INT. J. BIOL. BIOTECH., 2 (1): 215-221, 2005.

SOCIO-ECONOMIC FACTORS AND DEMAND OF VARIOUS FERTILIZERS IN DISTRICT PESHAWAR

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ABSTRACT

Pakistan is an agricultural country and its increased agricultural productions depend on the consumption of chemical fertilizers. In this paper an effort has been made to highlight the socio-economic factors affecting fertilizer use in district Peshawar. Regression analysis revealed that the educational status, farmers tenurial status, prices of fertilizers, farm income and the annual credit significantly ($p < 0.05$) affect the demand of various fertilizers. While the acreage under crops and the farmer's age do not play a pivotal role in the consumption of N, P and K-fertilizers.

Key words: Socio economic factor, demand of fertilizers, Peshawar, econometric model, multiple stage sampling

INTRODUCTION

Chemical fertilizers hold strategic place amongst the improved farm inputs responsible for increased agricultural production. The use of fertilizers gained momentum in the past and further potential of its use is being exploited in Pakistan. Chemical fertilizers were first imported in the country during 1952-53 but their use on a comparatively larger scale started in late 50's. Since then there has been a significant increase in its consumption and during the period 1959 to 1974 its use increased from about 19.40 to 425.50 thousand nutrient tons consumed per year. Out of total fertilizer consumed, approximately 90% was in the nitrogenous form. Moreover, about 70% of the total fertilizers used in the Punjab, the most prosperous and developed region of the country (Khalid and Saeed, 1977).

Some systematic attempts have been made in the past and useful results obtained, like Leonard (1969) determined that the rise in farm income and overtime awareness of farmers about fertilizer's usefulness significantly determined the increased use of fertilizers in Pakistan and price of fertilizers least affected its demand. Ayub (1975) concluded that demand for fertilizers in Pakistan over the years 1958-65 was not determined by its 'real' price whereas it ('real' price') was significant determinant of the demand for fertilizers over the years 1966-73. On the basis of his findings he suggested the Government not to withdraw subsidy on the sale of fertilizers. Khalid and Saeed (1977) concluded that the real price of fertilizers, agricultural income index and the acreage under crop significantly affect whereas the agricultural credit did not effect the demand of N-fertilizer. Raju (1989) determined that the net income significantly effect while fertilizer prices relative to output prices appeared not to have a strong influence on fertilizer use. Iqbal (1979) concluded that farmer's age" and farmer's tenurial status don't affect the consumption of N-fertilizers in Pakistan while the effect of farm size and the farmer's education was found significant.

MATERIALS AND METHODS

The study is based on primary data and the interview schedule/questionnaire were used as a research instrument for collection of data needed for the study. The data was collected from 300 farmers in the six randomly selected villages of district Peshawar.

Selection of Sample Size

A sample of 300 farmers was selected in four stages using the technique of multi-stage sampling as fallows:

In the first stage, all the population of Peshawar district was divided into four towns (Town-1 was dropped from the study because it consists of all the urban areas). In the second stage towns were further divided into urban and rural areas. In the third stage only rural areas were selected and the fourth stage consists of the random selection of six locations (two from each Town). Because of time and financial constraints a sample of 300 farmers was selected by selecting 50 farmers from each location. The randomly selected locations are; Gul Bela and Khazana from Town-2, Malkandhir and Regi from Town-3 and, Musa Zai and Aza Khel from Town-4, respectively.

Multi-Stage Sampling

One of the problems of simple random sampling is that if the sample selected is widely scattered over the district (in more general over the country), the interviewer might spend more time in travelling than he does in actually interviewing. Often, then, the cost of taking such a sample would be prohibitive. One can imagine the problems involved if a person is to take a sample of people scattered all over the district because of spending a lot of time, labour and cost in data collection. In order to overcome this problem; technique of multi-stage sampling has been developed. It does so in such a way that cost and time of final interviewing is minimized.

In multistage sampling the units are selected into a number of stages. At the first stage of sampling, sampling units are selected from the universe by some suitable method. The sampling unit created in the first stage is called the primary sampling unit (PSU). At the second stage of sampling the units are selected from each of the selected first stage units by some suitable technique. This process is continued until the required sample is selected (Cochran, 1977).

Statistical Analysis of data

Various statistical techniques were applied to analyze the data and to meet the required objectives of this study. In the given study, demand for N, P and K-fertilizers is a function of various factors like education, small grower or large and tenurial status of the farmers, the weighted average prices of N, P and K-fertilizers, annual on-farm income, farm area in acres, annual credit and the farmer's age were tested.

The following models were used to test the significance of various factors for the demand of N, P and K fertilizers:

The following model was used to test the significance of education for the consumption of various fertilizers.

