39,977 in FS1 and FS2 in the optimum plans.

**Optimisation with Hiring and Borrowing Activities**

*Cropping Pattern*

The effect of optimization with the provision of hiring and borrowing has led to the increase in the gross cropped area in all the size groups of farms and also within the identified farming systems.

**Table 4. Existing Vs. Optimal Plans for Large Size Group**

| Particulars | Unit | Existing Plan | | Optimal Plan | | Optimal Plan without hiring and borrowing | |
|---|---|---|---|---|---|---|---|
| | | FS1 $P0_1$ | FS2 $P0_2$ | FS1 $P1_1$ | FS2 $P1_2$ | FS1 $P2_1$ | FS2 $P2_2$ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *Summer* | | | | | | | |
| 1. Autumn Rice (Local) | Ha | 0.170 (3.30) | 0.175 (3.32) | 0.100 (1.12) | 0.150 (1.56) | 0.100 (1.56) | 0.150 (2.37) |
| 2. Autumn Rice (HYV) | Ha | 0.340 (6.60) | 0.400 (7.58) | 0.970 (10.85) | 1.400 (14.58) | 0.426 (6.63) | 0.400 (6.30) |
| 3. Summer Vegetables | Ha | 0.372 (7.22) | 0.335 (6.95) | 0.930 (10.40) | 0.850 (8.05) | 0.930 (14.48) | 0.850 (13.43) |
| 4. Jute | Ha | 0.081 (1.57) | 0.085 (1.61) | — | — | — | — |
| 5. Sugarcane | Ha | 0.233 (4.52) | 0.220 (4.17) | 0.080 (8.95) | 0.600 (6.25) | — | — |
| *Kharif* | | | | | | | |
| 1. Winter Rice (Local) | Ha | 0.860 (16.69) | 0.875 (16.58) | 0.340 (3.80) | 0.400 (4.17) | 0.340 (5.29) | 0.400 (6.32) |
| 2. Winter Rice (HYV) | Ha | 1.721 (33.40) | 1.800 (34.12) | 3.150 (35.23) | 3.250 (33.08) | 1.400 (21.80) | 1.210 (19.12) |
| 3. Sesamum | Ha | 0.157 (3.06) | 0.160 (3.03) | — | — | 1.230 (19.15) | 1.250 (19.25) |

Table 4—Contd.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| *Rabi* | | | | | | | |
| 1. Mustard | Ha | 0.288 (5.59) | 0.295 (5.59) | 0.190 (2.12) | 0.200 (2.08) | 0.190 (2.96) | 0.200 (3.16) |
| 2. Wheat | Ha | 0.151 (2.93) | 0.155 (2.94) | 0.280 (3.13) | 0.600 (6.25) | — | — |
| 3. Potato | Ha | 0.070 (1.36) | 0.075 (1.42) | — | — | — | — |
| 4. Vegetables | Ha | 0.211 (4.10) | 0.201 (3.81) | 0.800 (8.95) | 0.800 (8.33) | 0.800 (12.45) | 0.800 (12.60) |
| 5. Pulses | Ha | 0.305 (5.92) | 0.300 (5.69) | 0.830 (9.29) | 0.800 (8.33) | 0.830 (12.92) | 0.800 (12.60) |
| 6. Summer Rice (Local) | Ha | 0.064 (1.24) | 0.065 (1.23) | 0.250 (2.80) | 0.250 (2.60) | — | — |
| 7. Summer Rice (HYV) | Ha | 0.129 (2.50) | 0.135 (2.56) | 0.300 (3.36) | 0.300 (3.12) | 0.177 (2.77) | 0.273 (4.35) |
| Gross Cropped Area | Ha | 5.152 (100.0) | 5.276 (100.0) | 8.940 (100.0) | 9.600 (100.0) | 6.423 (100.0) | 6.330 (100.0) |
| Net Cropped Area | Ha | 4.288 | 4.300 | 4.288 | 4.300 | 4.288 | 4.300 |
| Cropping Intensity | % | 120.14 | 122.70 | 208.50 | 223.25 | 149.80 | 147.97 |
| *Other activities* | | | | | | | |
| 1. Dairy (Local) | Nos | 2.000 | 2.000 | 0.620 | 0.650 | — | — |
| 2. Dairy (Improved) | Nos | 1.000 | 1.000 | 1.000 | 1.000 | — | — |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 3. Goat | Nos | 2.000 | 2.000 | 0.500 | — | — | — |
| 4. Duckery | Nos | 8.000 | 8.000 | — | — | — | — |
| 5. Pigeon | Nos | 6.000 | 6.000 | 0.750 | 0.750 | — | — |
| 6. Buffalo | Nos | 0.300 | 0.300 | 0.750 | 0.750 | — | — |
| 7. Poultry | Nos | 0.350 | 0.400 | — | — | — | — |
| 8. Human Labour | MD | 455 | 468 | 775 | 845 | 528.6 | 521.67 |
| 9. Bullock Labour | PD | 170 | 168 | 291 | 294 | 217 | 215 |
| 10. Working Capital | Rs | 17100.00 | 17200.00 | 30730.00 | 34851.70 | 17022.00 | 16979.00 |
| 11. Net Returns | Rs | 24805.00 | 24355.40 | 52698.90 | 50709.65 | 40806.85 | 39971.50 |

Figures within brackets indicate percentages

$PO_1$—$PO_2$—Existing Plans;

$P1_1$—$P1_2$—Optimal Plan with borrowing and hiring;

$P2_1$—$P2_2$—Optimal Plan without borrowing and hiring.

