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hand and the level of farm productivity on the other. The exorbitant rise in the prices of modern farm inputs like fertilizer, irrigation and plant protection measures restricted their use by the farmers and thereby reduced the level of productivity in recent years. Therefore, to maintain the tempo of increased productivity, the prices of modern farm inputs should not be allowed to rise beyond the reach of the majority of the farmers.

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## IMPACT OF INCREASE IN THE PRICES OF FERTILIZERS ON THE PRODUCTION AND PROFITABILITY OF HIGH-YIELDING VARIETIES OF RICE AND WHEAT CULTIVATION

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*Introduction*

Fertilizer is one of the most important inputs in agricultural production. This is particularly so in the context of modern agricultural technology which devolves round high-yielding varieties programme. The high-yielding varieties of various crops are very responsive to the application of fertilizers upto fairly high doses. Fertilizer is also the one input which utilizes maximum share of cash resources of the farmers. Therefore, the demand for fertilizers is bound to be highly sensitive to any change in its price. On the other hand, the consumption of fertilizers influences the production to a great extent. Although high-yielding varieties have been developed for a number of crops, their cultivation on a large-scale is mainly confined to rice and wheat crops. In this paper an attempt has been made to study the impact of increase in the price of fertilizer on the production and profitability of rice and wheat cultivation under cultivators' conditions.

*Impact of Increase in the Price of Fertilizer on Production and Profitability*

If a farmer is not working under resource constraint he would continue to utilize any one input to a level that the marginal physical return from that input is equal to the ratio of its price to the price of the output or in other words as long as its use is remunerative. That, however, is not the real situation. Most of the farmers in India have little resources and any increase in the price of one or more inputs forces him to utilize it at a lower level and this definitely affects production. The type and quality of change will, however, depend upon the type of relationship between the input and the output. If there is a linear relationship between the two the production is bound to decrease due to an increase in the price of the input at whatever level the input might be used. If, on the other hand, there is a non-linear relationship between

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the two, the type and magnitude of change may also depend upon the level at which the input is being utilized.

In order to study the impact of increase in the price of the input on profitability it will be appropriate to consider two types of situations, *viz.*, (*i*) when the price of the produce is not affected by an increase in the price of the input and (*ii*) when there is a corresponding increase in the price of the output for any increase in the price of the input. Under a linear relationship however between the input and the output the profit of the farmer is bound to go down as the price of the input increases. Under a non-linear relationship, however, there will be a decrease or increase in profit as the production decreases or increases. Now let us see what happens when the prices of both input and output increase in the same proportion. Obviously under a linear relationship, although the production will decrease there will not be any change in the profit of the farmer. On the other hand, under a non-linear relationship the increase in the price of input may lead to a profit or loss depending upon the type of relationship and also the level at which the input is being utilized.

*Data Utilized*

Such studies were undertaken with the help of the data available from the following schemes : (*i*) Simple fertilizers trials on cultivators' fields and (*ii*) Sample surveys for assessment of high-yielding varieties programme, for *kharif* and *rabi* seasons of 1972-73 and 1973-74. Although all the important cereals, *viz.*, rice, wheat, jowar, maize and bajra were covered under the schemes the present study is confined to only rice and wheat crops. Under the former scheme experiments on cultivators' fields are conducted under conditions of adequate water supply. In the series known as 'type A experiment,' nitrogen at 40, 80, 120 and 160 kg./ha. is applied over a uniform level of phosphorus and potassium (60 kg. $P_2O_5$ and 60 kg. $K_2O$/ha.) and zinc over a uniform basal level of nitrogen, phosphorus and potassium (120 kg.N, 50 kg. $P_2O$ and 60 kg. $K_2O$/ha). In the series known as 'type B experiment,' the responses of phosphorus over a uniform basal level of nitrogen and potassium and to potassium over a uniform basal level of nitrogen and phosphorus were studied. These treatments helped in studying the type and magnitude of response to nitrogen, phosphorus and potash separately. Each selected district was divided into three homogeneous zones by suitably combining contiguous tahsils/taluks/sub-divisions/revenue circles on the basis of climate, soil, cropping pattern, etc. In each zone two blocks each consisting of 50-100 villages were selected and from each block 8 villages were randomly selected. From each selected village two cultivators were randomly selected for conducting type A and B trials in one field each. Although the scheme was implemented in a large number of districts only a few districts, *viz.*, Chitradurga and Cuddapah (both Andhra Pradesh) for *kharif* and *rabi* rice and Sangrur (Haryana), and Fatehpur (Uttar Pradesh) for wheat were selected for the present study.

