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AN ANALYSIS OF COTTON LEAF CURL VIRUS DISEASE IN PAKISTAN'S PUNJAB

By

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> If WE pleased, WE could certainly make it (crop cultivated) cut down, crushed. Then a whole day would you be surprised (and say): "surely we remained indebted: Nay, we are deprived ones". .... Al-Quran

This paper attempts to identify factors that influence the incidence of the Cotton Leaf Curl Virus (CLCV) in cotton zone of the Punjab, Pakistan. The results show that practice of sowing the same variety for an extended period of time, better land preparation, normal use of fertilizer and pesticide and plant thinning help reduce the probability of incidence of CLCV disease. Farms having larger area under a particular variety of cotton show similar response. The incidence of the CLCV attack on farms being operated by experienced and educated farmers is also reported to be less. However, the attack of CLCV disease on farms operated by aged (traditional) farmers was more pronounced. Higher (excessive) use of seed and fertilizer, intensity of insect attack and soil salinity seem to increase the chances of CLCV attack. It is observed that severity of CLCV disease varied from area to area and variety to variety. The results of study on the whole are significant and carry important implications both for cotton breeders and the farmers.

1. Introduction

Cotton crop has a multi-dimensional impact on the overall well-being of the economy. It provides edible oil, animal feed, fibre and fuel to

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a large proportion of urban and rural population. It works as an economic means for a bulk of farming families, ginners, spinners, weavers, finishers and the allied industries. It supplies raw material for about 1200 ginneries, 180 spinning units, about 320 textile mills and 50 ghee mills operating in the country. It accounts for 55 percent of the domestic edible oil production. Nearly 66 percent of the total export earnings come from raw cotton, its products and by-products [Govt. of Pakistan (1996)].

Cotton production in Pakistan has been putting up a variable behaviour during the last about 15 years. Having achieved a break-through during the late 1980's mainly because of varietal improvement and use of appropriate plant protection package, cotton production touched the highest level of 12.8 million bales in 1991-92. During the recent years, the crop suffered a set-back as a result of a wide spread attack of Cotton Leaf Curl Virus (CLCV). Resultantly, cotton production dropped to 9 million bales during 1992-93, which further declined to 8 million bales during 1993-94. The CLCV menace is not new in Pakistan. Its history goes back to 1967 when it appeared in cotton fields of Multan district [Hussain and Ali (1975)]. Because of casual occurrence and minor losses, the disease did not attract much attention of the scientists or the government until it covered more than 50 percent of the total cotton area, of which 20 percent was severally affected [Ali, *et al* (1993)].

The intensity of CLCV disease varied with the varieties grown, from farm to farm and even from field to field [Farooq, *et al* (1992), Ali, *et al* (1993); Sharif, *et al* (1994); and Mirza, *et al* (1994)]. Moreover, physical scientists have also argued that the intensity of disease also depends on severity of insect attack particularly white fly, quantity and type of fertilizer used, time of sowing etc., [Mirza, *et al* (1994) and Ali, *et al* (1993)]. However, it had been observed that even under the worst circumstances, certain farmers were able to reap good cotton yields.

Keeping in view the importance of cotton crop in Pakistan's economy, the study was conducted in the major cotton growing region of the Punjab province with the objective of obtaining first hand information from the farmers for an assessment of both quantitative and qualitative factors which could help avert leaf curl virus attack on cotton crop.

2. Methodology

2.1. The Data

The study is based on cross-sectional data collected through personal interview method from the cotton growers during a field survey conducted in 1995 for 1993-94 cotton crop. The crop year, 1993-94 was selected because the attack of leaf curl virus was severe during this year. Of the four major crop ecological zones of Punjab province, the study was confined to the cotton based cropping zone. Over 80 percent area under cotton is concentrated in this zone. For the purpose of selecting appropriate sample, a stratified sampling technique was used. Firstly, the six constituent districts of the selected zone were ranked in a descending order in accordance with the area under the cotton crop. Subsequently, four districts were drawn in the above order of importance for further stratification. In the second step, one representative tehsil from each selected district was chosen using the above mentioned criterion of selection. In the third step, three villages per tehsil from the list of villages in selected tehsils were randomly drawn. Finally, from each selected village, a list of farm households was first drawn in an ascending order of size of holding. A sample of 24 farm respondents per village was finally drawn, i.e., 8 from each farm size category. The farm size categories considered were: small up to 5 hectares, medium 5 to less then 10 hectares and large 10 hectares and above. Thus, the overall sample for this study comprised 288 farmers.

2.2. Analytical Procedure

Identification of key factors responsible for the incidence of Cotton Leaf Curl Virus (CLCV) can be analyzed by using binary choice models.

Such models are appropriate when the choice between two alternatives depends on the characteristics of the problem [Pindyck and Rubinfield (1981) and Amemiya (1981)]. Alternative forms of binary choice models include the linear probability model, the logit model and the probit model [Judge, et al (1980)]. Application of linear probability models to this type of problem suffers a number of deficiencies. Firstly, the variance of the disturbance term is heteroscedastic. Secondly, the distribution of the disturbance term is not normal. Finally, it allows the predicted value of the dependent variable to fall outside the unit interval [Capps and Kramer (1985)]. These difficulties can be overcomed by using monotonic transformation (probit and logit specifications) which ensures that the values of prediction be within the unit interval [Capps and Kramer (1985)].

The probit analysis is associated with the standard cumulative distribution function. Following Capps and Kramer (1985), the probability of the incidence of the CLCV disease can be written as:

$$P_i = F(z_i) = \int_{-\infty}^{z_i} (2\pi)^{-1/2} \exp\left(\frac{-s^2}{2}\right) ds$$

Where $-\infty < z_i < \infty \text{ and } z_i = X'\beta$

Probit model has been criticized on the grounds that in econometric applications, justification of the normality assumption is not very strong [Pindyck and Rubinfield (1981) and Capps and Kramer (1985)]. Another alternative is the use of logit analysis. This analysis is associated with the logistic cumulative distribution function. For the logit model, the probability of the incidence of the CLCV disease can be written [Capps and Cramer (1985)] as:

$$P_i = F(z_i) = \frac{e^{zi}}{1 + e^{zi}}$$

Where $\infty < z_i < \infty \text{ and } z_i = X'\beta$

The change in P_i with respect to a change in X is given by

$$\frac{dp_i}{dx_i}=\left(\frac{df}{dz_i}\right)\left(\frac{dz_i}{dx_i}\right)=f(z_i)\beta$$

where f (z_i) represents the value of the standard normal density (Probit model) or logistic density function (logit model).

In this study, both the probit and logit models are estimated. The choice between these two alternative models is difficult, since the cumulative normal distribution and the logistic distribution are very much similar to each other. The only difference is that the logistic distribution has slightly heavier tails than that of the standard normal density and more closely resembles to the distribution with seven degrees of freedom [Capps and Kramer (1985), Greene (1993) and Amemiya (1981)]. Thus, for most of the intermediate values of $X'\beta$, the two distributions produce similar probabilities [Greene (1993)]. However, the results could differ; (i) when sample size is large enough where observations could fall at the tails [Maddala, (1986)], (ii) when samples include very few responses (i.e., Y=1) or very few non-responses (i.e., Y=0), and (iii) when an important exogenous variable has wide variation [Greene (1993)].

2.3. The Empirical Model

The probit/logit model used in this study to analyze the variables responsible for the incidence of CLCV disease is written as:

$$\begin{aligned} Y = \; & b_0 + b_1\,\text{GROWPRD} + b_2\,\text{LANDPRE} + b_3\,\text{SEED} \\ & + b_4\,\text{SEEDM} + b_5\,\text{FERTIL} + b_6\,\text{FERTM} + b_7\,\text{IRRIGNO} \\ & + b_8\,\text{INSECT} + b_9\,\text{PESTEXP} + b_{10}\,\text{ASOWN} + b_{11}\,\text{SALTY} \\ & + b_{12}\,\text{TIMSOW} + b_{13}\,\text{PTHIN} + b_{14}\,\text{EXPER} + b_{15}\,\text{AGE} \\ & + b_{16}\,\text{EDUC} + b_{17}\,\text{D1} + b_{18}\,\text{D2} + b_{19}\,\text{D3} + B_{20}\,\text{NIAB78} \\ & + b_{21}\,\text{CIM109} + b_{22}\,\text{CIM240} + b_{23}\,\text{MNH93} + b_{24}\,\text{BH36} \\ & + b_{25}\,\text{OTHVAR} \end{aligned}$$

Where 'b's are regression coefficients and variables as defined below:

Y	=	1 if the field is infected with CLCV disease; 0 otherwise.
GROWPRD	=	Years - variety has been grown on the farm
LANDPRE	=	Land preparation cost – including costs of deep tillage, ploughings and plankings valued at village cost in 100 rupees per acre.
SEED	=	Cotton seed sown in kgs per acre.
SEEDM	=	1 if seed sown is greater than sample average; 0 otherwise
FERTIL	=	Chemical fertilizer used per acre in kgs
FERTILM	=	1 if fertiliser is used more than sample average; 0 otherwise
IRRIGNO	=	Number of irrigations applied
INSECT	=	Intensity of insect attack: 0=nil; 1=low; 2=medium; and 3 = high
PESTEXP	=	Pesticide cost in 100 rupees per acre
ASOWN	=	Area sown in acres of particular variety
SALTY	=	Salinity level: 0=nil; 1=slightly patchy; 2=moderately patchy; and 3=highly patchy
TIMSOW	=	Time of sowing in days

PTHIN	=	Number of plant thinnings done
EXPER	=	Years of farming experience
AGE	=	Age of the farmer in years
EDUC	=	Education in years
D1	=	1 if Khanewal district; 0 otherwise
D2	=	1 if Rahim-Yar-Khan district; 0 otherwise
D3	=	1 if Bahawalnagar district; 0 otherwise*
NIAB78	=	1 if variety sown is Niab-78; 0 otherwise
CIM109	=	1 if variety sown is CIM109; 0 otherwise
CIM240	=	1 if variety is CIM-240; 0 otherwise
MNH93	=	1 if variety is MNH-93; 0 otherwise
BH36	=	1 if variety is BH36; 0 otherwise
OTHVAR	=	1 if others (except above varieties and S12); 0 otherwise*

3. Empirical Results

Descriptive statistics for variables used in logit and probit analyses are given in Table-1. Mean values of the qualitative variables refer to the proportion on a particular qualitative attribute. For example, about 39 percent of the fields were infected with the CLCV disease and on 15 percent of the fields, NIAB-78 cotton variety was sown. Mean values for continuous variables indicate averge quantities used per acre for the entire sample. For example, on an average, a farmer was growing variety for 3.85 years, using 6.59 kgs of seed, spending Rs 539 per acre for land preparation, applying 6.65 irrigations, expending Rs 1,230 per acre on pesticides, having 21.26 years of farming experience, having 5.65 years of schooling etc.

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* District Vehari has been treated as control district and S 12 as control variety.

Table 1: Descriptive Statistics for Variables Used in Logit and Probit Analyses

Variable	Unit	Mean	Std. Dev.	Minimum	Maximum
Y	Ratio	0.39	0.49	0	1
GROWPRD	Years	3.85	2.71	1	20
LANDPRE	100 rupees/acre	5.39	1.46	1.6	11.95
SEED	Kgs/acre	6.59	1.51	4	12
SEEDM	Ratio	0.48	0.50	0	1
FERTIL	Kgs/acre	75.76	28.82	0	193
FERTILM	Ratio	0.55	0.50	0	1
IRRIGNO	No	6.65	1.53	1	11
INSECT	Ratio	2.52	0.63	0	3
PESTEXP	100 rupees/acre	12.30	3.56	0.4	24.15
ASOWN	Acres	11.80	18.30	0.5	200
SALTY	Ratio	0.47	0.74	0	3
TIMSOW	Days	15.39	11.89	1	32
PTHIN	No	1.12	0.59	0	3
EXPER	Years	21.26	12.85	0	62
AGE	Years	42.57	13.22	18	90
EDUC	Years	5.65	4.89	0	16
D1	Ratio	0.26	0.44	0	1
D2	Ratio	0.20	0.40	0	1
D3	Ratio	0.28	0.45	0	1
NIAB78	Ratio	0.15	0.35	0	1
CIM109	Ratio	0.08	0.27	0	1
CIM240	Ratio	0.32	0.47	0	1
MNH93	Ratio	0.15	0.35	0	1
BH36	Ratio	0.10	0.30	0	1
OTHVAR	Ratio	0.06	0.23	0	1

The summary statistics of the probit and logit are shown in Table-2. Both the models required six iterations to generate the maximum likelihood estimates. The value of McFadden's R^2, which is commonly used to measure the goodness-of-fit for binary choice models, is 0.32 for both the probit and the logit models. McFadden's R^2 in the range of 0.2 to 0.4 is typical for such models [Capps and Kramer (1985) and Sonka, Hornbaker and Hudson (1989)]. On the basis of summary statistics, neither model performed better than the other in explaining the incidence of the CLCV disease on cotton crop. However, minor differences are found in marginal probabilities and their levels of significance.

