

Economics of Fertilizer Application to Wheat Crop: The Results of a Survey in Lyallpur District

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INTRODUCTION

Reliable knowledge about the contribution of various factors responsible for increasing agricultural production is indispensable for planning. This holds particularly for the fertilizer use, which has been recognized as one of the quickest and, perhaps, the cheapest means for increasing agricultural production.

In Pakistan the emphasis on planned development is gaining momentum and for this purpose more data and fuller information on fertilizer response are becoming increasingly essential.

The Agricultural Research Stations in the country have been conducting experiments with a view to determining the extent to which the cropped yield may increase due to the application of fertilizer. But such experiments, because of their somewhat controlled nature in respect of certain factors, obviously cannot tell us with a desired measure of accuracy as to what is actually happening at millions of private farms throughout the country. And, as such, the planning in this regard is apt to be wrong.

Therefore, a pilot study was conducted to work out the economics of fertilizer application to wheat crop on cultivators' fields in Lyallpur district in

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1966/67 and very interesting results were obtained. This is the first attempt to work out economics of fertilizer use by interview method and the study will provide answers to such questions as:-

- i) What is the proportion of fertilizer users and fertilized acreage?
- ii) What is the relationship between literacy and fertilizer use?
- iii) What is the model time and method of application of fertilizer?
- iv) What is the average dose of fertilizer per fertilized acre?
- v) What is the average yield per acre of fertilizer users and nonusers and the significance of difference between average yields?
- vi) What is the relationship between dose of fertilizer and yield of crop per acre?
- vii) What is the monetary return per rupee spent on fertilizer?
- viii) What is the actual and projected increase in outturn and monetary returns of wheat crop due to fertilizer use in the Lyallpur district?

II. REVIEW OF LITERATURE

As already stated, the Agricultural Research Stations in the country have been conducting experiments on the use of fertilizers but there has been no study in the actual context of the problem. However, some related literature is reviewed as follows:-

Wahhab [7] reported the results obtained from Demonstration Plots laid out in various districts of the former Punjab. In the case of wheat (irrigated), the results were highly significant for all the fertilizers. The increased yield ranged from 3 to 6 maunds of wheat per acre for 30 pounds of nitrogen. At the then prevailing prices of fertilizer and wheat even an increase of 3 maunds was economical.

Ministry of Food and Agriculture [3] conducted a survey on the use of fertilizer in Pakistan and reported that in West Pakistan largest number of cultivators applied fertilizer to wheat. The increase in yield due to fertilizer use was 28.8 per cent. Financial return per rupee spent on fertilizer was reported to be 2.8 rupees at 40-per-cent subsidy.

The method employed for determining increase in yield due to the use of fertilizer, however, seemed to be very unsatisfactory. The farmers were asked to report the yield of fertilized and unfertilized portions of a crop separately. Since they did not harvest the treated and untreated crop separately, they could

not possibly have known accurately the yields separately. The sampling of villages in a district and that of farmers in a village, being all by randomization, was very defective in the presence of heterogeneous conditions prevailing.

Tufail [5] found the financial return per rupee spent on fertilizer in Lyallpur tehsil to be 4.7 rupees.

Revelle [6] reported that the fertilizer-response coefficients for wheat in West Pakistan had shown 9 pounds return per pound of plant nutrient applied.

Ahmad and Sodager [1] reported a monetary return of 3.00 rupees per rupee spent on fertilizer at the minimum, rising to as high as 7.00 or 8.00 rupees in some cases. In most cases, higher yields were obtained with an *N.P.* combination rather than nitrogen alone.

