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Economics of Sugarcane-based Farming System in Western Uttar Pradesh

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Abstract

Amongst 38 farming systems prevalent in the western Uttar Pradesh region, sugarcane–livestock–cereals–fodder has been found the major system being followed by a majority of the farmers. It has been found that sugarcane farmer keeps in general two dairy animals, largely for household milk consumption. The major income source of farmers in the area has been found sugarcane (58 per cent), followed by livestock and cereal crops. The study has revealed that marginal farmers take highest credit, while large farmers take minimum credit. It has also been observed that facility of Kisan Credit Card (KCC) is being availed by only 21 per cent farmers. Farming activity-wise analysis has revealed that sugarcane provides maximum employment, followed by livestock and wheat. In terms of income, the study has observed that a family worker earns Rs 41,270 per year in the study area, which is much lower than that in Punjab (Rs 74,080/year). The study has suggested that a combination of technology, policy and institutional innovations is needed for improvement in productivity and profitability of crops and livestock in the area.

Introduction

Sugarcane is an important cash crop in the western Uttar Pradesh. It has dominated the farming system in this region for a long time. Therefore, to explore the possibilities of raising farm production and farm income in this region, there is a need to understand sugarcane-based farming systems and their economics. The present study was carried out with the following specific objectives:

- Evaluation of the economic status of sugarcane-based farming systems in western UP, and
- Exploring the possibilities of optimum combinations of crop and non-crop enterprises for improving the income of farmers in the area.

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Methodology

Within western Uttar Pradesh, the Baghpat district characterizes high productivity and Ghaziabad represents low productivity district. Two blocks from each of these two districts and three villages from each block were selected using three-stage random sampling method. For selection of households different strata were drawn based on the prevailing farm enterprises. The households of marginal (<1 ha), small (1 to 2 ha), medium (>2 to 4 ha) and large (> 4 ha) groups were selected randomly for survey. In total 197 farmers, 101 from Baghpat and 96 from Ghaziabad district were interviewed. Out of 197 sample farmers, sugarcane provided highest gross income to 140 farm households. These farmers were identified as sugarcane-based farmers. The data pertained to the year 2004-2005.

Diversification at sugarcane growing farms was estimated using Harfindahal index (Theil, 1967;

Hakbart and Anderson, 1975) as per Equation (1):

$$HI = \sum_{i=1}^{n} P_i^2 \quad \ldots. (1)$$

where, $P_i = A_i / \sum_{i=1}^{n} A_{i,}$

i= 1,2,3….., n (Number of crop enterprises)

P_i is the proportion of area under crop, A_i is the area under the ith crop, and ΣA_i is the gross cropped area per ha.

The value of Harfindahal index varies from zero to one. It takes the value one when there is complete specialization and the value zero when there is a perfect diversification, i.e. it has inverse relationship with diversification.

Farm business income was computed by deducting the cost incurred on seeds, fertilizer, plant protection, hired human labour, farm machinery and implements, taxes, cess, water charges interest on working capital and expenditure on livestock maintenance, such as feed and fodder, mineral mixture, medicine and depreciation of owned-farm machinery, buildings and animals from gross return.

Results and Discussion

Profile of Farmers

The socio-economic characteristics of sample farmers have been presented in Table 1. Family size was found to increase with increase in farm size. Large farmers seemed to be supporting joint-family system as their average family size was above 13. The average family size in marginal, small, and medium farms was around 8.

More than 50 per cent of the family members were engaged in agricultural activities and about 30 per cent were the dependents. Remaining 20 per cent were in either regular or casual employment as labour.

Education profile of the family members shows that more than 10 per cent each male and female were graduates and 7 per cent postgraduates. Education index showed that family members of medium farmers were educated more than others. The education index was much lower for female than male.

For the sample as a whole, average size of operational holding varied from 0.73 ha for marginal farmers to 4.82 ha (Table 1) for large farmers. Incidence of leasing out land was found to increase with the increase in size of holdings.