Table 2: Summary Statistics of the Probit and Logit Analyses

	Probit Model	**Logit Model**
Number of iterations	6	6
Log of likelihood function Likelihood ratio test	- 240.24	-240.29
Mc Fadden's R^2	0.32	0.32

Empirical results for both the probit and logit models are given in Table-3. Since little is known about the relationship between the CLCV disease and the casual variables, a 20 percent level of significance is used as suggested [Manderscheid (1965) and Harper, *et al* (1990)] for such cases. Besides, the main interest is to know the direction of the effect whether the particular variable has a negative or positive influence on the intensity of the CLCV disease.

Table-3 : Maximum Likelihood Estimates and Marginal Probabilities Obtained Through Probit and Logit Models

Variable	Probit Model			Logit Model		
	Coefficient	Standard error	Marginal probability	Coefficient	Standard error	Marginal probability
Constant	+1.6394**	0.7705	-	+2.6282**	1.3075	-
GROWPRD	-0.0417*	0.0317	-0.0149	-0.0669	0.0538	-0.0141
LANDPRE	-0.1123**	0.0483	-0.0400	-0.1784**	0.0816	-0.0377
SEED	-0.0916	0.0923	-0.0326	-0.1469	0.1566	-0.0310
SEEDM	+0.3907*	0.2679	+0.1391	+0.6574*	0.4568	+0.1391
FERTIL	-0.0051	0.0043	-0.0018	-0.0095*	0.0075	-0.0020
FERTILM	+0.2938*	0.2235	+0.1036	+0.5369*	0.3861	+0.1119
IRRIGNO	-0.0649	0.0527	-0.0231	-0.1146	0.0927	-0.0242
PESTEXP	-0.0336*	0.0255	-0.0120	-0.0590*	0.0437	-0.0125
PTHIN	-0.2012	0.1334	-0.0717	-0.3592*	0.2266	-0.0759
INSECT	+0.4004**	0.1163	+0.1427	+0.6942**	0.2028	+0.1467
ASOWN	-0.0162**	0.0062	-0.0058	-0.0311**	0.0117	-0.0066
SALTY	+0.1763**	0.0996	+0.0628	+0.2698*	0.1712	+0.0570
TIM SOW	+0.0061	0.0059	+0.0022	+0.0118	0.0100	+0.0025
EXPER	-0.0367**	0.0100	-0.0131	-0.0670**	0.0179	-0.0142
AGE	+0.0249**	0.0095	+0.0089	+0.0467**	0.0170	+0.0099
EDUC	-0.0310**	0.0157	-0.0111	-0.0527**	0.0268	-0.0111
D1	-0.2631	0.2133	-0.0974	-0.4102	0.3599	-0.0928
D2	-1.7238**	0.3136	-0.3777	-3.0646**	0.5992	-0.3661
D3	+0.6471**	0.2258	+0.2530	+1.0769**	0.3826	+0.2621
NIAB78	-0.1725	0.3107	-0.0686	-0.2099	0.5383	-0.0523
CIM109	-0.2630	0.3409	-0.1042	-0.4378	0.5897	-0.1076
CIM240	-0.6357**	0.2224	-0.2400	-1.0413**	0.3755	-0.2387
MNH93	-0.3778*	0.2460	-0.1481	-0.5986*	0.4094	-0.1452
BH36	-1.2298**	0.3009	-0.3980	-2.0238**	0.5074	-0.3821
OTHVAR	-1.1207**	0.3156	-0.3830	-1.8334**	0.5385	-0.3611

* Significant at 20 percent level.

** Significant at 10 percent level or better.

A total of 25 parameters are estimated using alternative models; of which 18 are significant in case of probit model and 19 in logit model.

The parameter estimates which are significant in one or both of the models are: (1) years of variety grown on the farm (GROWPRD); (2) land preparation cost (LANDPRE); (3) seed used more than sample average (SEEDM); (4) per acre use of fertilizer (FERTIL); (5) fertilizer use above average (FERTIM); (6) pesticide cost (PESTEXP); (7) number of plant thinnings done (PTHIN); (8) intensity of insect attack (INSECT); (9) area sown of a particular variety (ASOWN); (10) salinity level (SALTY); (11) years of farming experience (EXPER); (12) age of the farmer (AGE); (13) education of the farmer in years (EDUC); (14) geographic location of the farm if located in Rahim Yar Khan district (D1); (15) if located in Bahawalnagar district (D2); (16) sowing of CIM-240 variety (CIM 240); (17) sowing of MNH-93 variety (MNH93); (18) sowing of BH-36 variety (BH36); and (19) sowing of other variety (OTHVAR).

Marginal effects of each additional year of growing the same variety at the farm reduced the probability of getting the crop infected with the CLCV disease to 0.01, which implies that it is possible that the farmers keep their own healthy seed for the next year crop. Although this variable is statistically non-significant in probit model, but is found significant in the logit model.

The land preparation variable (LANDPRE) showed negative relationship with the CLCV disease. An increase in expenditure in land preparation by one hundred rupees reduced the probability of incidence of the CLCV disease by 0.04. This perhaps results from the fact that an increase in the number of ploughings helps in the elimination of host plants of white fly, which is thought to be a carry vector of virus.

The fields where the seed was used more than the sample average were at a higher risk of getting infected by the CLCV disease as compared to fields where less seed was used. The probability of the disease risk is found to be 0.14. This probability is due to the fact that more use of seed results in higher plant intensity which is more conducive to CLCV disease.

The relationship between CLCV disease and the use of fertilizer is found negative. This relationship is statistically significant in the case of logit model and is found non-significant in the case of probit model. The use of fertilizer more than the sample average (FERTM) is estimated to increase the probability of the incidence of the CLCV disease by about 0.10. This may be due to the fact that with more application of fertilizers the cotton crop becomes tender and susceptible to insect attack including white fly.

An increase in expenditure by 100 rupees on pesticide applications reduces the probability of incidence of the CLCV disease by about 0.01. It implies that an increase in use of pesticides helps in the control of insects of the cotton crop. Higher intensity of insect attack resulted in significantly higher probability of CLCV attack. The marginal probability shows that each additional level of intensity is estimated to increase the probability of the CLCV disease attack by 0.14.

Plant thinning variable shows negative relationship with the CLCV disease. Although the coefficient of plant thinning in probit model is not statistically significant; but it is found significant in the case of logit model. Marginal probability shows that with each additional thinning, probability of CLCV disease decreases by 0.07. The results of both the models show that each additional acreage under cotton crop also reduced the probability of CLCV attack significantly. This implies that the larger farmers have higher resource base to save the cotton crop from this menace.

Cotton crop sown on salt affected soils is significantly at higher risk of getting infected by the CLCV disease. One of the potential reasons of this positive relationship is that the plants are usually under stress conditions on such soils which in turn reduces the crop's resistance to the disease.

Each additional year of farming experience significantly reduces the probability of disease attack. The same result was obtained in case of education variable. These results imply that the experienced and educated farmers are better managers than those of less experienced and uneducated ones. However, the probability of damage increased significantly with the increase in age.

The results for district dummies show that Rahim-Yar-Khan (D2) was significantly less affected than that of Vehari. The district of Bahawalnagar (D3) was significantly more affected than Vehari. The incidence between Vehari and Khanewal was not significantly different, however.

Marginal effects of 6 varieties - NIAB-78, CIM-109, CIM-240, MNH-93, BH-36 and Other Varieties are compared with S-12, since it was considered to be the most receptive variety to the CLCV disease. The results show that CIM-240, MNH-93, BH-36, and Other Varieties significantly reduced the probability of the CLCV disease. The magnitude of marginal probabilities show that BH-36 is the least affected variety followed by CIM-240 and MNH-93.

The remaining variables did not show statistically significant relationship in either of the models with the CLCV disease. These variables relate to seed sown per acre (SEED), irrigation applied (IRRIGNO), time of sowing and the dummy variables of district Khanewal (D1), NIAB-78 cotton variety (NIAB78) and CIM109 cotton variety (CIM109).

4. Conclusions

The objective of this study was to analyse and identify the factors that influence the incidence of the Cotton Leaf Curl Virus in cotton zone of Punjab, Pakistan. The results of this study showed that the greater years of sowing the same variety on the farm, better land preparation for sowing, normal use of fertilizers, use of pesticides and thinning of densely populated fields helped in reducing the probability of incidence of the CLCV disease. The fields of the farmers who had higher area under a particular variety of cotton were also less likely affected. Moreover, fields of more experienced and educated farmers were less affected by the CLCV disease. However, fields of aged farmers were at a higher risk of disease attack. Greater use of seed and fertilizer, severity of insect pest attack and salt affected soils significantly increased the chances of CLCV disease attack.

The results of this study further indicated that the severity of the disease attack significantly varied from area to area. The intensity of the CLCV disease attack also significantly differed from variety to variety.

Most important conclusions that can be drawn from this study are; (1) excessive use of fertilizer and seed are needed to be discouraged; (2) managerial capabilities of the farmers play an important role in decreasing the damage of CLCV attack; and (3) the adoption of cotton varieties having higher tolerance to the CLCV disease would significantly reduce the probability of the CLCV disease attack.

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COMPARATIVE ADVANTAGE OF WHEAT PRODUCTION IN PAKISTAN AND ITS POLICY IMPLICATIONS

By

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The present study was set to determine comparative advantage of wheat production and to see whether Pakistan qualifies for export of wheat and/or should produce wheat as import-substituting strategy to ensure food self-sufficiency. The analysis indicates that Pakistan does have competitiveness and comparative advantage in wheat production for food self-sufficiency but it does not have comparative advantage for export purposes. The sensitivity analysis depicts strong prospects for wheat production for food self-sufficiency and even for export if yield can be increased by 25 percent. The above pattern of comparative advantage can further be strengthened if indigenous technology for tractor production is introduced to reduce the costs of threshing and harvesting. The study further suggests that the country has the potential to overcome its food crisis if sincere efforts are made to avoid policy crisis and make policies consistent with our national food policy objectives.

1. Introduction

Food security means the availability of safe and nutritious food at affordable prices. It is the legitimate concern of all the countries through out the world. The major objectives of Pakistan's food policy are (i) maximum food self-sufficiency through proper incentives to producers; (ii) equitable distribution of food at reasonable prices to consumers and (iii) promotion of food grain exports. Being the staple food and major source of nourishment of the people of Pakistan, wheat ranks first both in acreage and production. Despite fertile land, strong irrigation system and extensive research over the last five decades, the country lagged behind the target of food self-sufficiency until recently.

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The population, on the other side, is growing at an exorbitant rate that demands sustainable increase in wheat productivity and its availability at cheap prices. One of the major reasons of low production is the lack of proper mix of market forces and government policies to get maximum advantages of our resources. Comparative advantage analysis is of major importance to get maximum advantage from our resources. Additional welfare gains can also be assured if proper policy incentives are used to strengthen and sustain comparative advantage in the future [Pearson, *et al* (1987), Byerlee (1989), Masters (1994) and Khan (1997)]. The principal objectives of the study were to; (i) determine comparative advantage and competitiveness of wheat production in Pakistan; (ii) assess whether Pakistan qualifies for export of wheat and/or should produce wheat as import-substituting strategy to ensure food self-sufficiency and (iii) measure the effects of policy incentives that might have favoured or discriminated against wheat production.

2. Materials and Methods

Comparative advantage of wheat production and its policy implications for food self-sufficiency/export were investigated over the four major farming regions (provinces) of Pakistan for harvesting year 1998-99. The four provinces are selected due to their diverse agro-economic and natural resource conditions. The analysis for Pakistan is obtained by taking the weighted average of provinces based on their shares in total wheat production. The cost of production data of the Agricultural Prices Commission (APCom) was supplemented by information about domestic and international prices of inputs and outputs to get representative budgets for wheat production.