Under the scheme "Sample surveys for assessment of high-yielding varieties programme" crop-cutting experiments were conducted on a sample of 80 fields growing high-yielding varieties of the crops under study using "stratified four-stage random sampling" in 88 districts spread over 15 States of the country. The strata were the community development blocks or groups thereof, the sampling units at the various stages being villages, cultivators and fields growing high-yielding varieties of the crops under study and a plot of specified shape and size within the selected field. The selection of the sample was done with equal probability and without replacement. In addition to the data on yield, ancillary information on the doses of fertilizers given and other agronomic practices followed by the farmer in the selected fields were also collected. However, since a good deal of variation exists in respect of soil, agronomic factors, and management conditions, for the purpose of studying the response to fertilizers all fields in the sample with a given level of application of fertilizers were grouped together and the relationship between the fertilizers and the yield was studied on the basis of average yield and average doses of N and P. For this purpose 11 classes, *viz.*, 0-20, 20-40, . . ., 180-200 and >200 were made on the basis of dose of N applied. The districts selected for the present study are Anantapur, Chittoor and Krishna (all Andhra Pradesh) for *kharif* rice and *rabi* rice and Amritsar (Punjab), Bulandshahr and Meerut (Uttar Pradesh) and Rohtak (Haryana) for wheat for the years 1972-73 and 1973-74.

*Methodology*

Mathematical approach of fitting response function was adopted for the study. A number of functions such as linear, quadratic, Cobb-Douglas and square root type were tried and depending upon the degree of goodness of fit as measured by the value of $R^2$, the significance of the regression coefficients and appropriateness of the relationship to the physical and biological conditions, one was chosen. Equations of best fit are given in Table I for each district. Based on the data from the scheme, Simple fertilizer trials, the responses to each of N, P and K were studied separately in the presence of the other two nutrients. There was no significant response to K in any of the districts under study. In the case of Sample surveys for assessment of HYVP also, since potash was reported to have been seldom applied and that also in very small doses, it was left cut from the study and response to N and P was studied.

It may be seen that the response to HYV of rice in HYV districts was mostly of Cobb-Douglas or square root type, except in Chittoor district for *kharif* rice where it was of quadratic type. In Chitradurga and Cuddapah (SFT districts) the response was mostly linear both to N and P except in Chitradurga district where response to P for *kharif* 1973-74 was of square root type. In Amritsar and Meerut (HYV districts) the response of HYV of wheat was of Cobb-Douglas type whereas in Bulandshahr (HYV district) it was of

