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Farm optimization of sugarcane based farming system in Meerut District (U.P)

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Abstract
The present study was conducted in Western Uttar Pradesh. The selection of District was chosen purposively whereas a multistage simple random sampling technique was used to select the block, Villages and farmers. A total number of 80 farmers were selected randomly for primary data collection. The economics of different crops and livestock shows that, sugarcane provides highest net return of Rs. 62960.34 per hectare, after sugarcane, paddy provides net return of Rs.49442.52 per hectare. Sugarcane provides net return of Rs. 57065.21, Rs. 61933.31, Rs. 59235.47 and Rs.64722.28 on marginal, small, medium and large farms, respectively. A cow and buffalo provides net return of Rs. 10603.83 and Rs. 15110.84 per year on all farms. The analysis of existing pattern of resource use has enhanced the necessity of an appropriate planning for the efficient utilization of available resource. Income and employment in existing plan is Rs. 203987.5 and 656.1 man days per year. Whereas, in alternative plan when income is maximized, the income goes to Rs. 242493.28 per year and employment goes to 790.06 man-days/year.

Keywords: Farming system, economics, farm optimization and LP model

Introduction
The Indian economy is mainly based on farm and rural community, and the diminishing size of land holding due to increase population create a big challenge to the sustainability, productivity and profitability of farming. The availability of land per capita was reduced from 0.5 hectare in 1950-51 to 0.15 hectare per capita by the turn of the century. It is estimated by the researcher that further decline to less than 0.1 ha by 2030, it is essential to develop the new policy, strategies and agricultural technologies for generating the employment opportunity and income generation for the rural and farm community who constitute more than 50 Percent of the total population of the country. The research and development in agriculture provide a way of farming or cropping in such a manner that makes the efficient management/use of available farm resources by the farmers or farm community. The continuous reduction in the size of land holding it is necessary to develop the farming system according to the size of farms with allied activities like poultry, fishery, livestock, bee keeping, horticultural crops etc. with more socio-economic development of the farm community. Integrated farming systems provide an opportunity for efficient utilization of natural resources and IFS helps to the farm community to generate more income and employment throughout the year. Farming system approach is provide an opportunity to overcome the problems of sustainable economic growth for farm population/community in India.

The spectacular growth of Indian agriculture during last five decades, *i.e.*, after the beginning of green revolution skills, ushered in a period of independency in food-grain production, rural prosperity and element of resilience in the area of agricultural. The impact of green revolution was so inspiring that India become an example for several other developing countries. The common efforts done by the Scientist, policy makers and farm community put India to 'bread-basket' status from 'begging-bowl' in a small period of two decades or so. National food grain production has registered nearly three times an increase from mere 82 MT in 1960-61 to 277.49 MT in 2017-18. During this period, area under food grain crops increased merely from 115.58 million ha to 121.37 million ha and the major share of enhanced food production may be ascribed to improvement in crop productivity, which has increased from 710 to 1798 kg/ha. Obviously, it is a matter of pride to the nation and great achievement to the Agriculturist/researchers and farm community of the country. During first two decades of green revolution, *i.e.*, up to mid-eighties only food grain production (mainly rice and wheat) witnessed an impressive growth but subsequent efforts, made toward technology generation, led to other land marks also in the area of different agricultural production system, such as dairy (white revolution), oilseed production (yellow revolution) and fisheries (blue revolution).

Under the compulsions of ever increasing food demand, shrinking of agricultural land as well as operational holdings, changes in food habits with growing economy, market globalization and fundamental changes in agricultural trade and tariff policies; farmers do not have any other options except to diversify into multiple sub-system rather than depending on a single or double enterprise in practice. Further, they need to manage them as industry, rather than a subsistence activity for ensuring national food and nutritional security, gainful employment for rural youth, augmenting household income, social equity, eco-system protection and conservation of natural resources.

India is the world's largest producer of sugarcane. Sugarcane is cultivated in about 4.20 million hectare producing about 277.75 million tonnes of sugarcane with an average productivity 66.1 tonnes per hectare of several agricultural crops, sugarcane is the most profitable crop and has a very high economic biomass to total biomass ratio. Sugarcane crop required more water and fertilizer compared to other crops. About 60 percent of cane in India is produce in the subtropical zones and 40 percent in tropical zone. The productivity of the sugarcane differs significantly between these zones; it is 89 to 58 tonnes per hectare, respectively.