Livestock-based farming was the second most important system being followed by the marginal, small and medium farmers. Buffalo was the important milch animal kept by the farmers, the average being 1.64/household. The local cow was kept only by some of the households. Crossbred cows were popular in the area and their number was about 40 per cent of the dairy buffaloes. Due to low fat content in cow milk and high fat content in buffalo milk, farmers generally keep mix of crossbred cows and buffaloes and sell their milk after mixing to get better prices.

Identification of Sub-farming Systems

The share of different farming systems in the gross farm income according to size of holdings has been presented in Table 2. Different activities of farming system including income earned by hiring out of farm machinery (FM) were arranged in the descending order and Sugarcane + Livestock+ Cereal+ Fodder system was found most important in terms of contribution to farm income in the area. Its share was more than 21 per cent. However, its importance declined with increase in the size of holding. Sugarcane+ Cereal+ Livestock+ Fodder system ranked second with 13.57 per cent share. Sugarcane and fodder were common to all farmers. However, a considerable portion of medium and large farmers had included farm machinery in farming.

Crop Diversification

Share of individual enterprises in the total farm income shows that sugarcane, cereal and livestock were the major farm enterprises, which contributed about 90 per cent to the farm income (Table 3). Sugarcane alone contributed more than 50 per cent to the total income and its share increased with the increase in the size of holding. Livestock was the

Table 1. Socio-economic characteristics of the sample farmers in western plains of UP

Characters	Marginal	Small	Medium	Large	All farms
Family size (No.)	8.92	7.90	9.36	13.52	9.77
Employment (No.)					
Regular salaried	0.93	0.84	0.54	0.65	0.91
Temporary salaried	0.22	0.18	0.05	0.09	0.17
Casual labour	0.07	0.02	0.13	0	0.11
Agricultural labour	4.74	4.9	5.38	8.17	5.69
Dependents	2.96	1.96	3.26	4.61	2.89
Education index*					
Male	9.23	8.79	10.65	10.01	9.6
Female	6.11	5.3	7.83	6.8	6.41
Total	7.95	7.33	9.42	8.62	8.24
Landholding in ha					
Owned land	0.73	1.52	2.88	5.5	2.4
Leased in	0.02	0.03	0	0	0.02
Leased out	0.02	0.09	0.38	0.69	0.25
Total operated area	0.73	1.47	2.5	4.82	2.16
Livestock population (No.)					
Milch cow (local)	0.33	0.25	0.1	0.3	0.24
Milch cow (crossbred)	0.26	0.37	0.56	0.74	0.46
Dairy buffaloes	1.04	1.57	1.74	2.3	1.64
Bullocks/ He buffalo	0.67	0.67	0.59	0.91	0.69
Calves	0.93	0.92	0.85	1.26	0.96
No. of fishes in pond	0	0	0	1739.13	285.71
Participation in cooperative membership (per cent)					
Primary Agril. Cooperative Societies (PACS) only	7.41	5.88	20.51	26.09	13.57
Farmers Service Cooperative Societies (FSCS) only	7.40	25.49	5.13	8.7	13.57
PACS and FSCS both	85.19	62.75	69.23	65.22	69.29
None members	0	5.88	5.13	0	3.57
Credit card holders (%)	2.14	10	6.43	2.86	21.43

*Education index $EI_i = \sum_{i=1}^{6} w_i f_i / \Sigma f_i$ (illiterate=0, primary=1, middle=2, matric= 3, twelveth = 4, graduate=5 and post- graduate=6) where, w_i = weights (0 to 6) and f_i = No. of family members

second most important source of farm income, but its share declined with increase in the farm size, so much so that income from cereals could achieve same /higher level for marginal and small farmers.

Sugarcane – wheat (cereal) was the major farming system in terms of area coverage, about 84 per cent of the total cropped area in western plains of UP (Table 4). As farm-size increased the area under wheat decreased and area under sugarcane increased. It indicated that marginal and small farmers were more dependent on the wheat crop for their food security, while medium and large farmers were more interested in growing sugarcane being a cash crop. Some other reasons for the popularity of sugarcane were: (i) Sugarcane being a hardy crop, can tolerate more / less or water/delay in harvesting, (ii) There is less risk from wild animals, and (iii) Sugarcane mills provide good service and the government provides price support for this crop. Vegetable crops like cucumber, green pea, cauliflower, onion, ladyfinger, pumpkin, radish, spanish, brinjal, luffa, and potato were found to be grown on 3.59 per cent area in the western plains.