TABLE I—RESPONSES† OF HIGH-YIELDING VARIETIES OF RICE AND WHEAT TO FERTILIZERS

| Crop | District | Season | Nutrient | Response function | |
|---|---|---|---|---|---|
| | | | | 1972-73 | 1973-74 |
| (1) | (2) | (3) | (4) | (5) | (6) |
| *Rice* | Anantapur (HYV) | *Kharif* | N + P | $0{\cdot}48711\ F^{0.95536}$ | $-0{\cdot}17371\ F + 4{\cdot}97069\ F^{\frac{1}{2}}$ |
| | | *Rabi* | N + P | $-0{\cdot}53984\ F + 9{\cdot}14708\ F^{\frac{1}{2}}$ | $-0{\cdot}36211\ F + 6{\cdot}55270\ F^{\frac{1}{2}}$ |
| | Chittoor (HYV) | *Kharif* | N + P | $-0{\cdot}09456\ F + 0{\cdot}00048\ F^2$ | $0{\cdot}23366\ F - {\cdot}00096\ F^2$ |
| | | *Rabi* | N + P | $0{\cdot}37901\ F^{0.92720}$ | $1{\cdot}72003\ F^{0.62493}$ |
| | Krishna (HYV) | *Kharif* | N + P | $-0{\cdot}08275\ F + 2{\cdot}49686\ F^{\frac{1}{2}}$ | $-0{\cdot}20615\ F + 4{\cdot}22551\ F^{\frac{1}{2}}$ |
| | | *Rabi* | N + P | $0{\cdot}60001\ F^{0.61951}$ | $0{\cdot}33603\ F^{0.91607}$ |
| | Cuddapah (SFT) | *Kharif* | N | $0{\cdot}08418\ N$ | $0{\cdot}13366\ N$ |
| | | *Rabi* | N | $0{\cdot}10942\ N$ | $0{\cdot}15404\ N$ |
| | | *Kharif* | P | * | $0{\cdot}20858\ P$ |
| | | *Rabi* | P | $0{\cdot}16840\ P$ | $0{\cdot}17737\ P$ |
| | Chitradurga (SFT) | *Kharif* | N | * | $0{\cdot}11541\ N$ |
| | | *Rabi* | N | * | $0{\cdot}08653\ N$ |
| | | *Kharif* | P | * | $0{\cdot}44056\ P - 2{\cdot}14458\ P^{\frac{1}{2}}$ |
| | | *Rabi* | P | * | $0{\cdot}11855\ P$ |
| *Wheat* | Amritsar (HYV) | *Rabi* | N + P | $0{\cdot}98401\ F^{0.69910}$ | $0{\cdot}96611\ F^{0.69858}$ |
| | Bulandshahr (HYV) | *Rabi* | N + P | $0{\cdot}19580\ F - 0{\cdot}00043\ F^2$ | $0{\cdot}22457\ F - 0{\cdot}00077\ F^2$ |
| | Meerut (HYV) | *Rabi* | N + P | $0{\cdot}90150\ F^{0.69461}$ | * |
| | Fatehpur (SFT) | *Rabi* | N | $0{\cdot}20144\ N - 0{\cdot}00033\ N^2$ | $0{\cdot}20831\ N - 0{\cdot}00030 N^2$ |
| | | *Rabi* | P | $0{\cdot}14434\ P$ | $0{\cdot}15063\ P$ |
| | Sangrur (SFT) | *Rabi* | N | $0{\cdot}17381\ N - 0{\cdot}00050\ N^2$ | $0{\cdot}17949\ N - 0{\cdot}00052\ N^2$ |
| | | *Rabi* | P | $0{\cdot}09485\ P$ | $0{\cdot}10926\ P$ |

† Since we are considering only response to fertilizer the constant term has not been given except in the case of Cobb-Douglas function.

HYV stands for a district covered under the scheme "Sample Surveys for Assessment of HYVP." SFT stands for a district covered under the scheme "Simple fertilizer trials on cultivators' fields."

N + P = F.

* None of the functions tried indicated a significant relationship.

quadratic type. The response to HYV of wheat in the SFT districts of Fatehpur and Sangrur was quadratic for nitrogen and linear for P. None of the functions tried indicated a significant relationship between yield and fertilizer in Cuddapah (*kharif* 1972-73, phosphorus), Chitradurga (both *kharif* and *rabi* 1972-73 both N and P) for rice crop and Meerut (1973-74) for wheat crop. An interesting feature was the consistency of the type of response during the two years in all the districts except Anantapur. Having estimated the response function the impact of change in the price of the fertilizers on production and profit can be studied as follows:

Let $y = f(X)$ be the response function where y is the additional yield and x the quantity of fertilizers. Let the amount spent on fertilizers be $c = px$ where p is the initial price. Let $p' = (1+\frac{r}{100})\ p$ be the new price) (after an increase of r per cent) of fertilizer. Assuming that the amount spent on fertilizers (c) remains constant the new dose applied after price increase x′ is given by

$x' = \frac{100}{100+r}\ x$ and the new response by

$y' = f(x')$ and thus decrease in yield is given by $y - y' = f(x) - f(x')$ Decrease in profit (loss) when there is no change in the price of the produce can be worked out by multiplying the decrease in yield with the price ($p_y$) of the produce.