$Y_i = \beta_0 + \beta_1 D + \varepsilon$ ---------- (1)

Where,

Y_i = aggregate quantity demanded of i^{th} fertilizers in nutrient kilograms, for i = N, P, K.

D (dummy variable) = 1, if a farmer is educated

D = 0, otherwise

β_0 = the intercept term to give the average consumption of ith fertilizer (i = N, P and K) by the illiterate farmers.

To test the significance of grower's status, the following model was specified.

$Y_i = \alpha + \beta D_1 + \varepsilon$ ---------- (2)

Where,

Y_i represents the use of various types of fertilizers in nutrient kilograms (i = N, P, K) and D_1 is the dummy variable for large growers. The dummy variable was specified as follow:

D_1 = 1, if the farmer is large grower (having area > 5 acre).

D_1 = 0, otherwise.

In Model 2, "α" would give the average consumption of fertilizers by small growers and "β" would give the magnitude by which the use of fertilizers of large growers differ from smaller one.

To test the significance of tenurial status of the farmers with regard to the use of various types of fertilizers, the following model(s) was used.

$Y_i = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \varepsilon$ ---------- (3)

Where,

Y_i represents the use of various types of fertilizers in nutrient kilograms (i = N, P and K) and D_1 and D_2 are the dummy variables for the growers who are "owner" and "owners-cum-tenant" respectively. The dummy variables were specified as follow:

D_1 = 1, if the grower is owner

D_1 = 0, otherwise

D_2 = 1, if the grower is owner-cum-tenant

D_2 = 0, otherwise

In Model 3, "β_0" would give the average use of fertilizers by the growers who are tenant and "β_1" and "β_2" would give the magnitude by which the use of fertilizers of owners and owner-cum-tenant differ from the tenant one, denoted by "β_0".

In similar way, to test the significance of other factors like the weighted average price of N, P and K-fertilizers, the annual on-farm income, the farm size, the annual credit and the farmer's age, the following model was specified.

$Y_i = \beta_0 + \beta_1 X_{1N} + \beta_2 X_{2P} + \beta_3 X_{3K} + \beta_4 X_{4I} + \beta_5 X_{5A} + \beta_6 X_{6C} + \beta_7 X_{7Ag} + \varepsilon$ ---------- (4)

Where:
Y_i = aggregate quantity demanded of i^{th} fertilizers in nutrient kilograms, for i = N, P, K
X_{1N} = weighted average price of N-Fertilizers
X_{2P} = weighted average price of P-Fertilizers
X_{3K} = weighted average price of K-Fertilizers
X_{4I} = annual on farm income
X_{5A} = cropped area in acres
X_{6C} = annual credit in rupees, and
X_{7Ag} = farmer's age in years
ε = random error component and is normally distributed having zero mean and constant variance σ^2 (for all the specified models).

RESULTS AND DISCUSSION

Educational Status of the Farmers

The information regarding farmers education was classified into two categories i.e. literates and illiterates; the literates were further divided into primary, middle, matric and above matric categories. The educational level of the farmers in the study area is given in Table-1.

Table 1. Educational Status of the farmers.

Educational level		Numbers	Percentage
Illiterate		138	46
Literate	Primary	65	21.7
	Middle	51	17
	Matric	31	10.3
	Above Matric	15	5
	Total	300	100

The Table 1 shows that 46% farmers were illiterate, while the remaining (54%) were literate. About (21.7%) farmers were educated up to primary level, 17% up to middle level, 10.3% up to matric level and 5% up to above matric leveling the study area.

To test the significance of education with regard to the use of various fertilizers, Model-1 was applied and the following parameters estimates under the model(s) are obtained:

N-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	492.753	23.833	20.676	0.000	0.052	0.049
D_1	-135.895	33.704	-4.032	0.000		

P-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	161.120	7.997	20.148	0.000	0.045	0.042
D_1	-42.272	11.309	-3.738	0.000		

K-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	34.656	3.030	11.438	0.000	0.021	0.017
D_1	-10.711	4.285	-2.500	0.013		

Hence, the models obtained are:

$Y_N = 492.753 - 135.895\ D_1$ ---------- (5)
$Y_P = 161.120 - 42.272\ D_1$ ---------- (6)
$Y_K = 34.656 - 10.711\ D_1$ ---------- (7)

The standard error for the regression coefficient of D_1 (Model-5) is 33.704, with negative t-ratio of 4.032 and p-value is 0.000, which indicates that education has significant effect at both 1% and 5% level of significance, for the demand of N-fertilizers. The standard error for the regression coefficient of D_1 (Model-6) is 11.309, with t-value – 3.738 and p-value is 0.000, which shows that the effect of education is significant at both 1% and 5% level of significance for the demand of P-fertilizers. Whereas, the standard error of estimate for the regression coefficient of D_1 (Model-7) is 4.285, with negative t-value 2.500 and p-value is 0.013, explains that effect of education for the demand of K-fertilizers at 5% level of significance is considered to be significant ($p < 0.05$). Our results are compatable with Iqbal (1979) who concluded that farmer's education significantly affect the demand of fertilizers.