Table 2. Identification of sub-farming systems in western plains of UP

(in per cent)

Sl. No.	Farming system	Marginal	Small	Med	Large	All farms
1	S.Cane+ Fodder	3.70	0.00	0.00	0.00	0.71
2	S.Cane+ Cereal	**7.41**	0.00	0.00	0.00	1.43
3	S.Cane+ Cereal+ Fodder	0.00	7.84	0.00	0.00	2.86
4	S.Cane+ Cereal+ Fodder+ Livestock	0.00	0.00	5.13	8.70	2.86
5	S.Cane+ Cereal+ Mustard+ Livestock+ F M*+ Fodder	0.00	0.00	5.13	8.70	2.86
6	S.Cane+ Cereal+ Livestock	3.70	1.96	0.00	0.00	1.43
7	**S.Cane+ Cereal+ Livestock+ Fodder**	**11.11**	**17.65**	**12.82**	**8.70**	**13.57**
8	S.Cane+ Cereal+ Livestock+ Fodder+ Mustard	0.00	3.92	2.56	0.00	2.14
9	**S.Cane+ Cereal+ Livestock+ F M+ Fodder**	0.00	1.96	**12.82**	**21.74**	7.85
10	S.Cane+ Cereal+ Livestock+ Vegetable+ Fodder	**7.41**	3.92	2.56	0.00	3.57
11	S.Cane+ Cereal+ Livestock +Mustard+ Fodder+ Orchard	0.00	0.00	0.00	13.05	2.13
12	S.Cane+ Cereal+ Pulses+ Livestock+ Vegetable+ Fodder	0.00	0.00	0.00	4.35	0.71
13	S.Cane+ Vegetable+ Livestock+ Fodder	3.70	0.00	0.00	0.00	0.71
14	S.Cane+ Vegetable+ Livestock+ Fodder+ Cereal	0.00	5.88	2.56	0.00	2.86
15	S.Cane+ Vegetable+ Cereal+ Livestock+ Fodder+ FM	0.00	0.00	2.56	4.35	1.43
16	S.Cane+ Livestock+ Cereal	**14.81**	0.00	0.00	4.35	3.57
17	**S.Cane+ Livestock+ Cereal+ Fodder**	**37.04**	**21.57**	**17.95**	**8.70**	**21.43**
18	S.Cane+ Livestock+ Cereal+ Fodder+ Orchard	0.00	3.92	0.00	0.00	1.43
19	S.Cane+ Livestock+ Cereal+ Fodder+ Vegetable	7.41	5.88	2.56	0.00	4.29
20	S.Cane+ Livestock+ Cereal+ Fodder+ Mustard	0.00	3.92	2.56	0.00	2.14
21	S.Cane+ Livestock+ Cereal+ Fodder+ Pulses	0.00	1.96	2.56	4.35	2.14
22	**S.Cane+ Livestock+ Cereal+ F M+ Fodder**	**0.00**	**7.84**	**10.26**	**4.35**	**6.43**
23	S.Cane+ Livestock+ Cereal+ Mustard+ F M +Fodder	0.00	3.92	0.00	0.00	1.43
24	S.Cane+ Livestock+ Cereal+ Vegetable+ Mustard+ Fodder	3.70	0.00	2.56	0.00	1.43
25	S.Cane+ Cereal+ Livestock +others	**0.00**	**7.84**	**17.92**	**4.35**	**7.82**

Note: F.M indicates farm machinery

Table 3. Per farm gross income from different components of farming systems in western plains of UP

(in per cent)