III. METHODOLOGY

i) Because of the inapplicability of the results of research conducted at experiment stations for policy matters, an interview method was employed.

ii) Because of the homogeneity of some factors in an assessment circle, an assessment circle¹ approach was adopted. This was considered necessary in order to minimise the influence of factors other than fertilizer.

iii) From each of the 5 assessment circles of Lyallpur district, 10 cases were drawn by randomization from each of the three sizes of farms, *viz.* small (below 5 acres), medium (5 to below 25 acres), and large (25 acres and above) from each of the three systems of land tenure *viz.*, peasant proprietors, owner tenants and tenants.

iv) The farmers were classified into users and nonusers of fertilizers.

v) Two separate schedules were prepared for collecting information from fertilizer users and nonusers. The schedule for the nonusers was directed towards finding out the average yield of wheat crop sown by them. The information collected from the users aimed at finding out average fertilizer dose and the average yield obtained with its application.

vi) Increase in yield due to the use of fertilizer was found out by comparing with the yields of nonusers.

vii) In order to translate the increase per acre in monetary terms, the price of the input, *i.e.*, the fertilizer applied, and of the output, *i.e.*, the harvest price of the product, was enquired into.

¹An assessment circle is a group of villages possessing similar agricultural conditions, *i.e.*, soil, rainfall, depth of water, climate, type of irrigation and type of crops grown, so that they have similar revenue-paying capacity and admit of a uniform assessment rate. Within an assessment circle all other yield-increasing factors are assumed to be constant.

IV. RESULTS AND DISCUSSION

As stated earlier, 90 cases were selected from each of the 5 assessment circles of the Lyallpur district. 450 farmers were interviewed in detail to find answers to the questions raised earlier. The number of reporting cases was 448. The results are presented and discussed below.

i) The Proportion of Fertilizer Users and Fertilized Acreage

It was found that 63 per cent of the wheat growers applied fertilizer on 83 per cent of the crop acreage. The proportion of fertilized acreage was 84 per cent, 89 per cent, and 77 per cent in the case of peasant proprietors, owner tenants, and tenants, respectively. Thus, fertilizer was applied to wheat crop by all categories of the farmers on a very high proportion of its acreage in Lyallpur district.

ii) Relationship between Literacy and Fertilizer Use

The study revealed a higher percentage of fertilizer users in literate farmers² (82 per cent) as compared to illiterate ones (65 per cent). The Chi-square value is significant at 1-per-cent level.

iii) Time and Methods of Application of Fertilizer

There was a great variation in time and method of application of fertilizer. As many as 10 timings and 9 methods of application of fertilizer were used. This indicates that even the farmers of Lyallpur district, which represents today one of the most highly developed irrigation systems in the world and is unparalleled for its agricultural prosperity in the Indo-Pak subcontinent, were not aware of the proper time and method of application of fertilizer, which is very important if higher returns are to be obtained with the application of fertilizer.

It was observed that 50 per cent of the fertilizer users applied fertilizer in December only and 31 per cent in December and January, *i.e.*, in two doses. As regards the method of application, 42 per cent farmers applied fertilizer by broadcast method and 23 per cent by broadcast plus 'at source of irrigation' method.

iv) Average Dose of Fertilizer per Fertilized Acre

It may be seen from Appendix A that the weighted average dose of fertilizer per fertilized acre was 31 nutrient pounds. This is only about 27 per cent of 115 nutrient pounds, which is believed to be the "optimum dose".

²One who could read with understanding a short statement on every-day life in any language.

The peasant proprietors applied heavier dose of fertilizer as compared with owner tenants and tenants. The weighted average dose of fertilizer per fertilized acre being 35, 27 and 26 nutrient pounds in the case of peasant proprietors, owner tenants, and tenants, respectively.

v) *Average Yield per Acre of Fertilizer Users and Nonusers*

The study of Appendix B reveals that the weighted average yield per acre of fertilizer users and nonusers was 17 and 11 maunds, respectively. The increase in yield due to fertilizer use was 6 maunds per acre, or 55 per cent. The weighted average yield per acre of fertilizer users was 19, 15 and 15 maunds and that of nonusers 13, 9 and 9 maunds in the case of peasant proprietors, owner tenants, and tenants, respectively. Thus, the average yield for the fertilizer users for each category of farmers is very significantly higher than for the corresponding category of fertilizer nonusers.

vi) *Relationship between Fertilizer Dose and Yield per Acre*

The correlation coefficient, regression coefficient, standard error of regression coefficient and the regression equation of yield upon fertilizer dose in case of wheat are given below in a tabulated form (Y = yield per acre and x = fertilizer per acre):

Time of application of fertilizer	Number of observations	Correlation coefficient	Regression equation of yield upon fertilizer dose
December	161	+ 0.525*	$Y = 8.86 + 0.196X$ (0.097)
December + January	100	+ 0.603*	$Y = 6.16 + 0.343X$ (0.123)

*Significant at 1-per-cent level.