This decrease in yield of rice/wheat crop for the districts indicated in Table I was worked out at different levels of application of fertilizers corresponding to an increase of 10, 20 and 30 per cent in the price of fertilizers and the results are presented in Tables II and III.

If there is a corresponding increase (r per cent) in the price of the produce also then the change in profit can be worked out by subtracting for the initial profit ($p_y\ xy$) from the new profit ($p_y' xy'$) and will be given by

$$p_y' \cdot y' - p_y \cdot y \qquad \text{where } p_y' = p_y\left(1+\frac{r}{100}\right).$$

This decrease will be zero in case the response is linear. The decrease (—)/ increase (+) in profit in the districts and for the nutrient for which response was non-linear was worked out and the results are presented in Tables IV and V.

*Results*

It may be seen from Tables II and III that under resource constraint an increase in the price of fertilizers could lead to substantial decrease in yield of rice/wheat crop. Thus the decrease in yield of rice could vary from around

TABLE II—DECREASE IN YIELD OF HYV OF RICE DUE TO AN INCREASE OF r PER CENT IN THE PRICE OF FERTILIZERS UNDER RESOURCE CONSTRAINT

| District | Season | Nutrient | Year | Decrease in yield (q/ha.) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | r = 10 | | | | | r = 20 | | | | | r = 30 | | | | | |
| | | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | | |
| | | | | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) |
| Anantapur (HYV) | *Kharif* | N+P | 1972-73 | 1·78 | 3·45 | 5·08 | 6·69 | 8·28 | 3·27 | 6·34 | 9·34 | 11·79 | 14·21 | 4·53 | 8·79 | 12·95 | 16·54 | 19·59 |
| | | | 1973-74 | 0·85 | 0·73 | 0·46 | 0·11 | —0·29 | 1·61 | 1·44 | 0·96 | 0·33 | —0·39 | 2·32 | 2·10 | 1·47 | 0·62 | —0·36 |
| | *Rabi* | | 1972-73 | 0·56 | —0·65 | —2·15 | —3·80 | —5·54 | 1·14 | —1·03 | —3·74 | —6·72 | —9·89 | 1·72 | —1·21 | —4·91 | —9·01 | —13·36 |
| | | | 1973-74 | 0·51 | —0·24 | —1·20 | —2·27 | —3·41 | 1·02 | —0·33 | —2·06 | —4·00 | —6·06 | 1·52 | —0·30 | —2·67 | —5·32 | —8·15 |
| Chittoor (HYV) | *Kharif* | N+P | 1972-73 | —0·22 | —0·03 | 0·58 | 1·68 | 3·06 | —0·42 | —0·11 | —0·94 | 2·71 | 5·23 | —0·60 | —0·22 | 1·14 | 3·37 | 6·79 |
| | | | 1973-74 | 0·65 | 0·46 | —0·56 | —2·42 | —5·10 | 1·21 | 0·96 | —0·76 | —3·94 | —8·60 | 1·72 | 1·47 | —0·73 | —4·89 | —11·02 |