The Policy Analysis Matrix (PAM) was modelled to analyze the data. The PAM is a matrix of enterprise budgets indicating costs and revenue structures. It consists of two accounting identities (Table 1).

The first identity depicted by second and third columns of the matrix shows that profit is equal to revenue minus costs measured in either private or social opportunity cost terms. The second identity shown by last column measures the policy effects i.e., the difference between observed (market) values and efficiency (social) values.

Table-1: The Structure of the Policy Analysis Matrix (PAM)

Budget items	Private budget at market prices	National budget at national opportunity costs	Policy effects (transfers)
(1)	(2)	(3)	(4=2-3)
1. Revenue	A	F	K[c]
2. Labor costs	B	G	L
3. Capital costs	C	H	M
4. Tradable input costs	D	I	N
5. Net Profitability (1-2-3-4)	E[a]	J[b]	O[d]

Source: Adopted from Comparative Advantage of US Agriculture and Effects of Policies on Agricultural Development and Trade: the unpublished Ph.D. Thesis of Noor P. Khan, 1997.

Notes:

a. Net private profitability (NPP) or competitiveness, E = (A-B-C-D).

b. Net national profitability (NNP) or Comparative advantage, J = (F-G-H-I)

c. Output Transfers, K= (A-F)

d. Total policy effects, O = (E-J) = (K-L-M-N) = (NPP– NNP).

In the PAM context, net private profitability or competitiveness (E) is defined as the difference between revenue (A) and costs (B, C, D) valued at market prices and thus incorporates the costs of all the distortions of government intervention and market failure. The net national profitability or comparative advantage (J) is defined as the difference between revenue (F) and costs of domestic factors (G, H) and tradable inputs (I) priced at national opportunity cost values. The social valuation eliminates the underlying economic costs of policy intervention and market imperfections, and therefore NNP is the measure of comparative advantage. Determination of net national profitability (NNP) is the most crucial component of the PAM analysis which applies cost-benefit analysis and basic concepts of international trade theory to determine social opportunity costs of inputs and outputs and hence profits. World (border) prices are taken as efficiency prices for tradable inputs and outputs after proper adjustment for foreign exchange rates, policy transfers and all intermediary margins, including processing, transporting, and marketing. In the analysis that follows import parity price is used to assess comparative advantage as import substitution strategy for food self-sufficiency and export parity price for producing wheat for export purposes (Annex-I and II).

The divergences between the private and social values stem from the varying interests of the farmers and the society. A crop can be profitable to farmers but its production may not be an efficient use of national resources and vice versa. The overall net policy effects (O) equals the output effects (K) less the labor market transfer (L) less the capital transfer (M) less the tradable input effects. The net transfer can also be found by subtracting social profitability from private profitability ($O = E - J$). This kind of analysis is useful to know whether the activity is profitable because of policy incentives ($J < 0$, $O > 0$) or because of comparative advantage ($J > 0$). More specifically, the positive value for net transfer indicates that policies have supported the activity and private profitability has increased. While the negative value means that resources are transferred from this particular activity and private production is discouraged.

3. Policy Analysis Matrix Results

3.1 Private profitability (competitiveness)

Table-2 summarizes competitiveness of wheat production in the four provinces of Pakistan. It shows that wheat is a profitable enterprise for farmers in Sindh followed by Punjab and Balochistan. The private profitability of wheat in Sindh is Rs 1,297 per acre, followed by Punjab amounting to Rs 483 per acre. Farming of wheat in Balochistan shows private profitability of Rs 29 only. Farmers in NWFP are making losses by producing wheat to the tune of Rs 1,004 per acre. The high private profitability of wheat production in Sindh and Punjab is mainly due to comparative lower cost of land rent and mechanization (harvesting and threshing) and high yields in these regions. The opposite is true in Balochistan and the NWFP that explain the lower and negative profitability of wheat respectively. High water charges are another factor for low wheat profitability in Balochistan. The high cost of land in NWFP is due to the high value competing crops and limited land resources. The country on the whole, however, shows strong private competitiveness in wheat production.

Table-2: Private Profitability of Wheat Production

Farming regions	Profitability
	Rupees per acre
Pakistan	1126
Punjab	483
Sindh	1297
NWFP	-1004
Balochistan	29

3.2 Net social profitability (comparative advantage)

Measuring profitability in terms of opportunity costs alters relative incentives for farmers and, therefore changes the ranking based on private profitability. Most of the changes in the ranking of social profitability have occurred due to high opportunity costs of land and use of export/import parity prices instead of market prices. National or social profitability both for import substitution and export promotion is set in Table-3. Net social profitability of wheat is highly positive in Sindh and Punjab as import substitution strategy and positive only in Sindh in export regime. The social profitability of wheat is better as import substitution than in export regime. The analysis indicates that no farming region (except Sindh) can produce wheat for export given the current agricultural conditions and policies. Wheat can be produced with further comparative advantage for import substitution/food self-sufficiency if efforts are made to make the micro-macro economic policies consistent with our food self-sufficiency policy.

Table-3: National Profitability of Wheat Production

Farming Regions	Import Substitution	Export Promotion
	---- Rupees per acre ----	
Pakistan	2203	-493
Punjab	2643	-175
Sindh	2670	729
NWFP	-11	-3096
Balochistan	-2914	-4957

3.3 Policy effects on wheat profitability in Pakistan

One of the objectives of this study was to compare and contrast private and social profitability of wheat production in Pakistan to determine whether the policy incentives have favoured or discriminated against wheat production and to know whether the current policies are consistent with our national food policy objectives.

Table-4 provides complete PAM budgets where the fourth column shows the transfer of resources from (and to) farmers. In the major wheat producing provinces of Punjab and Sindh policy transfers are negative, showing resource transfers from the farmers to the consumers. The same is true for NWFP, while in Balochistan resources are transferred to the growers. The country lacks consistent polices to minimize costs of production and improve revenue by introducing high yielding varieties and proper price support.

The net policy effects show that generally the production of wheat is discouraged in the country given the current set of conditions and policies.

Table-4: Policy Analysis Matrix Results of Wheat: 1998-99

	Market prices	Opportunity costs	Transfers
Pakistan			
--------- Rupees per acre --------			
Output	7933	9630	-1697
Labor	1302	1302	-
Capital	2915	3069	-154
Tradables	2590	3056	-466
Profitability	1126	2203	-1077
Punjab			
Output	6919	9656	-2737
Labor	1213	1213	-
Capital	2850	3000	-150
Tradables	2372	2799	-427
Profitability	483	2643	-2160
Sindh			
Output	7714	9686	-1972
Labor	1071	1071	-
Capital	2850	3000	-150
Tradables	2495	2944	-449
Profitability	1297	2670	-1373
NWFP			
Output	8305	8718	-413
Labor	1378	1378	-
Capital	4212	2962	1250
Tradables	3720	4390	-670
Profitability	-1004	-11	-993
Balochistan			
Output	11567	10193	1374
Labor	3216	3216	-
Capital	3772	4522	-750
Tradables	4549	5368	-819
Profitability	29	-2914	2943

3.4 Comparative advantage under different yield conditions

The PAM baseline results provide a clear picture of national comparative advantage. In the PAM framework, sensitivity analysis can be defined as the impacts of marginal change in input-output coefficients on national comparative advantage. Generally, a number of scenarios based on alternative conditions and policies can be studied, price support is one alternative. The price support, however, improves farmer's income in the short-run but increases the cost of wheat production in the long-run due to price support capitalisation into the land. The other alternative is the improvement of yield and wheat productivity. The wheat yield in Pakistan is lower than many countries in the World. Pakistan usually imports wheat from US. The yield of US is almost 25 percent more than that of Pakistan, though under different conditions. Thus, an effort here has been made to carry out sensitivity analysis by assuming a net 25 per increase in per acre yield keeping cost of production constant at current level.

Table-5 suggests that 25 percent positive net change in wheat yield above baseline can significantly improve comparative advantage of wheat production for food self-sufficiency. The analysis further indicates that a 25 per cent net increase in yield will not only strengthen the existing pattern of comparative advantage but also will turn some farming regions nationally profitable that were producing wheat previously with comparative disadvantage. Investment in technology that brings about a larger increase in yield would show a wholesale improvement in the social profitability of wheat production both under import substitution and export promotion regimes.

Table-5: Comparative Advantage of Wheat Under 25% Increase in Yield While cost of Production Remains Constant at Current Level

Farming regions	Import substitution	Export promotion
	---- Rupees per acre ----	
Pakistan	4612	1242
Punjab	5056	1533
Sindh	5091	2664
NWFP	2170	-1686
Balochistan	-366	-2920

4. Summary and Conclusions

The Policy Analysis Matrix was modelled to determine the competitiveness and comparative advantage of wheat production in Pakistan and whether the country qualifies for export of wheat or should produce wheat for food self-sufficiency. Another major objective of the study was to see the policy effect that might have favoured or discriminated against wheat production in Pakistan.

The results of the PAM exercise indicate that of all the provinces, wheat is the most competitive in Sindh, followed by Punjab. The private profitability in Sindh is Rs 1,297 per acre, Rs 483 in Punjab and Rs 29 per acre in Balochistan. Farmers in the NWFP given the current set of farming conditions and policies, are making loss of Rs 1,004 per acre by producing wheat.

The PAM results showed that Pakistan does have comparative advantage in wheat production for food self sufficiency but not for export purpose at the current input-output and price relationship. It is crystal clear from the results that no farming region (except Sindh) in Pakistan can produce wheat for export given the current conditions and policies. The export of wheat is merely an efficiency loss of scarce resources that might be used to produce other more socially profitable products or needed crops. The current export of wheat is subsidizing consumers of importing country from the tax payers' money of Pakistan. Wheat, however, can be produced with comparative advantage for import substitution and this advantage can further be improved, if efforts are made to make the micro-macro economic policies consistent with our food policy objectives.

The results show that farmers received less than the long run world prices during the 1998-99-harvest year, for which the private profitability is positive. The analysis shows negative price and income policy effects that might have discouraged wheat production in Pakistan. Also the yield of wheat is very low that reflects inadequate agricultural research and development efforts to develop high yielding varieties of the crop. Another policy area needing the attention of the concerned quarters is the high costs of harvesting and threshing specially in NWFP and Balochistan.

The sensitivity analysis indicated that a 25 percent net increase in yield will not only turn some farming regions nationally profitable in wheat production that were producing wheat previously with comparative disadvantage but also will strengthen the existing comparative advantage of wheat production thereby strengthening the prospects of its exports.

Wheat is the major staple food for 140 million people of Pakistan and has strong politic-socio-economic importance for the country. Pakistan like other sovereign countries no longer can depend on other countries for wheat import or food aid in the coming future. Therefore, it is high time for researchers, administrators and policy makers in Pakistan to think ways and means to promote wheat production self-sufficiency.

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ANNEX-I

WHEAT EXPORT PARITY PRICES USED IN PAM BUDGETS

Steps	Pakistan	Punjab	Sindh	NWFP	Balochistan
Fob price at Karachi (US $/tonne): 1994-95 to 1998-99 average	156	156	156	156	156
Fob price at Karachi (Rs/40 kgs at 1999 official Exchange rate	287	287	287	287	287
- Less Transport and other charges from farm gate to port	35	40	22	57	22
= Export parity at farm gate	252	247	265	230	265
X Quality correction factor	99%	99%	99%	99%	99%
= Quality corrected export parity prices at farm gate.	247	245	262	228	262

Sources:

1. Economic Survey of Pakistan, 1998-99, Finance Division, Economic Wing, Islamabad, Pakistan.
2. Comparative advantage of agricultural production systems and its policy implications in Pakistan, FAO Rome, 1987.

ANNEX-II

WHEAT IMPORT PARITY PRICES USED IN PAM BUDGETS

Steps	Pakistan	Punjab	Sindh	NWFP	Balochistan
CIF price at Karachi (US $/tonne) : 1994-95 to 1998-99 average	168	168	168	168	168
CIF price at Karachi (Rs/40 kgs at 1999 off. exchange rate)	309	309	309	309	309
+ Add transport and other charges from farm gate to port	35	40	22	57	22
= Import parity at farm gate	342	349	331	356	331
X Quality correction factor	99%	99%	99%	99%	99%
= Quality-corrected import parity prices at farm gate	339	346	328	353	328

Sources: Sources given in Annex-I.