Particular	Marginal	Small	Medium	Large	All farms
Size of holding (ha)	0.73	1.52	2.88	5.50	2.40
Cereal	17.23	15.47	14.84	14.94	15.55
Sugarcane	54.45	55.47	61.26	62.32	58.01
Vegetables	2.45	3.40	2.64	2.74	2.90
Pulses	0.00	0.18	0.86	0.71	0.42
Fodder	4.30	5.35	4.97	5.09	5.00
Mustard	0.00	0.44	0.55	0.59	0.41
Orchard	0.00	0.14	0.27	0.60	0.22
Livestock	21.56	18.47	13.27	11.45	16.46
Income from hiring out of farm machinery	0.00	1.09	1.34	1.56	1.03
Total	100.00	100.00	100.00	100.00	100.00
Gross income (Rs)	78990	145762	239508	430371	205758

Table 4. Crop diversification and cropping pattern under sugarcane-based farming system in western plains of UP

Range	No. of farmers	Average CDI Value	Area, %						
			Vegetable	Orchard	Pulses	Oilseed	S.cane	Fodder	Cereal
Marginal	27	0.4334	2.18	0.00	0.00	0.00	52.12	15.03	30.67
Small	51	0.3810	3.18	0.30	0.31	0.99	51.27	16.87	27.09
Medium	39	0.3933	2.07	0.95	0.38	1.53	53.51	15.41	26.16
Large	23	0.3901	1.98	1.08	0.94	1.40	53.95	14.27	26.38
All farms	140	0.3961	2.48	0.55	0.37	1.02	52.50	15.68	27.41

CDI – Crop diversification index

Table 5. Credit disbursement in sugarcane- based farming system in western plains of UP

(Rs/ha)

Farm size	Institutional				Non - institutional				Total
	Short-term	Medium-term	Long-term	Sub-total	Short-term	Medium-term	Long-term	Sub-total total	
Marginal	1589.51	8916.13	0.00	10505.6	0.00	2041.25	0.00	2041.25	12546.88
	(12.67)	(71.06)	(0.00)	(83.73)	(0.00)	(16.27)	(0.00)	(16.27)	(100.00)
Small	97.32	4022.41	4949.62	9069.35	0.00	0.00	980.39	980.39	10049.74
	(0.97)	(40.03)	(49.25)	(90.24)	(0.00)	(0.00)	(9.76)	(9.76)	(100.00)
Medium	0.00	1375.92	6451.97	7827.89	0.00	0.00	0.00	0.00	7827.89
	(0.00)	(17.58)	(82.42)	(100.00)	(0.00)	(0.00)	(0.00)	(0.00)	(100.00)
Large	21.74	2355.01	2867.67	5244.42	0.00	0.00	0.00	0.00	5244.42
	(0.41)	(44.91)	(54.68)	(100.00)	(0.00)	()0.00	(0.00)	(0.00)	(100.00)
All farms	345.57	3958.60	428.67	8732.85	0.00	393.67	357.14	750.81	9122.94
	(3.64)	(41.74)	(46.70)	(92.08)	(0.00)	(4.15)	(3.77)	(7.92)	(100.00)

Note: Figures within the parentheses are percentages to the total

The government may encourage the farmers towards these crops, depending upon the need. These crops provide higher returns and more employment.

Marginal farmers showed the least diversification among all farm-size categories. Crop diversification as measured by Herfindhal index showed very little variation across other farm-size categories.

Credit Availability

Credit plays a very important role in diversification towards cash and high-value crops and in promoting use of modern inputs. The per hectare credit borrowed by different categories of farmers was inversely related to farm-size (Table 5). Marginal farmers borrowed the highest amount (Rs12, 546), while large farmers borrowed the lowest credit (Rs 5244). It indicated that credit requirement of large size farmers was less than that of smaller farm-size categories. Also, the marginal and small farmers were more dependent on non-institutional agencies for credit. It can be interpreted that large farmers were more sound financially than other farm categories. It was also observed that about 79 per cent farmers were not having Kisan Credit Cards (KCC), i.e. only about 21 per cent farmers were holders of KCC. It was found that the marginal farmers preferred to take medium-term credit while the other farm categories opted for both medium- and long-term credits.