| | *Rabi* | | 1972-73 | 1·21 | 2·29 | 3·34 | 4·36 | 5·36 | 2·22 | 4·22 | 6·14 | 8·02 | 9·86 | 3·08 | 5·85 | 8·52 | 11·13 | 13·69 |
| | | | 1973-74 | 1·15 | 1·77 | 2·28 | 2·73 | 3·13 | 2·13 | 3·29 | 4·24 | 5·08 | 5·84 | 3·00 | 4·62 | 5·96 | 7·13 | 8·19 |
| Krishna (HYV) | *Kharif* | N+P | 1972-73 | 0·45 | 0·41 | 0·29 | 0·14 | —0·04 | 0·85 | 0·80 | 0·60 | 0·32 | —0·01 | 1·22 | 1·16 | 0·90 | 0·52 | 0·08 |
| | | | 1973-74 | 0·45 | 0·09 | —0·40 | —0·97 | —1·58 | 0·89 | 0·25 | —0·64 | —1·67 | —2·77 | 1·29 | 0·44 | —0·77 | —2·17 | —3·68 |
| | *Rabi* | | 1972-73 | 0·39 | 0·60 | 0·77 | 0·92 | 1·05 | 0·72 | 1·11 | 1·43 | 1·71 | 1·96 | 1·02 | 1·56 | 2·00 | 2·40 | 2·75 |
| | | | 1973-74 | 0·83 | 1·56 | 2·26 | 2·95 | 3·62 | 1·52 | 2·87 | 4·17 | 5·42 | 6·65 | 2·11 | 3·99 | 5·79 | 7·53 | 9·24 |
| Cuddapah (SFT) | *Kharif* | N | 1972-73 | 0·26 | 0·51 | 0·76 | 1·02 | 1·28 | 0·47 | 0·94 | 1·40 | 1·87 | 2·34 | 0·65 | 1·30 | 1·94 | 2·59 | 3·24 |
| | | | 1973-74 | 0·41 | 0·81 | 1.22 | 1·62 | 2.03 | 0·74 | 1·49 | 2.23 | 2·97 | 3.71 | 1·03 | 2·06 | 3·09 | 4.11 | 5·14 |
| | *Rabi* | N | 1972-73 | 0·33 | 0·66 | 0·99 | 1·33 | 1·66 | 0·61 | 1·22 | 1·82 | 2·43 | 3·04 | 0·84 | 1·68 | 2·52 | 3·37 | 4·21 |
| | | | 1973-74 | 0·47 | 0·93 | 1·40 | 1·87 | 2·33 | 0·86 | 1·71 | 2·57 | 3·42 | 4·28 | 1·18 | 2·37 | 3·55 | 4·74 | 5·92 |
| | *Kharif* | P | 1973-74 | 0·63 | 1·26 | 1·90 | 2·53 | 3·16 | 1·16 | 2·32 | 3·48 | 4·64 | 5·79 | 1·60 | 3·21 | 4·81 | 6·42 | 8·02 |
| | *Rabi* | P | 1972-73 | 0·50 | 1·00 | 1·50 | 2·00 | 2·50 | 0·92 | 1·83 | 2·75 | 3·66 | 4·58 | 1·27 | 2·54 | 3·80 | 5·07 | 6·34 |
| | | | 1973-74 | 0·54 | 1·08 | 1·61 | 2·15 | 2·69 | 0·99 | 1·97 | 2·96 | 3·94 | 4·93 | 1·36 | 2·73 | 4·09 | 5·46 | 6·82 |
| Chitradurga (SFT) | *Kharif* | N | 1973-74 | 0·35 | 0·70 | 1·05 | 1·40 | 1·75 | 0·64 | 1·28 | 1·92 | 2·56 | 3·21 | 0·89 | 1·78 | 2·66 | 3·55 | 4·44 |
| | *Rabi* | N | 1973-74 | 0·26 | 0·52 | 0·79 | 1·05 | 1·31 | 0·48 | 0·96 | 1·44 | 1·92 | 2·40 | 0·67 | 1·33 | 2·00 | 2·66 | 3·33 |
| | *Kharif* | P | 1973-74 | 0·86 | 2·00 | 3·19 | 4·40 | 5·62 | 1·57 | 3·65 | 5·82 | 8·03 | 10·27 | 2·15 | 5·02 | 8·01 | 11·07 | 14·17 |
| | *Rabi* | P | 1973-74 | 0·36 | 0·72 | 1·09 | 1·44 | 1·80 | 0·66 | 1·32 | 1·97 | 2·63 | 3·30 | 0·91 | 1·81 | 2·73 | 3·64 | 4·54 |

Negative values indicate increase in yield.