INTERVENTION IN AGRICULTURAL COMMODITY MARKETS: A VIEW POINT

By

Dr. Abdul Salam*

State intervention in agricultural markets dates back to 17th century B.C., when the Egyptian Government of that time devised and implemented a comprehensive food security programme of procuring food grains for seven consecutive years of plenty and preserving and rationing their release through the next seven years of great famine. The governments of today all over the world have also been intervening in agricultural commodity markets in one form or the other. Notwithstanding the current trend towards liberalization of economic activities, programmes providing for guaranteed producer prices for farm produce are still in vogue in many countries. In view of the importance of agriculture in addressing the issues relating to poverty alleviation and food security in Pakistan and the role of pricing policy in improving economic environment of the farmers, economic considerations and related concerns are highlighted for the continuation of the system of support prices in the country.

1. Introduction

During the recent past, a number of articles and lead articles have appeared in the newspapers on the subject of support price policy [Klasra, The News (April 14, 2001), Rasool, DAWN, Economic & Business Review (May 14 – 20, 2001), Ziauddin, DAWN, Economic & Business Review, (April 16 – 22, 2001), Business Recorder, (May 9,

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2001), DAWN (May 9, 2001)]. However, these articles neither covered/discussed the essential features of the programme nor addressed the conceptual issues involved. The articles barely touched the rationale for the programme in the context of obtaining ground realities and merely mentioned reliance or otherwise on market forces. It is with this background that this article is being penned to highlight the salient features of the support price policy in Pakistan, and its economic rationale and the future requirements/modifications to achieve the programme objectives. The paper is divided into 6 sections. The case for market intervention in agriculture is set out in Section 2, followed by brief discussion on support price policy in Pakistan in 3rd section. Role of price policy in transforming agriculture is highlighted in section 4. The need for continuing the support price policy is spelled out in section 5 in the light of observations from authoritative sources on the subject. The discussion is rounded off in the concluding section 6.

2. Why Intervene in Agricultural Commodity Markets?

The prices of agricultural commodities experience wide fluctuations on account of (i) their low price elasticity of demand (ii) biological nature of production, and (iii) seasonal nature of agricultural industry i. e. output becomes available at particular time(s) in a year (Kahlon and Tyagi 1983).

As a sequel to inelastic demand proportionate increase in supply of farm products would result in greater decline in prices and vice versa. Similarly, in years of poor harvest marketable surplus declines more than the proportionate fall in production. Consequently, marginal changes in production are generally followed by disproportionate changes in the prices.

Agricultural production cannot be adjusted to changes in prices as rapidly as in other sectors due to time lag, especially for the commodities having low supply response. Due to seasonal nature of production, temporal distribution of supply is uneven while consumption in most of the cases is spread throughout the year. The bulky nature of the commodities, lack of on-farm storage facilities and liquidity requirements of farmers aggravate the seasonal glut in the commodity markets. Thus, prices of farm production are depressed during the post harvest period but tend to rise during the off-season when farmers have sold their produce. These fluctuations in prices add to the risk and uncertainty, the hallmarks of agricultural production.

The agricultural production reflects wide year-to-year variations mainly due to changes in weather conditions. The fluctuations are more pronounced in case of agriculture based on rainfall or having low levels of modern inputs use and technology.

Multitudes of small farmers, unorganized and scattered over wide area make considerable contribution to the farm production and also provide markets for the goods of the industrial sector. According to the 1990 Census of Agriculture, about 81 per cent of the total farms in the country are below 12.5 acres. These farms account for 39% of cultivated area, 49% of wheat acreage, 54% of rice, 43% of cotton, 48% of sugarcane, 39% of potato, 35% of the oilseeds and 24% of the area under pulse crops [Census of Agriculture (1990)]. Farmers in general, and small ones in particular, neither have adequate storage facilities nor sufficient staying power to hold on to their marketable surplus in the hope of getting better prices later. Thus, these farmers are forced to part with their surplus produce soon after the harvesting when prices are generally at the lowest level. These farmers producing under financial constraints have to indulge in distress sales at harvest time to meet their pressing requirements of cash. Left to the vagaries of imperfect markets, dominated by cartels of processors and middlemen, the farmers are hard pressed to sell their produce at abnormally low prices during the harvest season so as to meet their production and consumption needs. Such a situation will have adverse impact on the efforts aimed at alleviating rural poverty and addressing issue of food security at macro level.

As the market prices of farm products exhibit wide fluctuations from year to year as well as within a given year, the governments all over the world have been intervening in the commodity markets in one form or the other, to reduce the price risk. Notwithstanding the current trend towards liberalization of economic activities, programmes providing for guaranteed producer prices aimed at correcting the deficiencies of the market system of farm commodities are still in vogue in many countries, including E.U, U.S.A, Canada, Australia, India, etc. It would not be out of place here to mention that state intervention in agricultural marketing is not a recent phenomenon. In the history of agriculture it dates back to 17th century B.C., when the Egyptian Government of that time devised and implemented a comprehensive food security programme and procured food grains for seven consecutive years of plenty (good crop harvests) and stored the same and rationed their release during the next seven years of great famine (Al-Quran).

3. Support Price Policy in Pakistan

The Government of Pakistan annually reviews and announces the support prices of important commodities. The support prices are meant to act as minimum but guaranteed prices for the growers during the post harvest period. The sale of the produce at the support prices by the growers to the designated agencies is voluntary. In case market prices rule higher, farmers are under no obligation (in theory at least) to sell the produce to Government agencies at the fixed price. The support prices were previously fixed for wheat, cotton, rice, sugarcane, gram, potato, onion and non-traditional oilseed crops i.e. sunflower, soyabean, safflower and canola but recently it has been decided to limit the programme to four major crops of wheat, cotton, rice and sugarcane.

The price policy, as in vogue, in Pakistan has been primarily aimed at reducing price uncertainty for growers. In case of wheat, the major thrust of the price policy has been to maintain consumer prices at a reasonable level as the Government, in addition to announcing support price also fixes issue price, following a policy of pan-territorial and uniform issue price. Moreover, wheat imports have been, by and large, a government monopoly. The voluntary sale by the growers has often in practice, been violated either by restricting commodity movement, and/or through compulsory procurement. In case of export crops, resource mobilization through monopoly exports and export taxes has also been the main objective of agricultural pricing policy.

The objective of providing an insurance against uncertain prices, however may be negated in practice if arrangements for buying the produce at the guaranteed price in the post harvest months are not in place. This has happened many a times.

One of the important functions of fixing prices is to influence the resource allocation among competing enterprises. The pricing policy if judiciously used, can be an important tool in shifting the resources among competing enterprises. This would, however, require careful selection of the commodities from the competing crops as fixing prices of too many commodities competing with each other may not be helpful for shifting required resources and adjustments in cropping patterns.

The factors considered in determination of the level of support prices which inter alia include cost of production, international prices, export/import parity prices are discussed at length by Afzal, *et al* (1992), Niaz (1995) and Salam (2001).

The commodity coverage of support price programme, untill recently, encompassing wheat, cotton, rice, sugarcane, oilseeds, potatoes, onions, gram, tobacco extended to over 70 per cent of the annual cropped area. Implementation of support price covering such a wide area had taxed the administrative capacity and the limited financial resources. This lately became quite apparent as in a number of cases market prices fell below the level fixed by the Government but either no or inadequate arrangements were made for market intervention. A number of organizations such as Rice Export Corporation, Cotton Export Corporation, Agricultural Marketing & Storage Limited etc., have been wound up. The budgetary constraints and donors' pressure have also not been favourable to the government intervention.

Under such circumstances it may be advisable to limit the scope of the programme, as argued by Vyas (1994), to those commodities which are crucial (pace setters) and where technological breakthrough has been either made or is likely to be. Another important consideration in this context could be crops like gram, grown under high risk conditions where no viable alternatives are available and need to be protected against high price risk. In a high level meeting on May 7, 2001, it was decided to curtail the coverage of support price programme to wheat, cotton, rice and sugarcane crops only.

4. Transformation of Agriculture: Role of Price Policy

The literature on development of agriculture has emphasized the role of positive agricultural price policy in transforming subsistence agriculture [Raj Krishna (1967) and Schultz (1964)] which is by and large, a technological phenomenon. Favourable price movements can speed up the diffusion of innovations, absorption of new inputs, the utilization of idle capacity and institutional adjustments, thereby facilitating the modernization and development of agriculture . Among the technological factors, the development of irrigation and other infrastructure is the most important. Technological break-through is nevertheless predicated on the development and availability of modern inputs such as improved seeds, fertilizers, farm equipment, etc. It is also important that the technology package is cost effective and farmers have faith in the efficacy of that package.

The pricing policy by easing concerns of the growers pertaining to price uncertainty and providing a conducive economic environment for farm investment can motivate farmers in the adoption of technology. The role of technological developments and purchased inputs in sustaining production in commercial agriculture has assumed much greater importance. Uncertainty surrounding their supply, for whatever reasons such as inelastic supply because of production constraints, import limitations due to inadequate/delayed availability or allocation of foreign exchange, as well as price uncertainty because of fragmentation and market imperfections must not be allowed to stand in the way of their wide spread use. The income stream of farmers, because of the seasonality of production, seldom matches with their expenditure. Thus, liquidity problems and resource constraints of the farming community which impact on their inputs use ought to be addressed to facilitate investments in technology adoption.

However, it is important that prices once fixed by the Government are ensured to the growers at the harvest time when they bring in their produce. There have been a number of instances when the Government fixed prices were not ensured and farmers received much lower prices and they reduced their production in the next season.

5. Rationale For Continuing Price Policy Intervention

The Holy Quran while describing the causes of migration of the sons of Prophet Jacob (۴) points out an event that stresses the role of public sector in agricultural commodity marketing. Prophet Joseph (۴) interpreted the king's dream that seven years of great famine would follow the seven years of plenty, and on the request of the king formulated a comprehensive food policy. Under this policy, he continued procuring and preserving food grains for the seven consecutive years of plenty. When the cycle of good crop harvests was over and drought spread not only in Egypt but also in the neighbouring countries, Prophet Joseph (٣) devised a rationing system for providing food grains at reasonable prices to its country men as well as to the needy people coming from abroad. This event though does not provide us much arguments for public intervention but it do emphasize the role of a welfare state to intervene in agricultural commodity markets whenever the circumstances warrant.

V. S Vyas (1994) has noted that in a poor agricultural country the rationale of a positive agricultural price policy derives from the considerations of **equity, productivity** and **stability. Equity considerations** may aim at; (i) ensuring a price level for important commodities covering their cost of production, (ii) assuring reasonable terms of trade for agriculture and (iii) containing prices of output to arrest inflationary pressure in the economy. **Productivity considerations** prompt measures aimed at; (i) providing a conducive economic environment for the adoption of technology package in certain crops by announcing incentive prices, and (ii) influencing resource allocation among competing crops by changing inter-crop price relationships. **The stability considerations** seek to reduce seasonal fluctuations in prices.

The participation by the marketing functionaries and channels in the private sector has all along characterized the marketing of agricultural commodities in Pakistan. Nevertheless, available evidence suggests the fragmentation of commodity markets. Considerable time lag has been involved in adjustment of prices in the small markets with those located in commercial towns/cities [Kurosaki (1996) and Tahir & Riaz (1997)]. This has implications for the farmers in general and small growers in particular. Commodity markets in Pakistan are also dominated by powerful processors and their cartels. Multitudes of small and unorganized farmers cannot match and counteract their influence. Left to the vagaries of imperfect markets and at the mercy of the powerful cartels, the farmers are most likely to get a raw deal. Systematic differences in prices received by various groups of farmers are often pointed out at various forums.

Timmer (1996) has observed that domestic price stability induces the small farmers to specialize in single crop production and also results in regional diversification which helps the surplus not to develop at national level. But this strategy depends on price stabilization. Otherwise individual farmers must diversify to spread risk from price fluctuations.

Tomek and Robinson (1990) have observed that fluctuating prices result in inefficient use of resources both in production and processing. Government intervention in pricing , if it leads to stable and predictable prices, can have positive impact on resource use efficiency.