Employment in Different Farm Activities

Human labour employment is a vital issue in farm activities. To identify labour-intensive farm enterprises, per farm and per hectare employment

Table 6. Farm enterprise-wise employment generated by sample households in western plains of UP

(human-days/year)

Crops	Marginal	Small	Medium	Large	All farms
			Per farm		
Onion	6	1	1	2	2
Potato	0	4	5	6	4
Other vegetables	1	4	5	13	5
Orchard	0	1	5	12	4
Sugarcane	78	148	256	483	220
Fodder	18	30	41	69	37
Wheat	37	56	85	163	78
Other cereals	1	6	12	26	10
Pulses	0	1	1	5	1
Mustard	0	2	6	6	4
Animal	65	77	97	93	83
Sub-total	205	329	514	877	447
			Per hectare		
Onion	163	167	175	163	165
Potato	0	188	188	181	186
Other vegetables	150	55	88	138	87
Orchard	0	188	173	179	178
Sugarcane	119	118	116	119	118
Fodder	76	72	66	73	71
Wheat	88	88	86	88	87
Other cereals	138	131	108	140	125
Pulses	0	97	35	63	56
Mustard	0	98	80	55	74
Sub-total	73	120	112	120	115
Livestock	106	59	37	28	57
Total	179	179	149	148	172

level was estimated and has been given in Table 6. It revealed that on an average a farm employed labour for 447 human -days in all farming activities.

Farming activities-wise analysis showed that sugarcane generated maximum (220 human- days) employment, followed by livestock (83 human- days) and wheat (78 human-days) per farm / year. The total labour employed per farm per year was least (205 human-days) on marginal farms and maximum (877 human-days) on large farms.

The per hectare analysis (Table 6) revealed that crops like potato and onion provided more employment than by other vegetables. Sugarcane provided an average employment of 118 human- days/ ha/ year. From size-wise analysis did not indicate any clear pattern about the use of labour in crop production. However, in the livestock activity, the per hectare labour employment declined with increase in farm size. Therefore, it is suggested that farmers may be guided to grow more fruits and vegetables to generate more rural /agricultural employment.

Cost of Crop Production

Crop-wise cost of production by different farm-sizes has been given in Table 7. The average cost of production was found highest for potato (Rs 37,259/

Table 7. Crop-wise input cost in different crops in sugarcane- based farming system in western plains of UP

(Rs/ha)

Crops	Marginal	Small	Medium	Large	All farms
Onion	25633	20453	21366	22370	23730
Potato	-	38664	39418	34033	37568
Other vegetables	14768	14179	15970	18812	15835
Sugarcane	28696	29116	29487	32497	30418
Fodder	8368	7856	7667	8682	8083
Wheat	12600	13021	11678	12106	12256
Other cereals	13238	14109	11867	15310	13655
Pulses	-	8438	3471	5119	4868
Mustard	-	8291	6652	5948	6696
Cost of crop production	19995	20425	20563	22811	21259

Table 8. Cost of input-use in crop production under sugarcane-based farming system in western plains of UP

(Rs/ha)

Inputs	Marginal	Small	Medium	Large	All farms
Seed	3911	4162	4443	4311	4286
	(19.56)	(20.38)	(21.61)	(18.90)	(20.16)
Fertilizer	3196	3050	2761	4739	3547
	(15.98)	(14.93)	(3.43)	(20.78)	(16.68)
Insecticide/ Weedicides	363	261	353	204	279
	(1.82)	(1.28)	(1.72)	(0.89)	(1.31)
Irrigation charges	1273	1447	1509	1558	1493
	(6.37)	(7.08)	(7.34)	(6.83)	(7.02)
Labour	4128	4108	3979	4160	4085
	(20.65)	(20.11)	(19.35)	(18.24)	(19.22)
Machinery	4050	4233	4045	4113	4117
	(20.26)	(20.72)	(19.67)	(18.03)	(19.37)
Transport/MC	3073	3164	3473	3726	3451
	(15.37)	(15.49)	(16.89)	(16.33)	(16.23)
Cost of crop production	19995	20425	20563	22811	21259
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Note: Figures within the parentheses are percentages to the total

ha), followed by sugarcane (Rs 30,418/ha) and onion (Rs 23,730/ha). The item-wise input cost (Table 8) for all farm categories was maximum on seed (Rs 4286/ha), followed by farm machinery (Rs 4117/ha) and labour (Rs 4085/ha) The analysis indicated that labour, farm machinery, seed, fertilizer and marketing were the major cost components of crop production and constituted about 92 per cent of the total cost. It is worth mentioning here that expenditure on insect and pest management was found negligible in this area.