TABLE III—DECREASE IN YIELD OF HYV OF WHEAT DUE TO AN INCREASE OF r PER CENT IN THE PRICE OF FERTILIZERS UNDER RESOURCE CONSTRAINT

| District | Nutrient | Year | Decrease in yield (q/ha.) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | r = 10 | | | | | r = 20 | | | | | r = 30 | | | | |
| | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | | Level of application (kg/ha.) | | | | |
| | | | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| Amritsar (HYV) | N+P | 1972-73 | 0·98 | 1·59 | 2·11 | 2·58 | 3·01 | 1·81 | 2·95 | 3·91 | 4·78 | 5·58 | 2·54 | 4·12 | 5·48 | 6·70 | 7·83 |
| | | 1973-74 | 0·96 | 1·55 | 2·06 | 2·52 | 2·94 | 1·78 | 2·88 | 3·83 | 4·68 | 5·47 | 2·49 | 4·04 | 5·36 | 6·55 | 7·65 |
| Bulandshahr (HYV) | N+P | 1972-73 | 0·70 | 1·03 | 0·99 | 0·57 | —0·21 | 1·30 | 1·95 | 1·94 | 1·27 | —0·05 | 1·82 | 2·76 | 2·83 | 2·01 | 0·32 |
| | | 1973-74 | 0·69 | 0·71 | 0·06 | —1·26 | —3·25 | 1·28 | 1·39 | 0·32 | —1·93 | —5·35 | 1·81 | 2·04 | 0·70 | —2·21 | —6·69 |
| Meerut (HYV) | N+P | 1972-73 | 0·87 | 1·41 | 1·87 | 2·29 | 2·67 | 1·62 | 2·62 | 3·48 | 4·25 | 4·96 | 2·27 | 3·68 | 4·87 | 5·95 | 6·95 |
| Rohtak (HYV) | N+P | 1972-73 | 1·50 | 2·46 | 3·29 | 4·05 | 4·75 | 2·78 | 4·57 | 6·11 | 7·51 | 8·82 | 3·89 | 6·40 | 8·55 | 10·51 | 12·34 |
| | | 1973-74 | 0·85 | 1·69 | 2·54 | 3·39 | 4·23 | 1·55 | 3·10 | 4·66 | 6·21 | 7·76 | 2·15 | 4·30 | 6·45 | 8·59 | 10·74 |
| Fatehpur (SFT) | N | 1972-73 | 0·79 | 1·31 | 1·57 | 1·58 | 1·32 | 1·45 | 2·44 | 2·97 | 3·05 | 2·66 | 2·02 | 3·42 | 4·22 | 4·40 | 3·96 |
| | | 1973-74 | 0·82 | 1·37 | 1·67 | 1·70 | 1·48 | 1·51 | 2·56 | 3·15 | 3·28 | 2·95 | 2·10 | 3·58 | 4·45 | 4·71 | 4·36 |
| | P | 1972-73 | 0·66 | 1·31 | 1·97 | 2·62 | 3·28 | 1·20 | 2·41 | 3·61 | 4·81 | 6·01 | 1·67 | 3·33 | 5·00 | 6·66 | 8·33 |
| | | 1973-74 | 0·68 | 1·37 | 2·05 | 2·74 | 3·42 | 1·26 | 2·51 | 3·77 | 5·02 | 6·28 | 1·74 | 3·48 | 5·21 | 6·95 | 8·69 |
| Sangrur (SFT) | N | 1972-73 | 0·57 | 0·71 | 0·42 | —0·31 | —1·47 | 1·07 | 1·37 | 0·91 | —0·32 | —2·31 | 1·50 | 1·97 | 1·42 | —0·14 | —2·73 |
| | | 1973-74 | 0·60 | 0·76 | 0·50 | —0·21 | —1·34 | 1·11 | 1·46 | 1·05 | —0·13 | —2·07 | 1·56 | 2·10 | 1·62 | 0·12 | —2·40 |
| | P | 1972-73 | 0·43 | 0·86 | 1·29 | 1·72 | 2·15 | 0·79 | 1·58 | 2·37 | 3·16 | 3·95 | 1·09 | 2·19 | 3·28 | 4·38 | 5·47 |
| | | 1973-74 | 0·50 | 0·99 | 1·49 | 1·99 | 2·48 | 0·91 | 1·82 | 2·73 | 3·64 | 4·55 | 1·26 | 2·52 | 3·78 | 5·02 | 6.31 |

Negative values indicate increase in yield.