Bathrick (1998) argues globalization is forcing poorer agrarian based economies to assess their natural comparative advantage and quickly adapt their policies and structures to meet the new challenges. These changes no doubt, offer lot of new opportunities but many of the producers lack the relevant experience, skills and financial support to make the desired adjustments. Bathrick has observed that breaking from the past, agriculture has emerged as a leading economic sector. But its benefits are not as broadly based as could be the case. The majority of small to medium farmers and rural non-farm families are ill prepared to either gain the broader benefits of the changes in agriculture or respond to previously unknown competitors. Furthermore, distant and possibly more efficient producers now have more opportunities to penetrate markets or expand their market shares. However, with aggressive initiative and internal reforms, providing small and medium farmers and agricultural business with essential skills, tools and infrastructure and facilitating private investment these countries would be better suited to face the challenge and achieve more sustainable growth in political, economic and environmental terms, observes Bathrick.

As pricing policy cannot be a panacea for all the problems afflicting the agriculture sector, Mellor and Ahmed (1988) have emphasized to define the goals and objectives of pricing policy and design the policy instruments accordingly. Having defined its role and given the will to implement, judiciously formulated pricing policy can play an important role in achieving the programme objectives. By providing assurance about the producer prices at the harvest time, pricing policy can also facilitate technology adoption and increase resource productivity in the sector. Effective implementation of price policy would not only lessen the dependence of small and marginal farmers on higher cost non-institutional credit but also provide a conducive environment for farm investment and increase agricultural production.

6. Concluding Observations

The current global economic environment puts a premium on the free market economy, withdrawal of government from economic activities, de-emphasizing the role of public sector and increasing that of the private sector. However, at this stage of its development with fragmented and imperfect commodity markets, dominated by powerful vested interests, Pakistan can ill afford the unbridled policies of free market economy, without adequate checks and balances in general and in marketing of agricultural commodities in particular. Moreover, the support prices which act as minimum guaranteed prices during the harvest season do not interfere with the functioning of commodity markets. But mere announcement of support prices without adequate institutional arrangements and logistic support for their implementation will adversely affect the growth of agriculture with serious implications for the economy and well-being of the farmers. It is imperative to devise a long-term policy for agricultural development, including the support price programme backed with adequate institutional and financial arrangements for implementation.

The essence of liberalization reforms is to increase competition and improve competitiveness in the economy. The Government policy of announcing the support prices of important agricultural commodities in such situations not only provides a floor to the market but also strengthens the bargaining position of the growers by providing a reference point. It is not meant to replace the markets but to correct the market failures in situations of market gluts in the harvesting seasons. The support price programme acts as a bulwark against the collusion of processors and traders and tries to improve the functioning of the marketing systems.

No system comes without cost. But the benefits of the system in terms of increased production, higher productivity, and food security needs to be carefully weighed against the likely costs incurred in the process. At the same time role of pricing policy in poverty alleviation via inducing higher growth rate in the agriculture sector through technological changes needs to be recognized. The benefits of the positive pricing policy in agriculture sector in terms of productivity, equity and contribution to the causes of food security and poverty alleviation, if properly quantified in a country like Pakistan, should considerably outweigh the costs attributed to the programme. Effective implementation of price policy would also help reduce the dependence of small and marginal farmers on high cost non-institutional credit.

In view of the increasing input prices and water shortages, risk factor in agricultural production is on the increase. Risk on account of technical factors can be mitigated through technological/agronomic developments and their adoption on a large scale. But the adoption of technological developments leading to increased production requires conducive economic environment. Fixation of judiciously determined minimum guaranteed prices by assuring equitable price at the harvest time can be quite helpful in this context, otherwise it is most likely that prices in the wake of good harvest may crash, disheartening the growers in the process. One of the most important stumbling block in the implementation of the price policy in Pakistan has been the operational costs/losses of the implementing agencies. It is imperative to rationalize and economize the costs involved in the procurement of commodities. But it is also important to provide administrative and financial authority and autonomy to the agencies concerned with the programme implementation to enable them to take timely decisions. The operational costs involved in the procurement operations can be met by levying a small cess on the produce sold by the growers to these agencies.

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A REVIEW OF SUPPLY RESPONSE OF MAJOR CROPS IN PAKISTAN

By

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This paper reviews the economic literature on supply response of major crops in Pakistan. Of the two empirical approaches to estimating supply response - econometric and programming - all ten studies that have been identified and included in this review use the former approach. Accordingly, focus has been laid down on this methodology before reviewing the studies themselves. Moreover, other lines of inquiry for further research have also been suggested.

1. Introduction

There are two aspects to agricultural supply response: first, the physical response of output to inputs use (as expressed by the production function) and second, the behavioural response to input and output prices. The theory, normally constructed on the basis of a representative farm, involves identifying its objective and deriving the determinants of supply. The aggregate system is then assumed to behave analogously. Empirical estimation is used to measure the relationships and to test the validity of the theoretical model. Since prices are one of the most important policy instruments to influence resource allocation, most studies have also focussed on estimating supply price elasticities.

There have been a number of reviews of agricultural supply response including Nerlove (1958a, 1979), Askari and Cummings (1976, 1977), Scandizzo and Bruce (1980), Colman (1983), Rao (1989), Behrman (1989) and Hennebery and Tweeten (1991), which discuss and provide critiques of the alternative methodologies. This review

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concentrates on the Nerlovian model since nearly all the studies, identified here, use this method.

The aim of this paper is to review the literature on agricultural supply response which relate to the major crops in Pakistan. First, the empirical methodology is reviewed and, second, empirical results are examined. A final section summarizes and identifies two other lines of econometric inquiry for further research.

2. Econometric Methodology of Agricultural Supply Response Analysis

Agricultural supply response studies in Pakistan have all used annual time series data at an aggregate level. They examine either a single commodity, or several commodities either independently or simultaneously. The most important development in direct supply response models is Nerlove's (1958a) adaptive expectations (AE) and partial adjustment (PA) models and many studies of crop response in both developed and under-developed countries have used this approach [Koyck (1954), Nerlove (1956, 1958b) and Griliches (1967)]. By the mid-1970's, over 600 supply response studies of this basic type had been undertaken throughout the world [(Tsakok (1990)].

First, consider the AE model. Assume that quantity supplied (Q_t) is a function of expected price (P_t^*). In a linear form this relationship is expressed as:

$$Q_t = \beta_0 + \beta_1 P_t^* + \beta_2 Z_t + u_t \qquad (1)$$

where Z_t denotes other exogenous factors and u_t is a disturbance term. Since expected price is un-observable, the expectations are assumed to be formed as:

$$P_t^* = P_{t-1}^* + \delta(P_{t-1} - P_{t-1}^*) \qquad 0 < \delta \le 1 \tag{2}$$

where P_t denotes actual price in period t and δ is the coefficient of expectation. If $\delta \to 0$, there is no difference between this year's expected price and last year's expected price, and if $\delta = 1$, expected price is identical to last year's actual price. Equation (2) implies that farmers adapt their expectations of future price in the light of past experience and that they learn from their mistakes. By rearranging (2), it can easily be shown that the current year's expected price is a proportion of both last year's actual and expected prices. Thus, price expectations are a weighted moving average of past prices in which the weights decline geometrically. Substituting (2) into (1) and rearranging gives:

$$Q_t = \delta\beta_0 + \delta\beta_1 P_{t-1} + \delta\beta_2 Z_{t-1} + (1-\delta)Q_{t-1} + v_t \tag{3}$$

where $v_t = u_t - (1-\delta)u_{t-1}$ which is the AE model.

Now consider the PA model. Assume that desired output Q^* is a function of price (P_t) and other exogenous factors (Z_t):

$$Q_t^* = \beta_0 + \beta_1 P_t + \beta_2 Z_t + u_t \tag{4}$$

Since desired output is un-observable, the PA hypothesis is:

$$Q_t - Q_{t-1} = \lambda(Q_t^* - Q_{t-1}) \qquad 0 < \lambda \le 1 \tag{5}$$

where λ is the output adjustment coefficient and indicates the speed of adjustment between desired and actual output in the previous period. If $\lambda \to 0$, output remains unchanged from year to year, and if $\lambda = 1$, adjustment is instantaneous. Typically, adjustment to the desired output level is likely to be incomplete because of physical and institutional constraints, fixed capital, risk etc. Note also that λ provides the link between the short and long-run elasticities: the long-run price elasticity is equal to the short-run elasticity divided by λ. Rearranging (5) and substituting into (4) gives the PA model:

$$Q_t = \lambda\beta_0 + \lambda\beta_1 P_t + \lambda\beta_2 Z_t + (1-\lambda)Q_{t-1} + \lambda u_t \qquad (6)$$

Combining (1) and (4) gives:

$$Q_t^* = \beta_0 + \beta_1 P_t^* + \beta_2 Z_t + u_t \qquad (7)$$

where both desired output level (Q_t^*) and expected price (P_t^*) are un-observable. Substituting (2) and (5) in (7) gives the estimating equation:

$$Q_t = \alpha_o + \alpha_1 P_{t\text{-}1} + \alpha_2 Q_{t\text{-}1} + \alpha_3 Q_{t\text{-}2} + \alpha_4 Z_t + \alpha_5 Z_{t\text{-}1} + v_t \qquad (8)$$

where $\alpha_0 = \delta\lambda\beta_0$, $\alpha_1 = \delta\lambda\beta_1$, $\alpha_2 = (1-\delta)+(1-\lambda)$, $\alpha_3 = -(1-\delta)(1-\lambda)$, $\alpha_4 = \lambda\beta_2$, $\alpha_5 = -\lambda\beta_2(1-\delta)$, and $v_t = \lambda u_t - \lambda(1-\delta)u_{t-1}$.

The reduced form of (8) is over identified, since there are six reduced-form α–coefficients but only five structural parameters $(\beta_0, \beta_1, \beta_2, \lambda \text{ and } \delta)$. A further problem with (8) is the presence of a lagged dependent variable on the right hand side which makes the estimated parameters not only biased but also inconsistent if the error term is serially correlated. This has led various authors to propose alternative methods of estimation [Koyck (1954) and Nerlove (1958c)]. There are number of alternative estimable versions of the Nerlovian model where there is either no AE (δ =1) or no PA formation (λ =1). The former applies to the situations where administered prices are announced at planting time, implying $P_t^* = P_{t-1}$ [Sadoulet and Janvry (1995)]. The latter applies to situations where there are no fixed factors, and adaption is completed in a single period, implying $Q_t = Q_t^*$. The third alternative is where no exogenous supply shifters, (Z_t), are included and the restricted models, with either $\delta = 1$ or $\lambda = 1$, cannot be distinguished at the reduced form level.

Criticism of Nerlove's model has focussed mainly on its inadequate theoretical base and on the statistical estimation problems arising when ordinary least squares (OLS) is used [Johansen (1960), Griliches (1967), Doran and Griffiths (1978), Maud (1979), Hennebery and Tweeten (1991)]. There are four issues. First, farmers do not necessarily change their expectations of prices with observed price changes if these changes are considered temporary. Therefore, the formation of price expectations may overestimate real expected price changes and results may underestimate the true aggregate supply response. Second, prices are expressed in terms of current market realizations with expected prices defined in terms of past prices. There has been controversy about which price is appropriate for a particular crop and or region. Third, price expectations involve uncertainty but the price expectations coefficient is assumed to remain constant over time. This may be unrealistic because technical, economic and structural conditions may change over time. Fourth, the Nerlovian model fails to account for possible nonstationarity of the time series data; the model is formulated in terms of the levels of the variables and OLS requires that these series are stationary, which is not the case for most time series. It is argued that agricultural time series tend to be trended and regressions of trended data may produce significant results with high R^2s [McClelland and Vroomen (1988), Townsend and Thirtle (1994), and Schimmelpfenning *et al* (1996)], but may be spurious [Granger and Newbold (1974)]. The main advantage of the direct supply models is that they are simple in terms of data requirements and estimation procedure. Furthermore, they take into account the aggregate supply data which is the object of interest for future projections, and they handle dynamic adjustments to supply in such a way which other procedures do not.

3. Empirical Studies of Supply Response in Pakistan Agriculture

Much research has attempted to quantify supply response of crops in developing countries [Askari and Cummings (1977), and Henneberry and Tweeten (1991)]. This section reviews those that examine supply response of wheat, cotton, sugarcane, and rice in Pakistan. Annex-I provides a summary of the results.