In India, area under sugarcane is highest, 20.8 lack hectare in Uttar Pradesh. The productivity of Madhya Pradesh is lowest, 42.2 tonnes per hectare and highest in Tamilnadu *i.e.* 106.2 tonnes per hectare in the country. Sugarcane play an important role in the cropping system as a cash crop in the Western plain Zone of Uttar Pradesh. It is the main crop of the existing farming system from a long time because the marketing facility for sugarcane is favourable for farmers in this region. Therefore, to increase the farm income of the farm community of this region, there is a need to understand sugarcane-based farming systems and their economics.

Research methodology

The selection of District was chosen purposively whereas a multistage simple random sampling technique was used to select the block, Villages and farmers. District Meerut was selected purposively because it is one of the major sugarcane growing districts. Among the 12 development blocks of district Meerut two block namely-Daurala and Hastinapur selected randomly for the study purpose. A list of all the villages of selected block was prepared. Out of this, four villages were selected randomly. A list of all the sugarcane growers was prepared from the universe of selected 4 villages. A total number of 80 farmers were selected randomly. On the proportion of the farmer's falling in each village under different size group of farms. These farmers were grouped according to the land holding they possess, that are marginal farmer's (0-1hectare), small farmer's (1-2 hectare), medium farmer's (2-4hectare) and large farmers (above 4 hectare).

Analytical Tools

In order to meet out the purpose of the study tabular analysis and Linear programming technique was used to optimize the resources use for farms of the study area. Net income from different enterprises was calculated by subtracting the expenditure (Rs.) made on input materials (seed, fertilizer, plant protection measures, hired human labour, farm equipment and implements, water charges etc.) and expenditure on livestock management, such as feed and fodder, mineral mixture, medicine labour etc. from gross return.

(i) Mathematical Formulation of The Model

Programming approach of the following form was used use to optimize the return from Sugarcane Based Farming System.

(a) Objective function –I (Maximization of income)

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

Where,

Z = Net returns (income) variable cost in rupees

C_j = net return over variable costs per unit of j-th activity in rupees

X_j = the level of j-th activity,

Subject to,

$$\sum_{j=1}^{n} a_{ij} x_{ij} \leq b_i$$

$$X_{ij} \geq 0$$

(i = 1, 2, 3,…….. m, resources)

(j = 1, 2, 3, ……n, activities)

Where,

a_{ij} = amount of i-th resource required for the j-th activity,

b_i = total available quantity of i-th resources.

For using this model the following sets of data were needed

A. Data for technological matrix
B. Data on resource supply
C. Data on cost and return for different activities.

(A) Data for technological matrix

It is important to identify the activities for the model to obtain data for the matrix.

(i) Activities

There are mainly two crop seasons *i. e.* Kharif and Rabi in the study area. The crop grown during these seasons and livestock activities are considered as major activities, which are as follows:

S. No.	Activities	Symbol
1.	Sugarcane	X_1
2.	Paddy	X_2
3.	Jowar (Fodder)	X_3
4.	Urd	X_4
5.	Arhar	X_5
6.	Wheat	X_6
7.	Mustard	X_7
8.	Oat (Fodder)	X_8
9.	Potato	X_9
10.	Berseem (Fodder)	X_{10}
11.	Cow	X_{11}
12.	Buffalo	Z_{12}

All the farmers do not perform all these activities. Most of the activities are being performed traditionally for the family consumption.

(B) Data on Resource Supply

There are four major constraints used in the model and are given below:

I. Land restriction
II. Labour restriction
III. Capital restriction
IV. Variation in cropping pattern
V. Data on cost and return for different activities

Result and discussion

Economics of Various Enterprises

Cost of cultivation of various crops

Table 1: Economics of different crops in sugarcane-based farming system on different size of farms (Rs. /ha)