Growers' Land Holding Status

In the study area the farmers were divided into two categories namely, small growers (having ≤ 5 acre area) and large growers (having > 5 acre area). The information about the grower's status is given in Table 2.

Table 2. Growers' Land Holding Status.

Type of grower	No. of farmers	Percentage
Small (≤ 5 acre area)	148	49.3
Large (> 5 acre area)	152	50.7
Total	300	100

Table 2 shows that 49.3% farmers have ≤ 5-acre area and majority of the farmers (50.7 %) have above 5-acre area.

To test the significance of grower status with regard to the use of various fertilizers in nutrient kilogram, Model-2 was applied and the following parameters estimates under the models are obtained:

N-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	266.422	20.998	12.688	0.000	0.274	0.271
D_1	312.599	29.500	10.597	0.000		

P-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	88.314	7.083	12.468	0.000	0.261	0.258
D_1	101.980	9.951	10.248	0.000		

K-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	19.968	2.987	6.684	0.000	0.061	0.058
D_1	18.421	4.197	4.390	0.000		

Hence, the models obtained are:

$Y_N = 266.422 + 312.599\ D_1$ ---------- (8)

$Y_P = 88.314 + 101.980\ D_1$ ---------- (9)

$Y_K = 19.968 + 18.421\ D_1$ ---------- (10)

The above results indicate that the respective intercepts as well as the regression co-efficients of the employed models are statistically significant at both 1% and 5% level of significance. The estimated models present the significant ($p < 0.05$) effect of small and large growers for the demand of nitrogenous, phosphatic and potashic fertilizers, respectively.

Tenurial Status of the Farmers

Table 3 shows the percentages of owners, tenants and owner-cum-tenants in the study area. It indicates that half of the farmers (50%) were owners, 21% tenants and 29% owner-cum-tenants.

Table 3. Tenurial Status of the farmers.

Tenurial Status	Number of farmers	Percentage
Owners	150	50
Tenants	63	21
Owners-cum-tenants	87	29
Total	300	100

To test the significance of tenurial status with regard to the use of various fertilizers in nutrient kilograms, Model 3 was applied and the following parameters estimates under the model(s) are recorded:

N-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	364.111	35.508	10.254	0.000	0.119	0.113
D_1 (owner)	-7.253	42.313	-1.71	0.864		
D_2 (owner-cum-tenant)	221.797	46.625	4.757	0.000		

P-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	120.159	11.960	10.047	0.000	0.11	0.100
D_1 (owner)	-1.310	14.252	-0.092	0.927		
D_2 (owner-cum-tenant)	70.623	15.704	4.497	0.000		

K-Fertilizer

Parameter	Estimate	Standard Error	t-ratios	p-value	R^2	R^2_{adj}
Constant	28.737	4.661	6.165	0.000	0.030	0.023
D_1 (owner)	-4.791	5.555	-0.863	0.389		
D_2 (owner-cum-tenant)	10.207	6.121	1.668	0.096		

Hence, the models obtained are:

$Y_N = 364.111 - 7.253\ D_1 + 221.797\ D_2$ ---------- (11)

$Y_P = 120.159 - 1.310\ D_1 + 221.797\ D_2$ ---------- (12)

$Y_K = 28.737 - 4.791\ D_1 + 10.207\ D_2$ ---------- (13)

The above models indicate that the effect of "owners" is non significant at 5% level of significance ($p > 0.05$) for the demand of all three types of fertilizers, but the effect of owner-cum-tenant was found to be significant ($p < 0.05$) for the demand of N-fertilizers and P-fertilizers and, non significant for the demand of K-fertilizers ($p = 0.096$). Iqbal (1979) determined that the farmer's tenurial status play a non-significant role in the consumption of fertilizers.

Economic Factors and their Effect

In the light of economic theory it was hypothesized that the demand for fertilizers will be a function of its own weighted price, prices of their substitutes, annual on-farm income, area under the crops and the availability of annual credit. Moreover, it was also hypothesized that age of farmers will affect the demand of fertilizers in the study area.