Krishna (1963) studied the Punjab (un-divided) province, estimating acreage response for wheat, cotton, sugarcane, and rice for 1913/4-1945/6. OLS is used to estimate the PA model for each crop using equation 6 developed earlier in this paper. Crop acreage is assumed to be a function of lagged relative price (ratio of crop price to the price of alternative crop), lagged relative yield (ratio of crop yield to yield of alternative crop), total irrigated area, rainfall, and lagged acreage. Separate models are estimated for irrigated and non-irrigated wheat. For irrigated wheat, acreage is unresponsive to relative prices: the short and long-run price elasticities being 0.08 and 0.14. For non-irrigated wheat, acreage is more responsive to rainfall and the long-run price elasticity is estimated 0.22. For cotton, the acreage of American varieties is highly responsive both to its relative price and to the total irrigation capacity; the short and long-run price elasticities are 0.72 and 1.62. For local varieties, relative yield is an important explanatory variable besides relative price: The short and long-run price elasticities are 0.59 and 1.08. The sugarcane acreage planted in year t is influenced more by its price in year t-2 than in year t-1: the short and long-run price elasticities are 0.34 and 0.60 with regard to price in t-2, and 0.17 and 0.30 with regard to price in t-1. For rice, relative yield turns out to be an important explanatory variable besides relative price: The short and long-run price elasticities are 0.31 and 0.59. On the basis of these results, Krishna concludes that peasant farmers in the Punjab respond rationally to the economic incentives.

Falcon (1964) used OLS and the PA model as developed in equation 6 to estimate short-run acreage responses of cotton and wheat with lagged relative price as an explanatory variable for the period, 1933/4-1958/9 for West Pakistan. He also estimated the yield response of cotton. The short-run acreage price elasticity of cotton is 0.41 and the short-run yield elasticity is 0.002, which could be due to the unavailability of inputs, capital rationing, uncertainty, and low technology. The short-run price elasticity of wheat acreage ranges from 0.10 to 0.20. The results indicate that there is significant acreage response of both cotton and wheat to changes in relative prices.

Cummings (1975), using equation 8 incorporated both AE and PA models and estimated acreage supply elasticities of both cereals (wheat, rice and barley) and cash crops (cotton, rape and mustard seed, sesamum, and tobacco). The study period was 1949-68 for wheat and rice, 1950-62 for cotton, and 1951-67 for barley, rape and mustard seed, sesamum, and tobacco. Acreage is a function of lagged farm harvest-time prices, rainfall during and preceding sowing, lagged acreage, and a time trend. In order to avoid the identification problem, Cummings estimated the model for various values of the price expectation coefficient δ, using maximum likelihood methods. Because of the presence of a lagged dependent variable and auto correlation, the Cochrane-Orcutt (C-O) technique was used. The results show that the short and long-run price elasticities are 0.40 and 0.47 for American varieties, and 0.41 and 0.28 for local varieties of cotton. For wheat, corresponding elasticities are 0.10 and 0.22; and for rice 0.12 and 0.17. Cummings concludes that Pakistani agriculture shows positive responses to market incentives.

Tweeten (1986) used OLS and the AE and PA models incorporated in equation 8 to estimate own and cross price elasticities for wheat, cotton, sugarcane, and rice in Pakistan for 1962/3-1982/3. He specified the expected market price as weighted average of past prices, with (arbitrary) weights decreasing over time. Tweeten used output, area and yield as dependent variables and irrigated area, lagged yield, lagged crop area, input prices and output prices as explanatory variables. For cotton, the short and long-run acreage elasticities are 0.10 and 0.54, while yield elasticities are 0.25 and 0.49. For wheat, the short and long-run acreage elasticities are 0.07 and 0.27, while yield elasticities are 0.07 and 0.13. For rice, most of the price response comes from yield in the short run and from acreage in the long run. The short and long-run acreage elasticities are 0.08 and 0.40 while corresponding yield elasticities are 0.12 and 0.20. For sugarcane, the short and long-run acreage elasticities are 0.22 and 0.70, while yield elasticities as 0.08 and 0.20.

Pinckney (1989) criticized previous studies for using the combined data from pre and post-Green Revolution technology periods. Accordingly, he examined the period 1967/8-1984/5 and used OLS and the AE and PA models specifying equation 8 to estimate acreage and yield response of wheat. Acreage was specified using expected gross revenues, expected gross revenues from competing crops, expected input prices, lagged acreage, weather, and technology variables, while yield was specified using the expected prices of wheat and competing crops, input prices, weather, and technology. No lagged dependent variable was used in the yield equation because farmers faced few difficulties in adjusting desired amounts of variable inputs to changes in relative prices. The results indicate a low response of wheat acreage and yield to own and cross-output and input prices. The short and long-run own-price acreage elasticities are 0.09 and 0.20, and long-run yield elasticity is 0.34.

Ali (1990) used generalized least squares (GLS) to estimate a simultaneous equation model (SEM) for the output responses for wheat, cotton, rice, sugarcane, and maize for 1957-86 at the national level. He used an auto regressive integrated moving average (ARIMA) model to estimate the expected price of each crop. His estimated equation for each crop is of the form:

$$\ln Q_{it} = \ln \beta_i + C_{ii}^* \ln P_{it}^* + \sum_{i \neq j=1}^{k-1} C_{ij}^* \ln P_{jt}^* + \sum_{i=1}^{k} C_{ik}^* \ln P_{kt}^* + (1-\theta_i) \ln Q_{it-1} + D_i^* T_{it} + u_{it} \quad (9)$$

where Q_{it} is the actual production of crop i in period t, P_{it}^* is the expected own-output price of crop i in period t, P_{jt}^* is the expected output price of crop j in period t, P_{kt}^* is the expected price of input k in period t, T_{it} is a time trend used as a proxy for technology, D_i^* is the expected long-run productivity growth rate, C_{ii}^*, C_{ij}^* and C_{ik}^* are short-run parameters, and u_{it} is an error term. Ali's results indicate that farmers are responsive to output and fertilizer prices. Fertilizer price elasticities are higher for cash crops than for food crops. Similarly, own-price elasticities are high for cash crops and low for food crops because, in a subsistence economy, farmers produce food crops for family requirements, regardless of market prices. For wheat output, the short and long-run own-price elasticities are 0.23 and 0.33; for cotton, 0.72 and 1.34; for sugarcane, 0.52 and 0.81; and for rice, 0.41 and 1.92. The results also indicate that there is little potential to increase productivity by increasing prices, because either the own-price elasticities are low or because the negative cross-price effects on the output of other crops are high.

Khan and Iqbal (1991) used OLS method to estimate AE and PA models as specified in equation 8 for wheat, cotton, rice, sugarcane, maize, jowar, bajra, barley, gram and oilseed under three different expectation schemes - perfect foresight, static expectation and AE for 1956/7-1986/7 at the national level. The rationale for using these three expectation schemes was to test for the sensitivity of supply parameters under different expectations. Under perfect foresight, acreage is a function of relative price, relative yield, price and yield risk, rainfall during the sowing season, total irrigated area, and lagged acreage. Under static expectations which do not change from one period to the next, acreage is a function of lagged relative price, lagged relative yield, price and yield risk, rainfall during the sowing season, total irrigated area, and lagged acreage. The AE model expresses acreage as a function of the weighted sum of past relative price and yield, price and yield risk, rainfall during the sowing season, total irrigated area, and lagged acreage. For wheat acreage, the relative price variable (ratio of wheat to oilseeds price) is significant with short and long-run price elasticities of 0.07 and 0.11. Relative yield (ratio of wheat to oilseeds yield) is not significant. For cotton acreage, the relative price (ratio of cotton to jowar price) and relative yield (ratio of cotton to jowar yield) are significant; the short and long-run price elasticities are 0.06 and 0.12 while the corresponding yield elasticities are 0.14 and 0.27. For sugarcane acreage, the relative price (ratio of sugarcane to bajra price) is not significant. In contrast, the relative yield is significant with short and long-run elasticities of 0.52 and 4.35. For rice acreage, the relative price variable (ratio of rice to cotton price) is significant with short and long-run price elasticities of 0.13 and 0.53. Relative yield is not significant. Khan and Iqbal concluded that farmers respond to changes in relative prices as well as to relative yield.

Ashiq (1992) argues that the AE specification may not be relevant in the context of fixed support prices in Pakistan as these are minimum prices whose changes are recognised as permanent. He used three stage least squares (3-SLS) and the PA model (equation 6) and estimated acreage and yield responses for wheat and rice for 1975/6-1987/8 for the Punjab and Sind provinces. Acreage and yield are functions of the relative price, technology, and lagged acreage and yield; support prices are used instead of market prices.

Results show that the long-run output elasticity is almost unitary; in short-run yield shows more response to price than does acreage, and in the long run, both acreage and yield have almost the same response to price. In the Punjab, the short and long-run wheat acreage elasticities are 0.17 and 0.46, while yield elasticities are 0.28 and 0.49. Cotton and sugarcane are the major competing crops with wheat having short and long-run cross price elasticities of -0.19 and -0.11, and -0.40 and -0.23 respectively. For basmati, the short and long-run acreage elasticities are 0.19 and 0.51, while corresponding yield elasticities are 0.27 and 0.46. High yielding variety (HYV) rice from the International Rice Research Institute (IRRI) competes with basmati, and the short and long-run cross price elasticities are -0.16 and -0.35. For IRRI rice, the short and long-run acreage elasticities are 0.23 and 0.62, while corresponding yield elasticities are 0.26 and 0.44. Basmati competes with IRRI rice and the short and long-run cross price elasticities are -0.23 and -0.31.

In Sindh, the short and long-run wheat acreage elasticities are 0.18 and 0.49, while corresponding yield elasticities are 0.29 and 0.50. Cotton and sugarcane are the major competing crops with wheat in Sindh, having short and long-run cross price elasticities of -0.28 and -0.12, and -0.58 and -0.26 respectively. For IRRI rice, the short and long-run acreage elasticities are 0.17 and 0.46, while corresponding yield elasticities are 0.28 and 0.49.

In contrast to other studies, Ashiq found that in the analysis, technology has shown no significant effect on acreage or yield. This effect, however, might have been captured by the lagged dependant variable which moved in the same direction as technology did over the period of analysis. Due to the presence of such multicolinearity in the data, effect of technology could have not been, thus identified otherwise technology had a definite role in increasing agricultural production in Pakistan. Results show that supply response estimated at support prices is higher than at market prices and that the support price mechanism in Pakistan is effective in increasing output.

Himayatullah (1994) used the PA model (equation 6) and estimated output response for wheat, cotton, sugarcane, gram, maize and rice for 1971/2-1990/1. He estimated expected prices by taking the average of the previous two years prices. Output was specified as a function of expected own-output price, expected competing crop price, expected input price, a trend, and lagged output. By assuming supply of each crop homogeneous of degree zero, Himayatullah used the fertilizer price to normalize other prices. The results show that fertilizer price elasticities are higher for cash crops (cotton, sugarcane, gram and rice) in comparison with food crops (wheat and maize). Similarly, own-price elasticities are high for cash crops and low for food crops; and the cross-price elasticities of both cash and food crops are lower than own-price elasticities. For wheat, the short and long-run own-price elasticities are 0.23 and 0.38; for cotton, 0.65 and 1.14; for sugarcane, 0.63 and 1.05; and for rice, 0.43 and 1.39. The results show that farmers are responsive to output and fertilizer prices. They also indicate that cash crops like cotton, sugarcane and rice are own-price elastic. However, food crops have lower own-price elasticities implying that there is little potential for increasing output by raising own prices. The results also indicate that technological improvements can result in increased productivity.

Hussain and Sampath (1996) used OLS and the PA model (equation 6) and estimated acreage and output response for wheat for 1970/1-1993/4 at the national level using support prices. In the study, wheat acreage is a function of lagged wheat price, lagged cotton price, current year fertilizer price, technology, and lagged wheat acreage; output is a function of current year wheat price, lagged cotton price, current year fertilizer price, technology, and lagged wheat output. Estimated coefficients have expected signs and are significant, except for the fertilizer price coefficient which is insignificant in both equations. The short and long-run own-price acreage and output elasticities are 0.06 and 0.21, and 0.21 and 0.43 respectively. Cotton is the competing crop and cross-price acreage and output elasticities in the short and long-run are -0.09 and -0.27, and -0.31 and -0.55 respectively. The results also indicate that technology has a strong positive effect in increasing both wheat acreage and output. Hussain and Sampath concluded that wheat supply in Pakistan is not highly responsive to support prices and that the objective of self-sufficiency in wheat production can mainly be achieved through technological improvements, development of infrastructure, while support prices can play an important secondary role.