Crops	Marginal	Small	Medium	Large	All Farms
Sugarcane	34087.82	33467.57	34284.01	33199.70	33468.18
Paddy	22929.75	23517.87	23001.39	27019.55	25678.05
Jowar(Fodder)	8748.31	8738.44	8325.43	8646.72	8600.40
Urd	8850.00	8654.00	7673.81	8774.44	8234.35
Arhar	----------	10550.00	10200.00	10460.00	10430.00
Wheat	17685.00	17007.88	17416.80	17204.48	17239.48
Mustard	10582.00	10402.64	10742.52	10128.87	10282.47
Oat(Fodder)	----------	10583.83	11261.19	11228.71	11142.82
Potato	----------	43911.33	----------	38280.00	40157.11
Berseem(Fodder)	----------	7914.00	84.25	7978.00	7995.37

The table 1 shows that the cost of cultivation of various crop varies from Rs. 7995.37 for berseem (fodder) to Rs. 40157.11 for potato on the sample farms. After potato, the cultivation of sugarcane incurred the maximum cost *i.e.*, Rs. 33468.18. The cost of cultivation of sugarcane was found maximum *i.e.* Rs. 34284.01 for medium farmers followed by marginal, small and large farmers.

The table also reveals that the total cost of cultivation on marginal size of farms of various crop enterprises varies from Rs.8748.30 for jowar (Fodder) to Rs.34087.82 for sugarcane, from Rs. 7914.00 for berseem (Fodder) to Rs.43911.33 for potato on small size of farms, from Rs. 8325.43 for jowar (Fodder) to Rs. 34284.01 for sugarcane on medium size of farms and from Rs. 7978.00 for berseem (Fodder) to Rs. 38280.00 for potato on large size of farms.

Cost of livestock rearing on different size of farms

Table 2 shows that input cost for rearing one cow was Rs. 19477.35 and Rs.25110.44 for rearing a buffalo.

The table also reveals that the input cost of rearing one cow was maximum on small farms *i.e.*, Rs. 19574.79 followed by medium and large farms *i.e.*, 19563.68 and 19342.91, respectively. The input cost of rearing a buffalo was maximum on small size of farms *i.e.*, Rs. 25382.38 and minimum on medium size of farms *i.e.* Rs. 24748.67.

Table 2: Input cost in livestock in sugarcane based farming system on different size of farms (Rs. /Animal)

Livestock	Marginal	Small	Medium	Large	All Farms
Cow	--------	19574.79	19563.68	19342.91	19477.35
Buffalo	24987.93	25382.38	24748.67	25134.81	25110.44

Gross Income from different crops

Table 3: Gross Income from different crops in sugarcane-based farming system on different size of farms (Rs. /ha)

Crops	Marginal	Small	Medium	Large	All Farms
Sugarcane	91153.03	95400.88	93519.48	97921.98	96428.52
Paddy	73398.75	71225.22	68620.82	78022.45	75120.57
Jowar (Fodder)	14461.54	14482.62	14017.07	14608.76	14435.14
Urd	33950.00	42026.67	42179.76	37911.11	41115.76
Arhar	----------	45500.00	50700.00	50690.00	50172.50
Wheat	39992.94	38311.43	37690.85	39438.06	38821.95
Mustard	32500.00	31274.55	31327.83	32162.67	31884.82
Oat (Fodder)	----------	15265.83	15526.75	15032.35	15271.10
Potato	----------	85333.33	----------	74000.00	77777.78
Berseem (Fodder)	----------	15937.50	14100.00	15885.00	15741.81

Table 3 shows that the highest gross income *i.e.*, Rs.96428.52 per hectare was obtained from sugarcane cultivation followed by potato *i.e.*, Rs.77777.78 per hectare. The gross income obtained from sugarcane cultivation by marginal, small, medium and large farmers was Rs.91153.03, Rs. 95400.88, Rs. 93519.48 and Rs.97921.98, respectively. On marginal farms after sugarcane, paddy crop generate the gross income of Rs. 73398.75 per hectare. On small farms potato generate gross income of Rs. 85333.33 per hectare. Under medium and large farm condition after sugarcane, paddy provide highest gross income *i.e.*, Rs.68620.82 and Rs. 78022.45per hectare.

Gross income from livestock rearing

Table 4: Gross Income from livestock in sugarcane-based farming system on different size of farms (Rs. /Animal)

Livestock	Marginal	Small	Medium	Large	All Farms
Cow	----------	29537.14	32733.33	29488.57	30081.18
Buffalo	40566.00	40101.25	40626.25	39869.00	40221.29

Table 4 reveals that one cow provides gross income of Rs.30081.18 per year and one buffalo provide gross income of Rs. 40221.29 per year. On medium farms cow provide highest gross income of Rs. 32733.33 followed by small and large farms *i.e.*, Rs. 29537.14 and Rs. 29488.57, respectively. One buffalo generate gross income of Rs. 40626.25 on medium size farms and Rs.40566.00, Rs. 40101.25 and Rs.39869.00 on marginal, small and large farms, respectively.

