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Optimum Land Use Pattern Among the Sample Farms in Selected Mill Zones

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ABSTRACT

A study was conducted to determine the optimum combinations of different crops with sugarcane to maximize farm incomes with available resources among the sample farms during 1981-82, rabi season. The results reveal a distinct decline in areas of sugarcane, wheat,other crops and sugarcane–potato by optimum land use programming solution and it encourages significantly corresponding increase of land tosugarcane+ mustard cultivation. The extent of increase insugarcane+mustard cultivation is1199.15% in aggregate by optimum land use over the existing cultivationof sugarcane+mustard. The net return in aggregate for the recommended land use would be increased by 26.85% over the net return of existing land use.

INTRODUCTION

Optiumum allocation of land has been defined as one which,given physical, technical and resource conditions, shows what crop activities to undertake and how much land to allocate to each crop activity so that net farm returns(farm incomes) are maximized in an annual cycle(Heady, 1952). In the millzone areas, it is required to find out optimum combinations of different crops or intercropping that should be planted by farmers which willmaximize his income and minimize the limited farm inputs available (Libunao, 1982). This is possible through intensification of input use in optimum combination of crop production withavailable resources on the basis of operational research (Ahsan and Islam, 1981).

It is necessary to determine the level of efficiency in the agricultural inputs use for crop production at the farm level and to provide guideline towards the optimum land allocation for crop production for adoption of efficient cropping pattern in the mill zone areas to feed the sugar factories efficiently.

MATERIALS AND METHODS

The study was based on farm level primary information collected through a comprehensive field survey during January 1981–March 1982 . The locations of the study areas were selected from the three major cane zones comprising as Northern,Central and Southern based on the factors like rainfall,temperature,topography of land and cropping patterns. Three hundred and nine sample farms were randomly selected from four mill zone areas. Eighty two farms were selected from twenty four villages of Kushtia Sugar Mills zone (KSM Zone), seventy six farms from twelve villages of Shyampur Sugar Mills zone (SHSM Zone), sixty farms from thirteen villages of Joypurhat Sugar Mills(JSM Zone) and ninety one farms from twenty five villages of Thakurgaon Sugar Mills zone (TSM Zone) . Investigators in each mill zone were advised to interview selected farmers daily to record agricultural data throughout the year.

The analyses have been carried out in terms of five rabi crops namely wheat, sugarcane, sugarcane+mustard,sugarcane+potatoand other crops (minor crops). However, we have assumed

that the area under other crops cover small area of the total cropped area which include potato, mustard,gram,tobacco, pulses, spices etc. and it may also be termed as minor crops. Each crop was classified into activities. The crops which are considered to be technically feasible and which are acceptable to the farmers concerned,have been termed as crop activities. The linear programming technique which maximizes farm returns from various crop activities subject to the various constraints has been used as an analytical tool. Data from each of the selected location have been analysed for optimal land allocation and resources use with the help of mathematical model. A linear programming model for optimal land use and other resources as stated by Dahiya(1976) is as follows:

$$\text{Max} \quad Z_o = \sum_{j=1}^{n} C_j X_j$$

$$\text{Subject to} \quad \sum_{j=1}^{k} a_{ij} x_j \leq b_i$$

$$\vdots$$

$$\sum_{j=1}^{k} a_{ij} x_j \leq b_i \ldots\ldots (1)$$

$$\vdots$$

$$\sum_{j=1}^{k} a_{nj} x_j \leq b_n$$

$$x_j \geq 0 \quad \text{for all } j.$$

Where Z_o = the total net farm returns in Taka.

a_{ij} = the amount of ith input required per unit of jth activity,

c_j = net return in Taka per hectare of land allocated to jth activity,

b_i = the quantity available of the ith resource (i = 1,...n).

x_j = the level of activity j (j = 1,.....k).

The final solution of the problem has been obtained through smiplex procedure(Gass, 1975; Heady, 1954).