4. Conclusions and Areas for Further Research

Agricultural price policy plays a key role in increasing both agricultural output and farm income. To formulate an appropriate policy, a basic understanding of farmers' responses to price changes is needed and estimates of supply elasticities are central to assessing and appraising the impact of alternative price supports and other agricultural policies. Hitherto, there has been no literature review on agricultural supply response in Pakistan and this paper addresses this deficiency, and highlights its determinants that provide fundamental insights to policy makers.

First, results indicate that price elasticities are high for cash crops (cotton and sugarcane) and low for food crops (wheat and rice) and the general conclusion is that farmers respond to market incentives. Higher relative prices and yields encourage farmers to allocate more land under those particular crops. Moreover, high fertilizer prices have a negative effect on the supply of all major crops implying that low fertilizer prices may enhance production of all these crops. Second, instead of price policy being regarded the sole instrument to increase agricultural productivity, policy aims could be achieved by technological improvements - development of irrigation schemes, raising productivity through the introduction and adoption of further HYVs, improvements in production technology and practices, education and extension, and credit availability - and infrastructural development - roads, markets, electrification etc. Third, price and yield variability discourages risk-averse farmers from bringing more land into production.

The directly estimated OLS methods, which have been used in all studies of agricultural supply response in Pakistan, can be criticised on two grounds. First, they are *ad hoc*, and second, there are statistical problems regarding the stationarity of the data. To address the former, the dual approach has been developed where the supply response function is not estimated directly but instead is derived algebraically from estimating the indirect profit function from a profit maximization problem [Yotopoulos, *et al* (1976), Lopez (1982, 1984) and Hennebery and Tweeten (1991)]. The main advantage of the dual approach is its simplicity in terms of both functional form and data requirements. Since the output supply function is derived algebraically, more complex functional forms which impose less restrictions can be used (Lopez 1982). Further, the simultaneous equation bias can be avoided because profit and output supply (and input demand) are explicitly expressed as functions of exogenous variables (output prices, variable input prices, and quantities of fixed factors) which are determined independently of the firm's behaviour. However, the dual approach is based on the assumption of a profit-maximizing firm in a competitive market whereas farmers in developing countries may produce up to a target subsistence level of output. Further, other factors, such as price expectations and lagged adjustments, are not incorporated in the dual approach and there is a difficulty in distinguishing short and long-run elasticities.

Turning to the second problem, traditional econometric estimation is based on the assumption that the data are stationary. Most time series are non-stationary and can be rendered stationary by differencing. However, if differenced data are used, this leads to the loss of important long-run information. Error correction models (ECMs) solve this problem by first estimating a long-run model (equation 5) and then estimating the short-run ECM which postulates that a proportion of disequilibrium from one period is corrected in the next period [Engle and Granger (1987) and Hallam and Zanoli (1993)]. The ECM has four advantages. First, all variables are stationary and standard regression techniques are valid so the problem of spurious regression is overcome. Second, the estimated equation contains a well-behaved error term and avoids the problem of auto correlation. Third, it allows consistent estimation of parameters by incorporating both short and long-run effects. Fourth, it avoids the unrealistic assumption of fixed supply based on stationary expectations in the PA model. Indeed, the PA model (equation 5) is a special case of the ECM and is, therefore generally preferred.

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ANNEX-I

SUPPLY RESPONSE STUDIES FOR WHEAT, COTTON, SUGARCANE AND RICE IN PAKISTAN

Study/ Source	Crops	Period studied	Model (estimation method)	Dependent variable	Elasticity SR	Elasticity LR
Krishna (1963)	Wheat (dry farming)	1913/14-1945/46	PA(OLS)	Acreage	-	0.22
	Wheat (irrigated)	1913/14-1945/46		Acreage	0.08	0.14
	Cotton (local)	1913/14-1945/46		Acreage	0.59	1.08
	Cotton (American)	1913/14-1945/46		Acreage	0.72	1.62
	Sugarcane (P_{t-2})	1913/14-1945/46		Acreage	0.34	0.60
	Sugarcane (P_{t-1})	1913/14-1945/46		Acreage	0.17	0.30
	Rice	1913/14-1945/46		Acreage	0.31	0.59
Falcon (1964)	Wheat	1933/34-1958/59	PA (OLS)	Acreage	.1-.2	-
	Cotton	1933/34-1958/59		Acreage	0.41	-
				Yield	0.002	-
Cummings (1975)	Wheat	1949-68	AE and PA (C-O)	Acreage	0.10	0.22
	Cotton (local)	1950-62		Acreage	0.41	0.48
	Cotton (American)	1950-62		Acreage	0.40	0.47
	Rice	1949-68		Acreage	0.12	0.17
Tweeten (1986)	Wheat	1962/63-1982/83	AE and PA (C-O)	Acreage	0.07	0.27
				Yield	0.07	0.13
	Cotton	1962/63-1982/83		Acreage	0.10	0.54
				Yield	0.25	0.49
	Sugarcane	1962/63-1982/83		Acreage	0.22	0.70
				Yield	0.08	0.20
	Rice	1962/63-1982-83		Acreage	0.08	0.40
				Yield	0.12	0.20
Pinckney (1989)	Wheat	1967/68-1984/85	AE and PA (OLS)	Acreage	0.09	0.20
				Yield		0.34
Ali (1990)	Wheat	1957-86	SEM (GLS)	Output	0.23	0.33
	Cotton	1957-86		Output	0.72	1.34
	Sugarcane	1957-86		Output	0.52	0.81
	Rice	1957-86		Output	0.41	1.92

Annex-I........Contd.

Contd.......ANNEX-I

Khan and Iqbal (1991)	Wheat	1956/57-1986/87	AE and PA (OLS)	Acreage	0.07	0.11
				Yield	0.02	0.03
	Cotton	1956/57-1986/87		Acreage	0.06	0.12
				Yield	0.14	0.27
	Sugarcane	1956/57-1986/87		Acreage	0.06	0.47
				Yield	0.52	4.35
	Rice	1956/57-1986/87		Acreage	0.13	0.53
				Yield	0.05	0.21
Ashiq (1992)	Wheat (Punjab)	1975/76-1987-88	PA(3SLS)	Acreage	0.17	0.46
				Yield	0.28	0.49
	Wheat (Sindh)	1975/76-1987-88		Acreage	0.18	0.49
				Yield	0.29	0.50
	Basmati (Punjab)	1975/76-1987-88		Acreage	0.19	0.52
				Yield	0.27	0.46
	IRRI (Punjab)	1975/76-1987-88		Acreage	0.23	0.62
				Yield	0.26	0.44
	IRRI (Sindh)	1975/76-1987-88		Acreage	0.17	0.46
				Yield	0.28	0.49
Himayatullah (1994)	Wheat	1971/72-1990/91	PA(OLS)	Output	0.23	0.38
	Cotton	1971/72-1990/91		Output	0.65	1.14
	Sugarcane	1971/72-1990/91		Output	0.63	1.05
	Rice	1971/72-1990/91		Output	0.43	1.39
Hussain and Sampath (1996)	Wheat	1970/71-1993/94	PA (OLS)	Acreage	0.06	0.21
				Output	0.21	0.43

FACTORS AFFECTING AREA AND YIELD OF WHEAT CROP – A CASE STUDY

By
Noor Muhammad*

In this paper factors which have significant effect at different stages of the crop have been identified and their levels of impact have been quantified by analyzing monthly data on rainfall, water availability, fertilizer application, temperature, minimum guaranteed/support price of wheat etc. This analysis has been carried out for cotton zone of the Punjab Province as a case study. The analysis shows that the support price, canal water availability and rainfall during November are the factors that significantly affect the area sown under wheat crop. For yield, the important favourable factors identified are the support price, off-take of phosphatic fertilizers during Sep-Oct, off-take of Nitrogenous fertilizers during January, canal withdrawal during February, rainfall during October and February, low temperature during February and high during April. Such analysis needs to be carried out for other zones/provinces and crops as well. Through such analysis a system to monitoring crops condition for early warning can be developed. Development of such a system is in the interest of government, agribusiness and growers. Advanced information in their areas of interest would make them wiser to take strategic decisions.

1. Introduction

The literature on supply response shows that area under wheat crop depends upon post-harvest prices of wheat, water supply at sowing time, rainfall etc. Similarly, its yield depends upon a number of inputs/factors, like fertilizer application, water availability, rainfall, temperature during growth and maturity periods, wheat prices, area

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under the crop etc. These factors have different levels/patterns of impact at different stages of the crop. For example, timely announcement of support prices of wheat, proper supply of canal water, timely and adequate rainfall at sowing time have positive impacts on area brought under the crop. Similarly, availability and use of phosphatic fertilizers at sowing time and that of nitrogenous fertilizers, canal water, normal rainfall & temperature during growth period, especially during February and March have positive impacts on yield of the crop. It is important to identify such factors which have significant impact at different stages of the crop. Contrary to these, shortage of irrigation water and less rains during October-November have negative impacts on the area under the crop. Similarly, less or non availability of phosphatic fertilizers during November-December, dry weather condition, less use of nitrogenous fertilizer during February or heavy rains or high temperature during February and March have negative impacts on yield per hectare. Study of such situations can help the Government as well as the growers to take timely and suitable measures for increasing area and production of the crop.

In addition to early warning about the crop situation, the Government needs production forecast to have information regarding current year wheat production, well in time, so that supply (carry-over stock plus current production) and demand position is ascertained. On getting an indication of short domestic supply, government has to arrange for import to meet the domestic demand. Moreover, timely information about current size of wheat crop will help the government in making in time necessary arrangements for wheat procurement.

2. Methodology

2.1 Identification of cropping zones

Different parts of country get different levels of rain during different periods of time. Similarly, temperature varies from area to area.

Soil texture and cropping patterns are also different in different parts of the country. Thus, impact of these factors on wheat crop differs from area to area. To have homogeneous areas, with respect to impact of these factors, province of Punjab under study has been divided into following four cropping zones:

- Cotton zone,
- Rice zone,
- Mixed crops zone,
- Barani area zone.

Cotton zone comprises those areas where cotton in rotation with wheat is dominant crop. Rice zone comprises those areas where rice is cultivated in rotation with wheat. Mixed crops zone comprises those areas where no single crop is dominant except wheat. Barani area zone comprises un-irrigated rainfed areas. The cotton zone of Punjab Province, contributing 54 per cent of the provincial output of wheat is the focus of analysis. This zone includes Multan, Sahiwal, Okara, Pakpattan, Khanewal, Vehari, Muzaffargarh, Rajanpur, Bahawalpur, Bahawalnagar, R.Y.Khan, Lodran, D.G. Khan, T.T.Sing and Jhang districts.

2.2 Collection of data

Analysis has been based on historical data for the period, 1971-94 on the following parameters.

- District-wise area and production of wheat.
- Monthly/Station-wise total rainfall.
- Monthly/Station-wise mean minimum and mean maximum temperature.
- Monthly/District-wise N and P fertilizers off-take.
- Monthly/Canal-wise withdrawals.

- Support/Procurement prices of wheat.
- Support/Procurement as well as market prices of competing crops.

District-wise data regarding area and production was obtained from the Punjab Agriculture Department (Crop Reporting Service). Monthly rainfall and temperature data of various stations was supplied by Meteorological Department, Karachi, District-wise data on monthly sales of fertilizers was provided by Punjab Agricultural Development and Supply Corporation (PAD&SC). Punjab Irrigation Department supplied canal-wise monthly withdrawals. Support prices of all important crops were supplied by the Agricultural Prices Commission, Islamabad and market prices by the Federal Bureau of Statistics.

2.3 Analysis of data

Behaviour of independent variables, mutual and with the dependent variable can be identified through the study of scatter plots, correlation coefficients, analysis of variance and regression analysis. Thus, different sets of independent variables having significant effects on dependent variables have been identified through regression analysis.

3. Results

3.1 Factors affecting wheat crop area

Area under wheat crop mainly depends upon the lagged post harvest prices of wheat, rainfall and canal water supply. Rainfall and canal water supply has different levels of impact at different stages of the crop, which is not always significant or positive. To study the impact of each variable these were tested through the following model equation:

$$AREA = b_0 + b_1\ SPRICES + b_2\ WDEC + b_3\ RNOV.$$

Wherein 'b's are regression coefficients and other variables as defined below:

AREA	=	Irrigated area of wheat crop in Cotton zone of Punjab Province in thousand hectares.
SPRICE	=	Current year support price of wheat fixed by the Government in Rupees per 40 kilograms.
WDEC	=	Canal withdrawals of all canals during December in thousand acre feet.
RNOV	=	Rainfall during the month of November in millimeters.