Net Return from different crops

Table 5: Net Return from various crops in sugarcane -based farming system on different size of farms (Rs. /ha)

Crops	Marginal	Small	Medium	Large	All Farms
Sugarcane	57065.21	61933.31	59235.47	64722.28	62960.34
Paddy	50469.00	47707.00	45619.43	51002.90	49442.52
Jowar (Fodder)	5713.23	5744.18	5691.64	5962.04	5834.74
Urd	25100.00	33372.67	34505.95	29136.67	32881.41
Arhar	----------	34950.00	40500.00	40230.00	39742.50
Wheat	22307.94	21303.55	20274.05	22233.57	21582.47
Mustard	21918.00	20871.91	20585.30	22033.80	21602.35
Oat (Fodder)	----------	4682.00	4265.56	3803.65	4128.28
Potato	----------	41422.00	----------	35720.00	37620.67
Berseem (Fodder)	----------	8023.50	5675.00	7907.00	7746.45

Table 5 shows that sugarcane provides highest net return of Rs. 62960.34per hectare, after sugarcane, paddy provides net return of Rs.49442.52 per hectare. Sugarcane provides net return of Rs. 57065.21, Rs. 61933.31, Rs. 59235.47 and Rs.64722.28 on marginal, small, medium and large farms, respectively.

Table also reveals that paddy provides the net income of Rs. 50469.00, Rs. 47707.00, Rs. 45619.43 and Rs. 51002.90 on marginal, small, medium and large farms, respectively in kharif season. Large farms generate highest net return in case of sugarcane and paddy. In rabi season, wheat provides net return of Rs. 22307.94, Rs. 21303.55, Rs. 20274.05 and Rs.22233.57 on marginal, small, medium and large farms, respectively.

Table 6: Net Return from livestock in sugarcane-based farming system on different size of farms (Rs. /Animal)

Livestock	Marginal	Small	Medium	Large	All Farms
Cow	----------	9962.35	13169.65	10145.66	10603.83
Buffalo	15578.08	14718.88	15877.58	14734.19	15110.84

Table 6 reveals that the net return from one cow was highest *i.e.*, Rs. 13169.65 on medium size farm followed by large and small size of farms *i.e.*, Rs. 10145.66 and Rs. 9962.35, respectively. On all farms a cow provides net return of Rs. 10603.83 per year.

Table also shows that net return of Rs. 15110.84 was obtained by rearing a buffalo. A buffalo generates net return of Rs. 15578.08, Rs. 14718.88, Rs15877.58 and Rs. 14734.19 on marginal, small, medium and large farms, respectively.

Optimal Resource Use Plan

The analysis of existing pattern of resource use has enhanced the necessity of an appropriate planning for the efficient utilization of available resource. Reviewing resource situation, it was decided to formulate optimal resource use plan for farms of study area. Linear programming technique has been used to formulate this plan. This whole section is divided into two sub sections. Sub-section A is devoted to deal with the level of income and employment in existing and alternative plan and Sub-section B deals with the cropping pattern in existing and alternative plan and livestock level in existing and alternative plan.

A: Level of Income and Employment in Existing and Alternative Plan on Sample Farms

Table 7: Income and Employment on Sample Farms

Particulars	Existing Plan	Alternative Plan
		Maximization of Income
Income (Rupees)	203987.5	242493.28 (18.87)
Employment (Man-days)	656.1	790.06 (20.41)

Note: Figures in parentheses show percentage change over the existing plan.

The table 7 shows that the income in existing plan is Rs. 203987.5 and employment in exiting plan is 656.1 man days per year. Whereas, in alternative plan when income is maximized, the income goes to Rs. 242493.28 per year and employment goes to 790.06 man-days per year.

The above table also reveals that when income is maximized the income increased by 18.87 percent and employment by 20.41 percent over existing plan.

