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(iv) Production of sugarcane was not affected by the price changes in other crops, but price changes in sugarcane affected the production of other *kharif* crops such as maize, jowar, bajra and cotton inversely.

It was hypothesised that price elasticity, cross elasticity, etc., were inter-related and could be estimated with greater reliability through multiple regression analysis. This technique was used to examine the influence of wheat prices and other factors on acreage of wheat. Time series data were used (1950-51 through 1961-62) to run regression analysis after transforming the data in logarithms.

The regression analysis gave the following results :

$$Y = 0025 + 3.4253 \, x_1, - .4262 \, x_2 + .1015 \, x_3 + .0044 \, x_4$$
$$\quad\quad\;\; (.8697) \quad\quad (.1475) \quad\;\; (.1101) \quad\;\; (.0207)$$

where Y represents wheat acreage in the following year,

x_1 price of wheat in the preceding harvest,
x_2 price of gram in the preceding harvest,
x_3 rainfall (September to October),
x_4 time variable.

The figures in parenthesis indicated standard errors of corresponding regression coefficients.

The results showed that price elasticity of wheat acreage was 3.4253 which was significant at one per cent. This means wheat acreage responded to changes in the price of wheat in a significant way over a period of 1950-51 through 1961-62. But this acreage elasticity could not be compared with production elasticity obtained in Table III. Cross elasticity of wheat acreage relative to gram prices was obtained at —.4262 and was significant at 5 per cent. This means, rise in the price of gram would affect wheat acreage adversely. Rainfall and time factor indicated positive influence on crop acreage but the coefficients were not significant. The results of the study showed that prices of competing crops should be fixed simultaneously to achieve production targets.

RESPONSIVENESS OF RELATIVE AREA—OUTPUT OF SUGARCANE AND RICE TO CHANGES IN THEIR RELATIVE PRICES IN UTTAR PRADESH : 1954-63

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It is proposed to discuss in this paper the behaviour of price, area under and output in respect of rice and sugarcane in Uttar Pradesh during the period 1954-55

to 1962-63. The discussion is made at two levels : (i) the price of each of these two crops *vis-a-vis* its area—output; (ii) the relative price of the two crops *vis-a-vis* their relative area—output.

Both rice and sugarcane are important crops in the agricultural economy of this State. From the standpoint of area covered, paddy is the most important crop in U.P. Rice alone covered 19.8 per cent of area under all crops in U.P. in the year 1961-62. Sugarcane is the most important of all commercial crops in the State and it occupies the fifth position in area covered.[1]

While importance of the two crops in the economy of the State has been one of the reasons for selecting them for our discussion here, the more important reason has been the nature of their substitutability in cultivation. It is well-known that the land suited for rice cultivation is generally suited for sugarcane cultivation also. It is this substitutability that forms the major theme of our study and hence its importance in the selection of the two crops.

The data used in this study have been mainly taken from the *Monthly Bulletin of Statistics* issued by the Bureau of Economics and Statistics, Government of Uttar Pradesh.

Only elementary and very simple statistical techniques have been used in this paper as they were considered to be adequate to bring home the findings of this study. The value of more advanced techniques in the analysis of relative responsiveness of area—output to relative changes in prices is, no doubt, recognised by the author.

Behaviour of Price, Area and Output of Rice

In Table I are given the price of rice, the area under the crop and its output during the years 1954-55 to 1962-63. In order to have a more precise idea about the changes in these variables, their index numbers have also been constructed with 1954-55 as the base year and these index numbers are also given in the Table.

As could be seen from Table I the price of rice has been fluctuating from year to year. There has been both upward and downward fluctuations. But when we take the area under rice the year to year fluctuation does not appear to be any significant. In fact there has been a steady increase in area under the crop over the

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1. The details of area under some of the important crops in the State for the years 1961-62 and 1962-63 are given below :

('000 hectares)

| Crop | Years | | Crop | Years | |
	1961-62	1962-63		1961-62	1962-63
Rice	4,239	4,223	Sugarcane	1,363	1,272
Wheat	4,102	4,039	Maize	1,086	1,078
Gram	2,576	2,440	Peas	1,038	1,077
Barley	1,824	1,671	Bajra	969	1,034