The objective function of the model is to maximize net returns. We,therefore,have taken net return per hectare from crop output as an index of land use efficiency (Table 1) .The variable cost for each rabi crop for each location were estimated on per hectare basis. The various items of variable cost include casual labour hired,seeds,manures,fertilizers,water, bullock/tractor power, pesticides and interest on operating capital which are specific for the use of certain crops.

The input co-efficients for all the crop activities on all the selected farms of different locations were calculated on the basis of the actual quantities of different resources used for these crop activities. Gross returns were estimated from total area under study based on farm level yield estimates for different crops and their respective prices.

Net returns have been obtained by deducting from the gross income the variable cost incurred in the cultivation of crops.

Table 1. Input data used in LP Model to determine optimum land use pattern during rabi season 1982.

Locations and name of crops	Area under cultivation (ha)	Yield of crops (M. Tons/ha)	Net returns (Taka/ha)	Present level of output (M. Tons/ha) produced (minimum)
KSM Zone				
Wheat	3.60	1.13	2286.81	0.96
Other crops	9.05	4.54	3263.22	0.23
Sugarcane	63.04	46.69	9990.46	22.13
Sugarcane + Mustard	2.42	51.93	11568.99	25.64
SHSM Zone				
Wheat	3.56	1.57	2965.52	1.20
Other crops	2.74	7.99	4300.00	6.46
Sugarcane	43.57	38.58	9796.40	18.44
Sugarcane + Mustard	0.18	46.95	12175.26	23.54
Sugarcane + Potato	4.25	69.88	15374.23	34.18
JSM Zone				
Wheat	5.55	1.64	2127.34	1.04
Other crops	10.25	5.85	2750.68	0.36
Sugarcane	42.46	49.89	14709.67	14.75
Sugarcane + Mustard	3.44	61.39	18928.54	23.98
Sugarcane + Potato	2.23	74.99	18212.18	37.82
TSM Zone				
Wheat	22.24	1.33	2044.53	0.81
Other crops	7.25	2.44	2037.27	0.28
Sugarcane	72.87	26.95	6654.36	17.45
Sugarcane + Mustard	10.46	39.85	10748.99	23.48
Sugarcane + Potato	2.68	52.53	11371.00	27.37

Resource constraints:

Land supply is scare to farm and, therefore, available land cultivated under different crops have been considered as constraint in the matrix table. Human resources used in the production of different crops was also taken as a constraint on the basis of the extent to which the labour was used during the cropping period. Moreover, output of different crops at present level of production has been considered as minimum requirements of output of crops to be produced.

Resources like farm implements and other possible constraints in land use planning were not found to be of significant character in this developing economy and thus could easily be ignored.

RESULTS AND DISCUSSION

The optimization in land use as revealed in the study recommends a shift in land use from one crop to the others in different combinations (Table 2). Farmers of KSM zone cultivated sugarcane in about 80.71% of the total cropped area during rabi season, 1982. The optimum land allocation implies that only sugarcane should be cultivated in 0.68% of the total cropped area. The derived optimization in land use pattern encourages strongly in favour of cultivation of sugarcane +mustard in the rabi season at KSM zone of the sample farms. The recommended area under sugarcane + mustard is 98.03% of the total cropped area as against only 3.09% of the total cropped area presently used by the farmers at KSM zone of the sample farms. The optimum land use pattern does not recommend increased area under cultivation of wheat, sugarcane and other crops from the present level of cultivation of these crops.

The optimization in land use at KSM zone of the sample farms as revealed in the study has recommended shifting of area from wheat, sugarcane and other crops and corresponding increase in the cultivation of sugarcane+mustard. The extent of increase in sugarcane+mustard was 2738.43% over the existing land use under sugarcane+mustard cultivation. The reduction of land under cultivation from other crops was the highest 99.45% followed by sugarcane (99.25%) and wheat (76.11%) over the existing land use among the sample farms at KSM zone. The extent of increase in net return by recommended land use is about 15.58% over the present land use net return, at KSM zone of the sample farms (Table 2).