The regression coefficient represents that with the addition of one pound of fertilizer dose (nutrients), the corresponding increase in yield was 0.196 and 0.343 maunds, or 16 and 28 pounds in case of fertilizer applied in December and December plus January, respectively. This figure is higher than the figure reported by Revelle [6], who stated that the fertilizer-response coefficient for wheat in West Pakistan had shown 9 pounds return per pound of plant nutrient applied. The figure stated by Revelle is, however, on all-West Pakistan basis while our estimates are for the more prosperous Lyallpur district only.

Figures 1 and 2 depict the relationship between dose of fertilizer and yield of crop and regression line in case of fertilizer applied in December and December plus January, respectively.

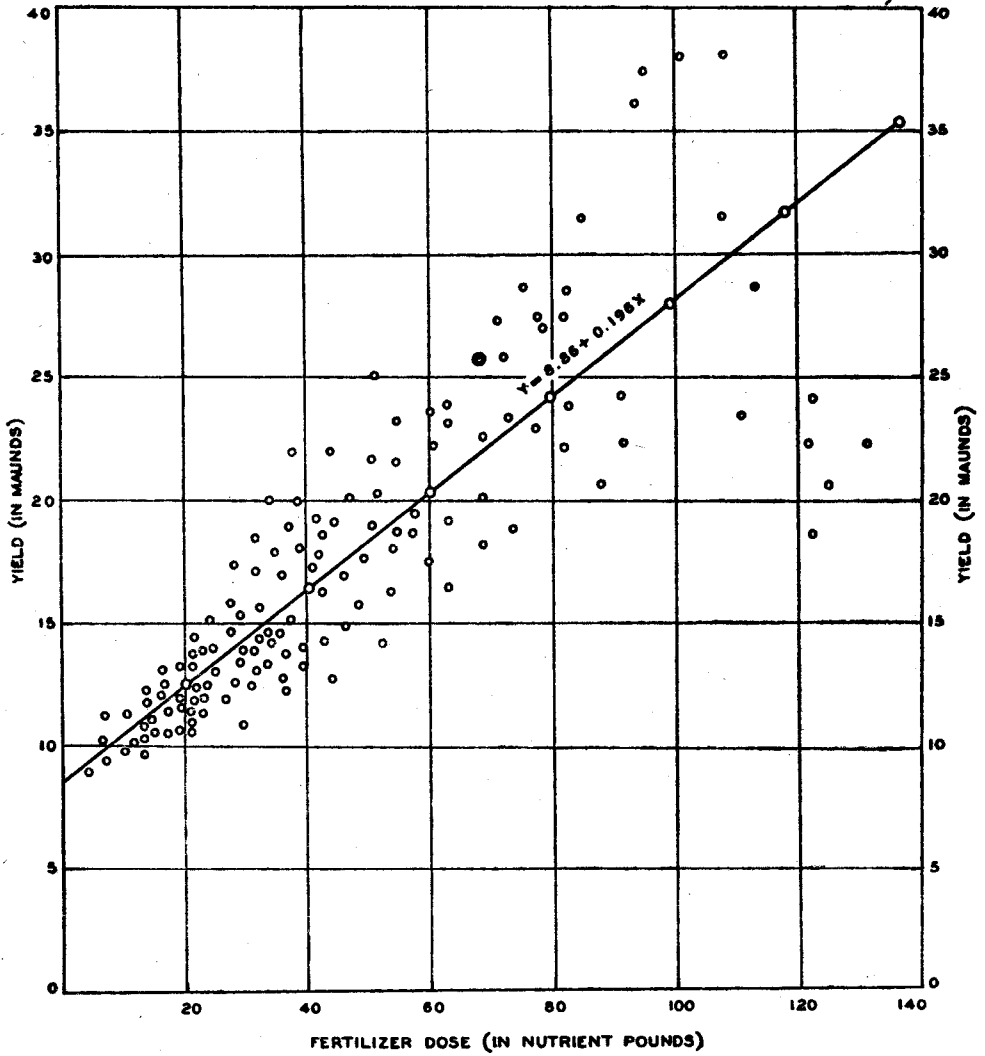


Figure 1. Relationship between Fertilizer Dose (applied in December) and Yield per Acre in Case of Wheat

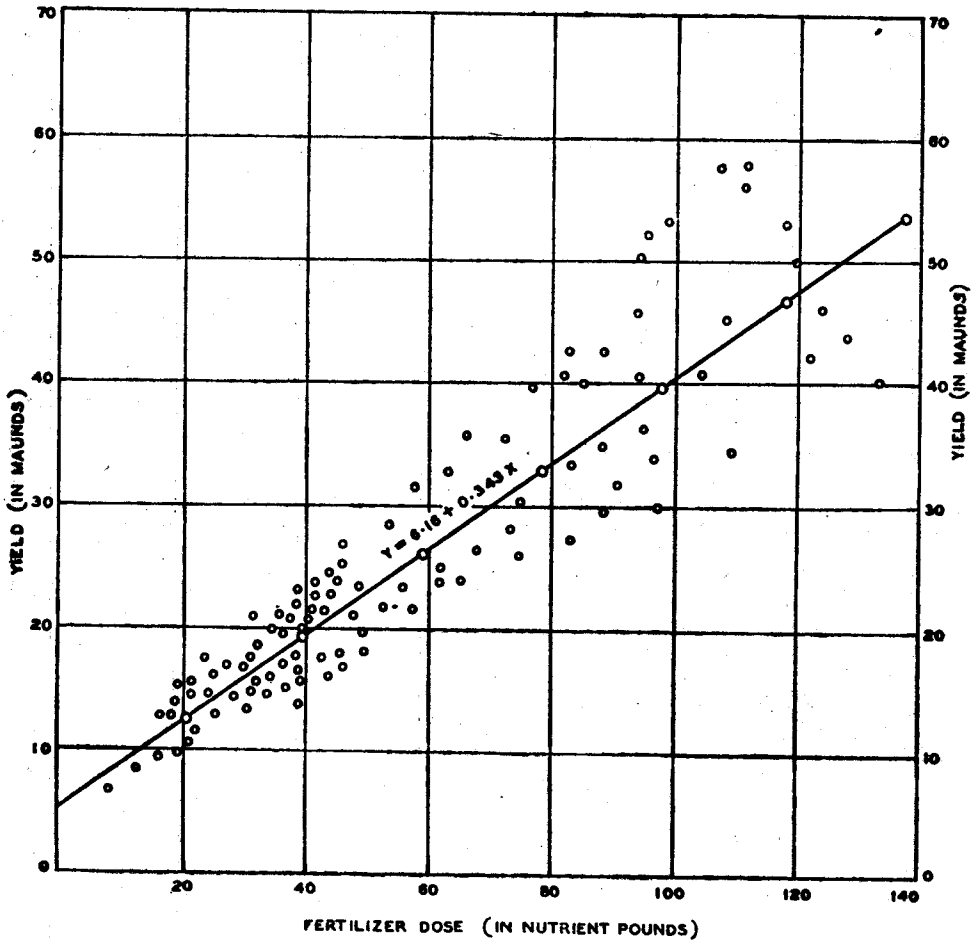


Figure 2. Relationship between Fertilizer Dose (applied in December-January) and Yield per Acre in Case of Wheat