TABLE I—PRICE, AREA AND OUTPUT OF RICE IN U.P. : 1954-55 TO 1962-63

Years		Price		Area		Output	
		Rs. per quintal	Index No.	In'000 hectares	Index No.	In'000 quintals	Index No.
1		2	3	4	5	6	7
1954-55	..	38·61	100·00	3,671	100·00	21,909	100·00
1955-56	..	39·25	101·66	3,762	102·25	24,709	112·77
1956-57	..	38·07	98·60	3,857	104·83	21,163	96·59
1957-58	..	57·07	147·81	3,897	105·92	23,365	106·64
1958-59	..	55·62	144·06	4,122	112·04	30,307	138·32
1959-60	..	47·29	122·48	4,140	112·53	24,074	109·87
1960-61	..	50·80	131·57	4,239	115·22	30,755	140·37
1961-62	..	51·63	133·72	4,168	113·29	33,778	154·16
1962-63	..	49·03	126·99	4,271	116·09	31,016	141·56

years included except in 1961-62 when there was a slight fall in the area. So also when we consider the output, this has been showing a steady upward tendency except for the years 1956-57 and 1959-60 when the output fell over that of the preceding years. In spite of the fluctuation in price the upward buoyancy of price existing throughout the period or that of the expected price must have probably boosted up the farmers' tendency to bring more and more area under the crop and also to increase the production.

One way of assessing the farmers' responsiveness to changes in prices would have been to relate each year's change in price to the subsequent year's (taking account of the time lag of a crop year) area—output and then to work out a correlation coefficient. Though this technique is useful and of immense value we have made use of only still simpler techniques in finding their inter-relationship. Straight line trends have been fitted to price, area and output data which gives the approximate annual rates of change in the three variables. These are presented in Table II.

TABLE II—AVERAGE ANNUAL RATE OF CHANGE IN PRICE, AREA AND OUTPUT OF RICE
1954-55 TO 1962-63

Variable	Average annual rate of change (as worked out by fitting straight lines)
Price	+ 4·08 %
Area	+ 2·08 %
Output	+ 6·35 %

As could be seen, the price of rice has been increasing at a rate of about 4.08 per cent per annum over the period of 9 years while the area has been increasing at about 2.08 per cent per annum. On the other hand, the output has increased at a relatively faster rate (6.35 per cent) compared to the rate of increase in price. Taking the period as a whole, there appears to have been positive relationship between price of rice and both area and output of it. This relationship has been more marked in the case of price and output than between price and area.

The other crop which we are considering is sugarcane and in Table III are given the price, the area under this crop and its output over the years 1954-55 to 1962-63.

TABLE III—PRICE, AREA AND OUTPUT OF SUGARCANE IN U.P.: 1954-55 TO 1962-63

Years	Price		Area		Output	
	Rs. per quintal	Index No.	In '000 hectares	Index No.	In '000 quintals	Index No.
1	2	3	4	5	6	7
1954-55	3·30	100·00	928	100·00	287,321	100·00
1955-56	3·49	105·75	1,101	118·68	288,852	100·53
1956-57	4·33	131·20	1,241	133·78	355,342	123·67
1957-58	4·15	125·74	1,227	132·27	311,919	108·56
1958-59	4·29	129·99	1,112	119·87	312,515	108·77
1959-60	4·31	130·59	1,191	128·39	325,430	113·26
1960-61	3·91	118·47	1,329	143·27	396,047	137·84
1961-62	3·95	119·69	1,363	146·93	515,370	179·37
1962-63	4·92	149·08	1,262	136·04	438,933	152·77

The related index numbers have also been worked out and are given in the same table. The year to year price fluctuations have been more marked in the case of this crop than in the case of rice, though the upward tendency is well marked here also. When we take the area under sugarcane, except for a significant fall in the year 1958-59 and for a negligible fall in the year 1957-58 there has been a steady rise in the area under sugarcane throughout the period. So also the output has been increasing more or less regularly.

The trend lines fitted to the price, area and output of this crop showed rates of changes in those variables as given in Table IV.

As could be seen from Table IV, the rates of increase in the case of both area and output have been more than that of price. The price of sugarcane increased on an average by 3.63 per cent while the area increased by 4.06 per cent and the output by 8.01 per cent per annum.