! Dairy unit shows no. of dairy cows, Goat unit shows no. of goats, Duckery unit shows no. of ducks, Pigeon unit shows pairs of pigeon, Buffalo unit shows no. of she buffalo and Poultry unit shows no. of poultry birds.

As in the earlier situation the area under highly remunerative crops like vegetables had increased whereas the less remunerative crops appeared with less area or were altogether eliminated from the optimum plans. Some of the livestock activities appeared in the optimum plans because of the imposition of minimum and maximum restrictions.

Small Farme

The cropping intensity had increased in all the identified farming systems, the increase being from 147 to 256 per cent and 163 to 271 per cent in FS1 and FS2, respectively. The area under rice decreased in all the farming systems, the decrease being from 47 to 39 percent in FS1 and from 45 to 41 percent in FS4. The area under vegetables increased from 26 to 56 per cent in FS1 and FS4 in the optimum plans over the existing ones. Mustard and sesamum appeared in the optimum plan but with relatively less area.

Among the livestock activities only duckery and pigeon appeared with their minimum number restrictions. Improved dairy appeared in FS1, FS2 and FS4 and goat in FS1 and FS3 but of course with their minimum number restrictions. Improved dairy appeared in FS1, FS2 and FS4 and goat in FS1 and FS3 but of course with their minimum number restrictions. As already stated the traditional method of rearing farm animals made them less remunerative as compared to crop activities.

Medium Farms

The increase in cropping intensity as a result of increase in gross cropped area was from 131 to 273 per cent in FS1 and from 131 to 279 per cent in FS2. The area under paddy decreased from 58 and 59 per cent in FS1 and FS2 to 47 and 49 per cent in the optimum plans. As on small farms, the area under vegetables showed marked increase, the increase being from 13 to 40 per cent in FS1 and FS2. The other crops were either eliminated or figured with relatively less area.

Among the livestock activities, dairy, local and improved, duckery and pigeon appeared in both the optimum plans with their minimum number restrictions. Goat enterprise was eliminated from the optimum plan of FS2.

Large Farms

Like the earlier two situations the cropping intensity increased from 120 to 209 per cent and 123 to 223 per cent in FS1 and FS2, respectively. The area under rice had decreased but that of vegetables increased significantly, the increase being from 11 to 19 per cent and 10

to 17 per cent in FS1 and FS2, respectively. Sugarcane being a remunerative crop figured in the optimum plan with increased area, the change being from 5 to 9 and from 4 to 6 per cent in FS1 and FS2, respectively. Mustard, wheat and pulses were also included in the optimum plan.

Among the livestock activities dairy (local and improved) duckery and pigeon were included in both the optimum plans with their minimum number.

**Labour Employment**

As a result of the increase in the gross cropped area the requirement of human and bullock labour increased in the optimum plans for all the three categories of farms and for the different farming systems included in the different categories.

Small Farms

The increase in human labour requirement varied from 203 to 350 mandays in FS1 and from 217 to 249 mandays in FS4. The relative increase in the requirement of bullock labour for the above 2 systems were from 55 to 106 and 65 to 108 pairdays.

Medium Farms

Human labour in terms of mandays increased from 325 to 636 and from 337 to 695 in the two identified farming systems. In case of bullock labour their relative increase was from 105 to 214 and 103 to 220 pairdays respectively.

Large Farms

In the two identified farming systems for this group i.e. FS1 and FS2 the increase in human labour was from 455 to 775 and 468 to 845, respectively. The increase in bullock labour in pairdays was from 170 to 291 in FS1 and 168 to 294 in FS2.

**Working Capital and Net Returns**

On account of the incorporation of hiring and borrowing activities and increase in gross cropped area, the utilization of working capital increased in the identified farming systems for all the size groups. The net returns had also increased in the optimum plans for the different farms.

Small Farms

The increase in working capital requirement varied from Rs. 6,760 to Rs. 9,345 in FS1 and from Rs. 6,900 to Rs. 9,036 in FS5. The simul-

taneous insrease in net returns was from Rs. 11,516 to Rs. 24,009 and from Rs. 13,535 to Rs. 22.577 for the above two systems.

Medium Farms

For the two identified farming systems in this category the increase in requirement of working capital was from Rs. 9,650 to Rs. 15,943 and from Rs. 10,200 to Rs. 16,351, respectively. The increase in net returns were from Rs. 17,180 to Rs. 42,329 and from Rs. 17,350 to Rs. 43,403, respectively in FS1 and FS2.

Large Farms

The requirement of working capital had increased from Rs. 17,100 to Rs. 30,730 and from Rs. 17,200 to Rs. 34,851 in FS1 and FS2 identified under this group. The net returns had increased from Rs. 24,805 to Rs. 52,698 and from Rs. 24,355 to Rs. 50,709, respectively, for the two systems.

**Conclusions**

Although a number of farming systems were in vogue in the district, only a few of these were common among the farmers. Capital was an important resouree constraint and the supply of human and bullock labour were in surplus. The effect of optimization led to better utilization of resources, increase in gross cropped area and higher net returns. However, the optimal plans can be made effective only when the constraints in resource availability like timely supply and liberalization of credit, creation of irrigation potentialities and supply of other farm inputs are removed.

The study would be of immense help to the government, agriculture department and other organization in formulating agrarian laws and policies pertaining to the state.