Farm Business Income

The source-wise income, presented in Table 9, for all farms has been found as Rs 28, 3943 during the year 2004-05. The per capita total family income (Table 10) in all farm categories has been found higher (Rs 29062/year) than the poverty level (Rs 16,425 / year).

The income per earner, calculated by dividing the annual farm business income by the number of earning family members was found as Rs 41,270 in

Table 9. Sources of gross farm family income over various farm-size categories in sugarcane-based farming system in western plains of UP : 2004-2005

(Rs/ ha)

Farm size	Crops	Livestock	Non-farm Income	Total
Marginal	60384	18606	72667	151656
	(39.82)	(12.27)	(47.92)	(100.00)
Small	117434	26583	76667	220684
	(53.21)	(12.05)	(34.74)	(100.00)
Medium	201613	34113	90987	326714
	(61.71)	(10.44)	(27.85)	(100.00)
Large	388878	34254	83848	506980
	(76.7)	(6.76)	(16.54)	(100.00)
Total	174476	28403	81065	283943
	(61.45)	(10.00)	(28.55)	(100.00)

Note: Figures within the parentheses are percentages to the total

the study zone, which was much lower than that in Punjab (Rs 74,080) during 2002-03 (Joshi *et al.*, 2003).

The farm business income per earner ranged from Rs 25,445 /year for marginal farmers to Rs 56,900/ year for large farmers. The analysis indicated that per earner income increased as farm- size increased.

Conclusions

It has been found that sugarcane and wheat are the dominant farming systems in the western plains of Uttar Pradesh. A majority of the farmers keep dairy animals also for household consumption. Small farmers sell milk to enhance their family income. Utilization of credit facility to diversify the farm business has been found very low.

The study has observed that farmers of the area follow traditional farming systems, which do not provide adequate income for a good living. There is a need to develop low cost technologies to bring down the cost of cultivation. Technologies like simultaneous planting of sugarcane with wheat using improved varieties and site-specific nutrient management with emphasis on balanced nutrition deserve due attention for increasing profitability of sugarcane-based farming systems (Anonymous, 2007). Emphasis should be given to develop heat-tolerant varieties of sugarcane and wheat crops to mitigate the effect of climate change, as suggested by Singh *et al*. (2006). Suitable varieties of basmati rice should be developed. Farmers need to be encouraged to adopt high-value low- volume crops, including medicinal and aromatic plants, high productive dairy animals, fisheries, poultry, piggery, bee-keeping etc, in the region. There is a need to create avenues for non-farm employment also. Due to their poor purchasing power, marginal and small farmers find it difficult to purchase inputs and farm implements for adoption of improved technologies. Therefore, strong efforts of government are needed to further strengthen the banking infrastructure to extend adequate credit facilities to the farmers. To develop confidence among farmers about government launched programmes, involvement of farmers at the planning as well as implementation stage is essential. Sugarcane is the main crop of the area and farmers are compelled to sale their 30-40 per cent cane to

Table 10. Per capita and per earner farm business income and total family income over various farm-size categories in sugarcane-based farming system in western plains of UP

(Rs / year)

Farm categories	Farm business income		Total family income	
	Per capita	Per earner	Per capita	Per earner
Marginal	8855	16664	17001	25445
Small	18230	29391	27934	37152
Medium	25184	43815	34905	53559
Large	31296	51790	37498	56900
Total	20765	35655	29062	41270

private crushers at lower rates. Concentrated efforts at government level are needed to either increase crushing capacity of the existing sugar mills or establish new sugar mills in the area. A combination of technology, policy and institutional innovations is needed for improvement in productivity and profitability of crop and livestock sectors in the area, as has been suggested by Birthal *et al.* (2006) also.

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