TABLE IV—AVERAGE ANNUAL RATE OF CHANGE IN PRICE, AREA AND OUTPUT OF
SUGARCANE : 1954-55 TO 1962-63

Variable	Average annual rate of change (as worked out by fitting straight lines)
Price	+ 3·63 %
Area	+ 4·06 %
Output	+ 8·01 %

If it is assumed that other factors remained the same, in the case of both rice and sugarcane it could be said that the area as well as output were responsive to changes in price.

When we take the price of either of the two crops relative to the other and compare the variation in its area—output relative to the other a slightly different result seems to emerge.

In Table V are given the price of sugarcane, area and output expressed as a proportion to similar variables in respect of rice. In order to have a clearer idea as to how these relative variables behaved index numbers have been prepared of the relative prices, relative area and relative output and are given along with the variables in the table. As was done in the earlier discussions, trend lines were

TABLE V—PRICE, AREA AND OUTPUT OF SUGARCANE RELATIVE TO THOSE OF RICE
1954-55 TO 1962-63

Years	Price Relative	Index No.	Area Relative	Index No.	Output Relative	Index No.
1	2	3	4	5	6	7
1954-55　..	0·085	100·00	0·252	100·00	13·11	100·00
1955-56　..	0·089	104·66	0·293	116·26	11·69	89·17
1956-57　..	0·114	134·06	0·322	127·77	16·79	128·07
1957-58　..	0·073	85·85	0·315	124·99	13·35	101·83
1958-59　..	0·077	90·55	0·270	107·14	10·31	78·64
1959-60　..	0·091	107·02	0·288	114·28	13·52	103·13
1960-61　..	0·077	90·55	0·314	124·60	12·88	98·25
1961-62　..	0·076	89·38	0·327	129·75	15·26	116·40
1962-63　..	0·100	117·60	0·295	117·06	14·15	107·93

fitted to these index numbers and the annual percentage changes in these, so obtained, are given in Table VI.

TABLE VI—AVERAGE ANNUAL RATE OF CHANGE IN RELATIVE PRICE, AREA AND OUTPUT OF SUGARCANE: 1954-55 TO 1962-63

Variable	Average annual rate of change (as worked out by fitting straight lines)
Relative Price	— 0·69 %
Relative Area	+ 1.53 %
Relative Output	+ 0·92 %

It could be seen from Table VI that while the price of sugarcane relative to that of rice had been declining at about 0.7 per cent per annum, its area and output relatively to that of the same crop has been increasing at about 1.5 per cent and 0.9 per cent respectively per annum.

While the earlier two analyses of the behaviour of area—output of individual crops in response to each of their prices does not leave much to be said as it was what would be expected under normal conditions, the fact that in spite of a decline in relative prices the relative area—output of sugarcane increased at a significant rate needs to be explained. In order to explain this it would be necessary to go a little further and enquire into the cost-return relationship of the two crops. In Table VII is given the value of output per hectare of both the crops for the period 1954-55 to 1962-63.

TABLE VII—VALUE OF OUTPUT PER HECTARE OF RICE AND SUGARCANE 1954-55 TO 1962-63

Years	Value of Output per hectare (Rs.)	
	Rice	Sugarcane
1954-55	226·76	1,021·72
1955-56	257·79	919·10
1956-57	208·89	1,239·83
1957-58	342·13	1,054·98
1958-59	408·92	1,205·66
1959-60	274·94	1,177·66
1960-61	388·55	1,165·19
1961-62	418·41	1,493,55
1962-63	356·06	1,711·21

There is a large disparity in the value of output per unit of land between the two crops. Throughout the period the value of output per hectare of sugarcane has varied between four and five times of that of rice. This, of course, is the gross value and before we draw any inference it is also necessary to know the cost of cultivating a unit of land for each of the crops and also the net return.