The optimization in land use as obtained in the study suggested a shift of land from wheat, other crops, sugarcane and sugarcane+potato to sugarcane+mustard among the sample farms of SHSM, JSM and TSM zones.

The optimum land use pattern shows an increase in area under sugarcane+mustard cultivation for about 25094.44% at SHSM zone, 1590.40% at JSM zone and 303.15% at TSM zone of the sample farms over the existing land use under sugarcane+mustard cultivation. The reduction of land under cultivation from sugarcane was the highest (99.90%) followed by sugarcane+potato (88.47%), wheat (78.65%) and other crops (70.44%) by optimum land use pattern over the existing land use at SHSM zone of the sample farms. The recommended land use with available resources enable to increase net return by 11.45% during the rabi season at SHSM zone of the farms (Table 2).

The reduction in land area under cultivation as recommended was for other crops (99.41%) followed by sugarcane (99.29%), wheat (88.47%) and sugarcane+potato (77.58%) over the existing land use of the sample farms at JSM zone. The recommended land use pattern could increase net return by 37.89% over the existing land use at JSM zone of the sample farms (Table 2).

Table 2. Optimum land allocation for different crops under oxisting farmers land use situation, rabi season, 1982.

Zone	Resource situation	Area (ha)				Sugarcane + Potato	Total land allocated to crops (ha)	Net returns (Tk.)	Mandays	Unused land (ha)
		Wheat	Other crops	Sugarcane	Sugarcane + Mustard					
KSM	*E.S.	3.60	9.05	63.04	2.42	.0	78.11	695380.21	9471.82	
	*O.S.	0.86	0.05	0.47	68.69	.o	70.07	803690.44	9471.82	8.04
SHSM	E.S.	3.56	2.74	43.57	0.18	4.25	54.30	516700.42	8003.30	
	O.S.	0.76	0.81	0.48	45.35	0.49	47.89	575867.44	8003.30	6.41
JSM	E.S.	5.55	10.25	42.46	3.44	2.23	63.93	810302.34	7758.82	
	O.S.	0.64	0.06	0.30	58.15	0.50	59.65	111344.00	7758.82	4.28
TSM	E.S.	22.24	7.25	72.87	10.46	2.68	115.50	688052.38	8660.04	
	O.S.	0.60	0.00	72.36	42.17	0.37	115.50	941410.81	8600.00	0.0
Total	E.S.	34.95	29.26	221.94	16.50	9.16	311.81	2710435.35	33893.98	0.0
	O.S.	2.86	0.92	73.61	214.36	1.36	293.11	3438312.69	33893.98	1873

*E.S. = Existing situation, *O.S. = Opitimum situation.

The optimum land allocation implies that at TSM zone of the sample farms,the reduction of land could be from wheat, sugarcane and other crops out of which,area under wheat could be reduced by 97.30% followed by area under sugarcane+potato (86.19%) and sugarcane (0.70%)over the existing land use pattern. Other crops have been completely eliminated probably due to economically less profitable crops at TSM zone of the sample farms. The optimum land allocation could increase net return by 36.82% over the net return of existing land use pattern at TSM zone of the sample farms (Table 2).

The optimal land allocation in aggregate distributes the land to sugarcane+mustard (73.13%), sugarcane(25.11%),wheat (0.99%),sugarcane+potato (0.46%)and other crops (0.31%) of the total land under cultivation. In aggregate, the net return of the optimal land use pattern could be increased to 26.85%over the net return of existing land use pattern (Table 2).

This work suggests that only sugarcane cultivation is not remunerative to the sample farms of KSM, SHSM, JSM and TSM zones. The optimal land use pattern indicates that only sugarcane cultivation experiences a distinct decline at KSM, SHSM,JSM & TSM zones of the sample farms. The optimal land use pattern strongly recommends an increase in sugarcane + mustard cultivation by 1199.15% in aggregate over the existing sugarcane + mustard cultivation.

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