TABLE IV—INCREASE IN PROFIT IN HYV OF RICE DUE TO AN INCREASE OF r PER CENT IN THE PRICE OF FERTILIZERS AS ALSO OF RICE AT DIFFERENT LEVELS OF APPLICATION OF FERTILIZERS UNDER RESOURCE CONSTRAINT

| District | Season | Nutrient | Year | Increase in profit (Rs./ha.) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | r = 10 | | | | | r = 20 | | | | | r = 30 | | | | |
| | | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | |
| | | | | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) |
| Anantapur (HYV) | *Kharif* | N+P | 1972-73 | 13 | 25 | 37 | 49 | 61 | 25 | 49 | 72 | 94 | 117 | 36 | 70 | 103 | 136 | 168 |
| | | | 1973-74 | 257 | 364 | 446 | 515 | 575 | 503 | 712 | 872 | 1,006 | 1,125 | 739 | 1,045 | 1,280 | 1,478 | 1,652 |
| | *Rabi* | | 1972-73 | 474 | 670 | 820 | 947 | 1,059 | 926 | 1,310 | 1,603 | 1,852 | 2,071 | 1,360 | 1,923 | 2,356 | 2,720 | 3,041 |
| | | | 1973-74 | 339 | 480 | 588 | 678 | 759 | 663 | 938 | 1,149 | 1,327 | 1,483 | 974 | 1,378 | 1,687 | 1,948 | 2,178 |
| Chittoor (HYV) | *Kharif* | N+P | 1972-73 | 16 | 65 | 147 | 262 | 409 | 30 | 120 | 270 | 480 | 750 | 42 | 166 | 374 | 665 | 1,038 |
| | | | 1973-74 | 43 | 131 | +295 | +524 | +818 | 60 | 240 | 540 | +960 | +1,500 | 83 | 332 | 748 | 1,329 | 2,077 |
| | *Rabi* | | 1972-73 | 15 | 28 | 41 | 54 | 66 | 29 | 54 | 79 | +103 | +129 | 41 | 78 | 114 | 149 | 183 |
| | | | 1973-74 | 108 | 167 | 215 | +257 | +296 | +210 | 324 | 418 | 500 | 575 | 307 | 474 | 611 | 731 | 841 |
| Krishna (HYV) | *Kharif* | N+P | 1972-73 | 129 | 183 | 224 | 259 | 289 | 253 | 357 | 438 | 506 | 565 | 371 | 525 | 643 | 742 | 830 |
| | | | 1973-74 | 219 | 309 | 379 | 437 | 489 | 428 | 605 | 741 | 856 | 957 | 628 | 888 | 1,088 | 1,256 | 1,405 |
| | *Rabi* | | 1972-73 | 38 | 58 | 74 | 89 | 102 | 73 | 112 | 144 | 172 | 198 | 107 | 164 | 211 | 252 | 289 |
| | | | 1973-74 | 12 | 23 | 33 | 42 | 52 | 23 | 43 | 63 | 82 | 100 | 33 | 62 | 90 | 118 | 144 |
| Chitradurga (SFT) | *Kharif* | P | 1973-74 | 74 | 105 | 128 | 148 | 166 | 145 | 205 | 251 | 289 | 324 | 213 | 301 | 368 | 425 | 475 |

Price of rice before increase has been taken as Rs. 150 per quintal.

TABLE V—INCREASE IN PROFIT IN HYV OF WHEAT DUE TO AN INCREASE OF r PER CENT IN THE PRICE OF FERTILIZERS AS ALSO OF WHEAT AT DIFFERENT LEVELS OF APPLICATON UNDER RESOURCE CONSTRAINT