There are no data available for the whole of U.P. as such giving the cost of cultivation per unit of land and that for all the years included in this study. We may, however, draw upon certain existing studies to have some idea about cost-net return differences. One such available source is the Studies in Farm Management conducted in two selected districts of U. P. under the auspices of the Ministry of Food and Agriculture, Government of India.[2] Under this, the cost of production per unit of area under sugarcane as well as rice has been studied. Again, the Agricultural Economics Research Centre of the Delhi School of Economics conducted a study in Deoria District of U. P. on farmers response to prices and marketing policies affecting sugarcane and paddy in the year 1961-62[3] and from this study also cost of cultivation with regard to the two crops is available. These are summarised in Table VIII.

TABLE VIII—VALUE OF OUTPUT, COST OF PRODUCTION AND NET RETURN PER HECTARE IN RESPECT OF SUGARCANE AND RICE

(Rupees)

Variable	Delhi Study (1961-62)		Farm Management (1956-57)	
	Rice	Sugarcane	Rice	Sugarcane
Value of output per hectare	441·8	1,641·0	403·7	1,204·6
Cost per hectare	170·9	303·2	295·0	761·6
Net return per hectare	270·9	1,112·0	108·7	443·0

In the two studies cited also, the gross return per hectare of sugarcane is between 4 and 5 times of that of the gross return per hectare of rice. As against this the cost of production in the case of the former is between two to three times of that of the latter. These studies were conducted in different districts of U.P. and in different years. Even then the nature of the cost and returns being so similar it is possible to take them as largely indicative of the cost-return relationship between the two crops in the State as a whole. The obvious conclusion that follows is that during the period under study the net return per hectare from sugarcane cultivation was much more than that from rice (about four to five times). Similarly, the cost of cultivating a hectare of sugarcane was also much more than cultivating a hectare of rice.

To a large extent these findings could be used to explain the peculiar result that we got in our earlier analysis that the relative area—output of sugarcane vis-a-vis rice behaved in the reverse direction of their relative prices. There is, as could be seen, a wide gap in the net returns received and the change in relative price compared to the existing gap was so small that this gap continued to be still very wide. Hence bringing of more and more area under sugarcane was still economically beneficial to the farmer. As long as the gap continues to be wide the type of response that we have seen may be expected to continue also.

        2. Studies in Economics of Farm Management in Uttar Pradesh, Report for the year 1956-57, 1960.
        3. S. C. Gupta and A. Majid : Farmers Response to Prices and Marketing Policies Affecting Sugarcane and Paddy, 1962 (Mimeo).

Incidentally a question that arises is as to why this gap continues to be there and the rice producing farmers are not taking advantage of the situation. Apparently there are two reasons for the large disparity in income per unit of the two crops: (i) the subsistence character of our agriculture and (2) the dearth of capital with the farmer. A large number of farmers in India, needless to say, are interested in producing their own consumption requirement of foodgrains. Thus foodgrains production for their own consumption is the first demand on their land. It is usually only after meeting this that they take to other crop enterprises. In this, economic considerations rarely enter into the calculations of the farmers. There are other factors like the particular variety of a foodgrain that the farmer and his family prefer for their consumption which enter into their consideration in this more or less economically irrational allocation of land.

The dearth of capital is no less a serious consideration. The fact that a relatively very small amount of capital can see him through rice cultivation compared to sugarcane also prompts a farmer to take to it in preference to the latter. Another contributing factor in this is the cost of borrowing. The rate of interest in rural areas continues to be still very high.

Reverting to the main theme of this paper, there are two major factors that brought about more area and more output in the case of sugarcane relatively to that of rice in spite of a decline in its relative price:

(1)   There was existing a wide gap in the return per hectare of sugarcane over that of rice throughout the period so that additional area brought under sugarcane was still highly profitable.

(2)   There was also the fact that area under rice also increased during this period. This may have had two effects. On the one hand, it may have increased the area above the subsistence size for some farmers thus enabling them to put more and more area to other crops. Again the larger income accruing as a result of both increased price and increased cultivation may have given the farmers larger surplus for ploughing back and in turn may have encouraged them to bring more and more area under sugarcane which could not be cultivated due to shortage of capital earlier.

Under conditions of perfect competition (where none of the factors of production is a bottleneck) the difference between marginal returns and therefore of average returns of two types of crops (which can be substitutably grown) may be non-existent and hence a shift in relative price is likely to bring about a similar shift in relative area—output. However, such a change need not be expected under conditions as found in this study where there is existing a large difference in the marginal returns.