Table 8: Existing and optimal farm plan for sample farms

Crops/livestock	Existing Farm plan	Maximization of Income
Sugarcane	77.28 (47.31)	78.60 (48.51)
Paddy	17.52 (10.72)	33.32 (20.56)
Jowar (Fodder)	20.24 (12.39)	5.60 (3.46)
Urd	3.68 (2.25)	0.00 (0.00)
Arhar	1.60 (0.98)	2.80 (1.73)
Wheat	32.84 (20.10)	9.60 (5.92)
Mustard	5.48 (3.36)	5.60 (3.46)
Oat (Fodder)	3.12 (1.91)	0.00 (0.00)
Potato	0.72 (0.44)	20.52 (12.66)
Berseem (Fodder)	0.88 (0.54)	6.00 (3.70)
Gross Cropped Area	163.36 (100.00)	162.04 (100.00)
Cow	0.8	0
Buffalo	1.5	3

Note: Figures in parentheses show percentage to the total cropped area

The table 8 reveals that the area under sugarcane increased to 48.51 percent in optimal plan from 47.31 percent in existing plan. The area under paddy and potato is also increased in optimal plan. The area of paddy increased from 10.72 percent in existing plan to 20.56 percent in optimal plan. The maximum increment in area in optimal plan was found in potato. Area of potato is increased to 12.66 percent in optimal plan from 0.44 percent in existing plan. The area under wheat and jowar (Fodder) is decreased in optimal plan. Area of wheat is goes down to 5.92 percent in optimal plan from 20.10 percent in existing plan. The area of jowar (fodder) is also decreased from 12.39 percent in existing plan to 3.46 percent in optimal plan.

The level of buffalo in optimal plan is increased to 3.0 numbers from 1.5 in existing plan. The level of cow is goes down to 0.0 in number in optimal plan from 0.8 in existing plan.

Summary and conclusion

The study regarding the occupation and employment on sample farms shows that 30 percent of the total population was unpaid family labour engaged in agriculture and 57.30 percent population was dependents. Out of the total cultivated area 3.39, 19.95, 19.41and 57.25 percent was on marginal

(below 1 ha. size group), small (1-2 ha. size group), medium (2-4 ha. size group) and large (above 4 ha. size group) size of holding with an average size of 0.816, 1.600, 2.590 and 6.262 hectare land, respectively. Regarding the existing cropping pattern, it was fond that most of the area is allocated under sugarcane because it is a profitable cash crop. The analysis of cost and return by size of farms reveals that sugarcane is most profitable crop followed by paddy and potato on all the categories of farms. In case of the intensity of cropping on marginal, small, medium and large size of farms, it was 135.29, 133.67, 144.86 and 133.45 percent, respectively. This indicates that the cropping intensity is less due to sugarcane cultivation. Reviewing the resource situation at the farm, it was decided to develop the optimum farming plan for increasing the income and employment on sample farms. It was found that if farmer adopt the optimal plan instead of existing one, the income level of farms can be increased by 18.87 percent. Not only income but the human labour employment can also be increased by 20.41 percent.

References

1. Behera UK, Jha KP, Mahapatra IC. Integrated management of available resources of the small and marginal farmers for generation of income and employment in eastern India. Crop Research. 2004; 27(1):83-89.
2. Hasija RC, Singh SN, Kadian VS, Singh KP. Economic Analysis of Dairy Enterprise in Different Farming Systems. Haryana Journal of Agronomy. 2003; 19(1):67-70.
3. Jha D. An overview of farming systems research in India. Annals of Agricultural Research. 2003; 24(4):695-706.
4. Mahapatra IC. Farming systems research challenges and opportunities. Eastern Indian Farming System Research & Extension, Newsletter. 1992; 6(4):3-10.
5. Mahapatra IC. Farming system research-A key to sustainable agriculture. Fertilizer News. 1994; 39(11):13-25.
6. Nedunchezhian P, Thirunavukkarasu M. Optimising Farm Plans in Different Farming Systems. Agricultural Economics Research Review. 2007; B:147-156.
7. Sharma GC, Gangwar B. Economic analysis of sugarcane production in Khadar area of Western U.P. Bhartiya Krishi Anusandhan Patrika. 2000; 15(½):69-75.
8. Singh SP, Gangwar B, Singh MP. Economics of Farming Systems in Uttar Pradesh. Agricultural Economics Research Review. 2009; 22:129-138.