vii) Monetary Returns per Rupee Spent on Fertilizer

Appendix C reveals that the monetary return per rupee spent on fertilizer at 35 per cent subsidized rate and at full cost was 7.85 and 5.10 rupees, respectively. This figure is higher than that reported by Ministry of Food and Agriculture [3] and Tufail [5]. The monetary return per rupee spent on fertilizer at subsidized rate was reported to be 2.8 and 4.7 rupees by these two studies, respectively. But the results of the present study are close to the results reported by Ahmad and Sodager [1], who stated that the monetary return per rupee spent on fertilizer was 7 or 8 rupees in some cases. The maximum monetary returns per rupee spent were obtained with the application of triple superphosphate plus urea, the returns being 17.16 rupees at 35 per cent subsidized rate and 11.15 rupees at full cost. The next highest monetary return per rupee spent was obtained with the application of superphosphate plus ammonium nitrate.

In general, our results show that it is economically beneficial for the cultivators to use fertilizer at the prevalent prices of wheat and fertilizer even without any subsidy on fertilizer. And, if only 63 per cent of the wheat growers applied fertilizer on 83 per cent of the land under wheat, as indicated earlier, it means that there are constraints which prevent farmers from applying fertilizer. These constraints may be lack of water, lack of knowledge, lack of fund, or nonavailability of fertilizer itself. Studies to point out these constraints should be undertaken to suggest means to increase the use of fertilizer and thereby increase the agricultural production.

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Appendix A

AVERAGE DOSE OF FERTILIZER PER FERTILIZED ACRE IN CASE OF WHEAT

Crop	Land tenure	Size of holding	Average dose/acre (nutrient pounds)	Weight of size of holding (per cent of all farms)	Weighted average dose/acre (nutrient pounds)	Weight of land tenure (per cent of all farms)	Weighted average dose/acre (nutrient pounds)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wheat	Peasant proprietors	Small	31.82	46.99	35.12	52.17	30.78
		Medium	36.84	47.73			
		Large	48.96	5.28			
	Owner tenants	Small	28.24	23.07	26.53	14.52	
		Medium	25.78	68.47			
		Large	27.95	8.46			
	Tenants	Small	22.43	39.77	25.83	31.31	
		Medium	27.72	53.76			
		Large	31.07	6.47			

Appendix B

AVERAGE YIELD PER ACRE OF FERTILIZER USERS AND NONUSERS IN CASE OF WHEAT

Land tenure	Size of holding	Average yield/acre		Weight of size of holding (per cent of all farms)	Weighted average yield/acre		Weight of land tenure (per cent of all farms)	Weighted average yield/acre		Percentage increase in yield due to fertilizer use
		Fertilizer users	Non-users		Fertilizer users	Non-users		Fertilizer users	Non-users	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		(...maunds...)			(...maunds...)		(...maunds...)			
Peasant proprietors	Small	17.23	10.57	46.99	19.02	12.52	52.17	17.18	11.11	54.63
	Medium	20.30	14.28	47.73						
	Large	23.44	13.96	5.28						
Owner tenants	Small	14.67	8.98	23.07	15.06	9.31	14.52	17.18	11.11	54.63
	Medium	15.17	9.51	68.47						
	Large	15.25	8.55	8.46						
Tenants	Small	12.08	8.99	39.77	15.23	9.70	33.31	17.18	11.11	54.63
	Medium	17.30	10.10	53.76						
	Large	17.46	10.68	6.47						

Appendix C

MONETARY RETURNS PER RUPEE SPENT ON FERTILIZER IN CASE OF WHEAT

1) Quantity of fertilizer used on one acre (<i>nutrient pounds</i>)	..	30.78
2) Value of fertilizer used on one acre at 35% subsidy (<i>Rs.</i>)	..	15.29
3) Additional yield per acre (<i>maunds</i>)	..	6.07
4) Value of commodity per maund (<i>Rs.</i>)	..	19.78
5) Value of the total additional yield (<i>Rs.</i>)	..	120.06
6) Returns per rupee spent on fertilizer at 35% subsidy (<i>Rs.</i>)	..	7.85
7) Value of fertilizer at full price (<i>Rs.</i>)	..	23.52
8) Returns per rupee spent on fertilizer at full cost (<i>Rs.</i>)	..	5.10