| District | Nutrient | Year | Increase in profit (Rs./ha.) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | r = 10 | | | | | r = 20 | | | | | r = 30 | | | | |
| | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | | Level of application (kg./ha.) | | | | |
| | | | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 | 50 | 100 | 150 | 200 | 250 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| Amritsar (HYV) | N+P | 1972-73 | 46 | 75 | 100 | 122 | 143 | 90 | 146 | 193 | 237 | 277 | 131 | 212 | 282 | 345 | 403 |
| | | 1973-74 | 45 | 74 | 98 | 120 | 140 | 88 | 143 | 190 | 232 | 271 | 128 | 208 | 276 | 338 | 395 |
| Bulandshahr (HYV) | N+P | 1972-73 | 10 | 41 | 92 | 164 | 259 | 19 | 75 | 169 | 301 | 470 | 26 | 104 | 234 | 417 | 651 |
| | | 1973-74 | 18 | 73 | 165 | 295 | 459 | 34 | 135 | 305 | 539 | 842 | 47 | 187 | 420 | 746 | 1,166 |
| Meerut (HYV) | N+P | 1972-73 | 42 | 68 | 91 | 111 | 129 | 82 | 133 | 176 | 215 | 251 | 119 | 193 | 256 | 313 | 365 |
| Rohtak (HYV) | N+P | 1972-73 | 65 | 107 | 143 | 176 | 207 | 126 | 207 | 277 | 341 | 400 | 184 | 302 | 404 | 496 | 582 |
| Fatehpur (HYV) | N | 1972-73 | 7 | 29 | 64 | 115 | 179 | 13 | 53 | 118 | 210 | 328 | 18 | 73 | 164 | 291 | 454 |
| | | 1973-74 | 7 | 29 | 64 | 115 | 179 | 13 | 53 | 118 | 210 | 328 | 18 | 73 | 164 | 291 | 454 |
| Sangrur (HYV) | N | 1972-73 | 12 | 48 | 107 | 191 | 298 | 22 | 87 | 197 | 350 | 547 | 30 | 121 | 273 | 485 | 757 |
| | | 1973-74 | 12 | 48 | 107 | 191 | 298 | 22 | 87 | 197 | 350 | 547 | 30 | 121 | 273 | 485 | 757 |

Price of wheat before increase has been taken as Rs. 105 per quintal.

0.5 (q/ha.) to about 3.0 (q/ha.) depending upon at what level the fertilizer is applied. As would be expected, the decrease in yield becomes steeper as the percentage increase in price becomes higher. Thus at higher levels of application of fertilizers when there is a 30 per cent increase in the price of fertilizers the decrease in yield of HYV of rice could be as high as 19.59q/ha. (Anantapur *kharif*, 1972-73). It is, however, interesting to note that in certain areas where the response is non-linear an increase in price could also lead to an increase in yield, *e.g.*, Anantapur (*kharif* 1973-74 and *rabi*, both in 1972-73 and 1973-74) and Chittoor (*kharif* both in 1972-73 and 1973-74). This is because at lower level of application the marginal returns to fertilizers are more than those at higher levels.

In almost all the districts studied it was seen that the yield of wheat also could decrease substantially due to an increase in the price of fertilizers. However, the decrease in yield is less fluctuating in the case of wheat than in the case of rice. An increase in the price of fertilizers could also lead to an increase in yield of wheat (*e.g.*, Bulandshahr and Sangrur both in 1972-73 and 1973-74) but mostly at higher levels of application. A comparison between the years shows that except in Anantapur and Chittoor *kharif* rice the decrease in yield due to an increase in the price of fertilizers did not vary much from year to year or in other words the impact of price rise is somewhat stable. This is particularly true at the low and moderate levels of application, *i.e.*, from 50 to 150 kg./ha. The stability was all the more high in the case of SFT districts. It is not difficult to see that the decrease in yield will lead to a loss to the farmer and this loss could be heavy in many cases.

A perusal of Tables IV and V indicates that if a rise in the price of fertilizer is compensated by a corresponding increase in the price of wheat/rice, the profit of the farmers growing the high-yielding varieties would increase considerably at all levels of application of fertilizers and under responses of different types. However, the increase in profits varies more violently in the case of rice than in the case of wheat. The stability of increase in profits from year to year is higher in the case of *rabi* crops than in the case of *kharif* crops.

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## IMPORTANCE OF PURCHASED INPUTS ON COST STRUCTURE—AN ANALYTICAL STUDY

Bhanudeb Bagchi and K. Sain*

In a developing economy still largely dependent on agriculture the general price level is substantially influenced by the prices of foodgrains. Introduction of modern technologies for reorganizing agriculture since the beginning of the 'sixties necessarily implies increasing use of non-farm inputs for the

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