Econometric model for demand of N-fertilizer

The following model estimates the demand for N-fertilizer:

$Y_N = 635.496 - 1.916\ X_{1N} + 0.371\ X_{2P} + 0.0098\ X_{3K} + 0.0007\ X_{4I} - 1.555\ X_{5A} + 0.0153\ X_{6C} - 1.223\ X7_{Ag}$ ------ (14)

t-ratios: (5.394) (-7.456) (5.766) (0.166) (5.736) (-0.225) (7.935) (-1.146)

P-value: (0.000) (0.000) (0.000) (0.868) (0.000) (0.822) (0.000) (0.253) $R^2_{adj} = 0.800$

The results of our study for the demand of N-fertilizers (Model-14) revealed that the coefficient of its own weighted average price is negative, the coefficient of the weighted average price of P-fertilizer is positive and that of weighted average price of K-fertilizer is also positive. The coefficient of the weighted average price of K-fertilizer is

found nonsignificant ($p > 0.05$) while the coefficients of its own weighted average price and the weighted average price of P-fertilizers are significant ($p < 0.05$) at 5% level of significance. Similarly, the coefficients of annual on-farm income and the annual credit are also positive and are significant at 5% level of significance. Further, no significant effect of farm area and the farmer's age is found ($p < 0.05$) for the demand of N-fertilizer.

Econometric model for demand of P-fertilizer

The following model estimates the demand for P-fertilizer:

$$Y_P = -220.642 + 0.922\ X_{1N} - 0.195\ X_{2P} - 0.0498\ X_{3K} + 0.00029\ X_{4I} - 3.048\ X_{5A} + 0.00445\ X_{6C} + 0.140 X7_{Ag} \quad \text{---- (15)}$$

t-ratios: (-5.171) (9.913) (-8.393) (-2.330) (6.602) (-1.216) (6.361) (0.361)

P-value: (0.000) (0.000) (0.000) (0.020) (0.000) (0.225) (0.000) (0.718) $R^2_{adj} = 0.765$

From equation (15) it is clear that the weighted average prices, the annual on-farm income and the annual credit significantly affect ($p < 0.05$) the demand of P-fertilizers. Whereas, the effect of farm area and the farmer's age is found nonsignificant ($p > 0.05$). It also indicates that there exits positive correlation between demand of P-fertilizer and the weighted average price of N-fertilizer, the annual on farm income and the annual credit, because of their positive coefficient. While, negatively correlated with the weighted average price of K-fertilizer and the farm area.

Econometric model for demand of K-fertilizer

The following model estimates the demand for K-fertilizer:

$$Y_K = 51.640 - 0.285\ X_{1N} + 0.00622\ X_{2P} + 0.121\ X_{3K} + 0.00004\ X_{4I} - 0.135\ X_{5A} + 0.00109\ X_{6C} + 0.247\ X7_{Ag} \quad \text{--- (16)}$$

t-ratios: (1.935) (-4.907) (0.429) (9.058) (1.268) (-0.086) (2.490) (-1.022)

P-value: (0.054) (0.000) (0.668) (0.000) (0.206) (0.932) (0.013) (0.308) $R^2_{adj} = 0.344$

The significance and nonsignificance of the factors for the demand of K-fertilizer is shown by Model 16. It revealed that the effect of weighted average price of N-fertilizer and its own weighted average price are found significant ($p < 0.05$) while the effect of other factors are found nonsignificant for the demand of K-fertilizers. Further it is observed that it has positive relationship with on weighted price. This result is not up to the mark.

Our results revealed that the prices of fertilizers, the annual on-farm income and the annual credit significantly affect the demand of fertilizers. Leonard (1969), Khalid and Saeed (1977) and Raju (1989) reported that the farm income significantly affect the fertilizer demand. Khalid (1979) further reported that the prices and farm area has significant effect while the agricultural credit has nonsignificant effect for the demand of fertilizers. Similarly, it was observed from the analysis that farmer's age, farm area, has no significant effect while education affects the fertilizers demand. Iqbal (1979) reported that farm size and education significantly affect the fertilizers demand; whereas, the farmer's age does not affect its demand.

CONCLUSIONS AND SUGGESTIONS

The present study has enabled us to draw the following conclusions.

Prices of fertilizers have been quite important in explaining fertilizer demand in the study area. It is, therefore, suggested that the prices of fertilizers be reduced to motivate the farmers to purchase more fertilizers for increasing agricultural production and hence the farm income.

1. Since the demand of fertilizers showed a positive relationship with the annual credit and play a significant role in the consumption of fertilizers. Therefore, it is suggested that interest free credit to the farmers be provided for the consumption of more fertilizers.
2. The education effect was found significant for the demand of various fertilizers. It is, therefore, suggested that in future, the extension workers may utilize various multimedia, visual and audio visual techniques to create awareness among the farming community about the usefulness of fertilizers. Verbal and non-verbal channels like agricultural news, journals, magazines, pamphlets and farming programs on radio and TV could also enhance the demand of various fertilizers.

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(*Accepted for publication 10 November 2004*)