The regression coefficients of the above equation have been estimated through Ordinary Least Squares (OLS) method. Estimated equation is given below.

$$AREA = 1653.25 + 8.33\ PRICE + 0.22\ WDEC + 9.12\ RNOV.$$

All the three independent variables have been found significant at 5 per cent level of probability as shown below:

Variable	Coefficient	S.E.	t-value	Significance level
(Constant)	1653.25	107.39	15.39	0.000
PRICE	8.33	0.72	11.57	0.000
WDEC	0.22	0.06	3.67	0.001
RNOV	9.12	4.29	2.12	0.046
Adjusted R-Square = 0.932				

Coefficient of support price (SPRICE) which is 8.33 means that with the increase in wheat support price by one rupee per 40 kilograms, its area will increase by 8.33 thousand hectares. Coefficient of WDEC shows that with one thousand acre feet additional canal water in December, area under the crop will increase by 0.224 thousand hectares. Similarly, one millimeter additional rain during the month of November will increase 9.12 thousand hectares area under wheat crop.

Value of Adjusted R-square indicates that 93.2 percent of change in area is due to these variables. And rest of 6.8 percent is due to all other factors either whose individual impact on area is not significant or which are highly correlated with the variables already included in the equation. This equation predicts area for the year 1993-94 as 3,267 thousand hectares which differs by 0.58 percent as against actual area of 3,248 thousand hectares. Through this analysis final production forecast can be provided on the 15th of February.

3.2 Factors affecting wheat crop yield

Yield of wheat mainly depends upon quantity of fertilizer applied, rainfall, canal water supply and temperature at different stages of the crop growth. To study the impact of these variables, each one has been specified as given in the following equation:

$$\begin{aligned} \text{YIELD} = \; & b_0 + b_1 \text{ SPRICE} + b_2 \text{ PSEP–OCT} + b_3 \text{ AREA} + b_4 \text{ NJAN} \\ & + b_5 \text{ WFEB} + b_6 \text{ ROCT} + b_7 \text{ RFEB} + b_8 \text{ FEBX} + b_9 \text{ MARX} \\ & + b_{10} \text{ MARXS} + b_{11} \text{ APRX} \end{aligned}$$

Wherein 'b's are regression coefficients and other variables as defined below:

YIELD	=	Yield of wheat in kgs. per hectare.
SPRICE	=	Current year support price of wheat in rupees per 40 kgs.
PSEP-OCT	=	Off-take of phosphatic fertilizer during Sept–Oct in nutrient tonnes.
AREA	=	Area under wheat crop in thousand hectares.
NJAN	=	Off-take of nitrogenous fertilizers during January in nutrient tonnes.
WFEB	=	Canal withdrawal during February in thousand acre feet.
ROCT	=	Rainfall during the month of October in milimeters
RFEB	=	Rainfall during the month of February in milimeters
FEBX	=	Monthly average maximum temperature during February in centigrades.
MARX	=	Monthly average maximum temperature during the month of March in centigrades.
MARXS	=	Square of monthly average maximum temperature during March in centigrades.
APRX	=	Monthly average maximum temperature during April in centigrade.

The above equation as estimated through Ordinary Least Squares (OLS) method is shown below:

YIELD = -2551.5 +4.04 SPRICE +0.25 PSEP-OCT -0.43 AREA +0.02NJAN +0.10 WFEB +22.49 ROCT +2.05 RFEB -13.47 FEBX +313.41 MARX -5.56 MARXS +17.91 APRX.

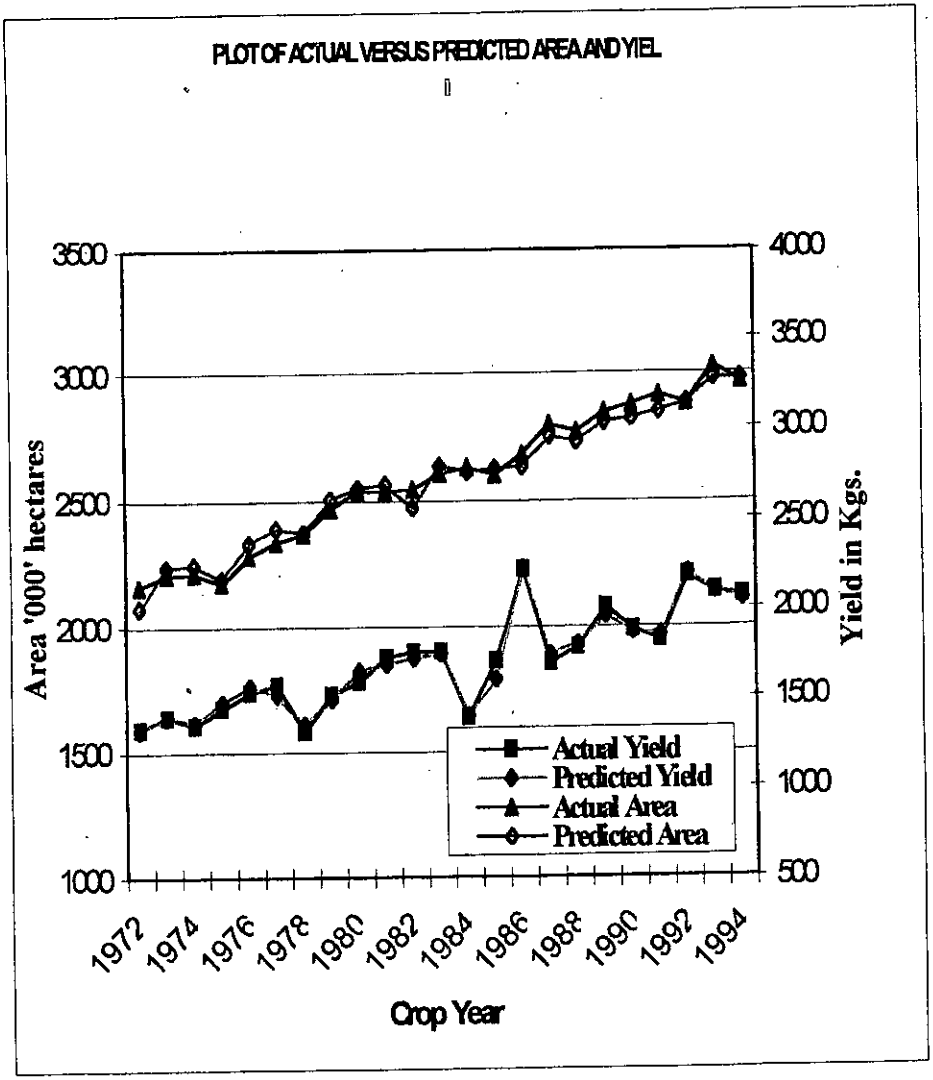
All the coefficients except that of temperature during February (FEBX) were found significant at 5% probability level and that of FEBX at 10% probability level as shown below:

Variables	Coefficient	S.E.	t-value	Significance level
(Constant)	-2551.54	1658.08	-1.54	0.155
SPRICE	4.04	1.44	2.81	0.018
PSEP–OCT	0.25	0.07	3.74	0.004
AREA	-0.43	0.12	-3.53	0.005
NJAN	0.02	0.01	2.38	0.038
WFEB	0.10	0.03	3.20	0.010
ROCT	22.49	3.91	5.76	0.000
RFEB	2.05	0.78	2.65	0.024
FEBX	-13.47	6.86	-1.97	0.078
MARX	313.41	115.46	2.71	0.022
MARXS	-5.56	2.03	-2.74	0.021
APRX	17.91	6.61	2.71	0.022
Adjusted R-Square = 0.963				

In the equation, support prices of wheat, off-take of phosphatic fertilizers during September-October, nitrogenous fertilizers during January, canal water during February, rain during October and February and monthly average maximum temperature during April have positive impacts on the yield of wheat. Whereas, area under the crop and rising temperature during February have negative impacts. With the increase in area, cultivation spreads to marginal lands with low yield, which depresses over all average yield also. Rising temperature during February induces early maturity which results in loss of weight, reduces grain size and lower the yield. During the month of March temperature upto a certain limit has positive effect but beyond a certain limit puts negative effect. Coefficient of each variable quantifies the change in yield per hectare in kilogram due to unit change in that variable.

Value of Adjusted R–square indicates that 96.3 percent change in the yield per hectare is due to these variables and rest 3.7 percent is due to otner factors either whose individual effect is not significant or those are highly correlated with variables already selected. This model has predicted yield for the year 1993-94 as 2,107 Kilograms per hectare, which differs by 0.56 percent as against the actual yield of 2,119 Kilograms per hectare. The model-predicted production stands at 6,885 thousand tonnes as compared to 6,883 thousand tonnes.

In the graph, shown, actual area and yield per hectare have been plotted against predicted area and yield. The predicted values show the same trends as are in actual values. It indicates that the estimated models both for area and yield give reliable results.



4. Recommendations

Timely availability of information on crop production can be very helpful to the government, agribusiness and growers in taking wiser policy decisions. Development of forecast models can help a lot to achieve this end. In this respect following recommendations are made.

- For development of systems for crop monitoring and early warning and for forecasting of crops production, a Crop Forecasting Centre should be established.

- The Centre inter alia, should develop forecasting models, collect detailed data and determine the impact of each factor at different stages of growth on permanent footing.

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MARKETING MARGINS FOR TOR KULU APPLE PRODUCED IN PISHIN -A CASE STUDY

By

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Javed Iqbal and Syed Muhammad Khair*

> It has strongly been prohibited from the sale and purchase of tree fruits till there appears the signs of maturity and usefulness in them
>
> .... Al-Bokhari/Al-Muslim

This study is aimed at determining the marketing margins for Tor Kulu apple in district Pishin. The producers in this district, supply apples to the market through the commission agents or they enter into pre-harvest contracts. The contractors then supply apples to the markets through commission agents. The other market intermediaries are wholesalers and retailers who are common to both the channels. The overall net marketing margins are about 67% when the growers are directly supplying to the market, and 76% when pre-harvest contractors supply to the market. Thus, the farmers just receive 24-33% of the price paid by the consumer, and the rest is going to middlemen or market functionaries.

1. Introduction

Balochistan is the dominant producer of apples in Pakistan. Its share in the country's apple production is over 80 per cent [Government of Pakistan (1997)]. District Pishin is one of the major producers of apple in the province. In 1996-97, it produced 1,16,120 tonnes of apples from an area of 8,189 hectares and its contribution was about 24% of the total production of the province [Government of Balochistan (1998)]. Tor Kulu is the principal apple variety grown in the district.

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Several marketing problems, confronting the farmers of Pishin district are eroding their income. The common marketing problems are: multiplicity of marketing intermediaries, inadequate roads, lack of proper grading and cold storage facilities for perishable products, long distances from markets, shortage of warehouses and lack of credit facilities. The marketing intermediaries, by manipulating the market conditions, receive the lion's share of the income from the apple sold in the market. They are organized, wealthy and well informed about market conditions, marketing system and price behaviour as compared to the farmers who are generally disorganized, financially weak and ignorant. These conditions are leading to wide marketing margins, and hence exploitation of the farmers.

This study has been undertaken in Pishin district of Balochistan to estimate the marketing margins for Tor Kulu apple, i.e. to determine the shares of producers as well as those of the middlemen in the consumer's rupee spent.

In the past, several studies have been undertaken elsewhere to underscore the marketing margins of agricultural commodities, with the main focus on fruits and vegetables. In these studies efforts have been made to determine the cost of production of crops, marketing costs, marketing margins at various levels, net returns to producers, gap between price paid by ultimate consumers and price received by the farmers and their marketing problems. In general, most of the studies [Abid (1980), FAO (1990), Iqbal (1992 and 1994), Mittendorf and Heritage (1982), Mohy-ud-din (1989), Singh, *et al* (1985) and Smith (1979)] show that farmers are being exploited by the middlemen and big marketing margins exist for agricultural commodities, ranging from about 10 to more than 80 per cent.

Some of the studies [Sial and Anjum (1990)] pointed out that marketing intermediaries are performing useful role by providing financial assistance, inputs and other marketing facilities to the farmers and like other businesses their motive is also profit making. These studies have stated that like other businesses it is competitive in nature and the belief that middlemen make high profits is contrary to the facts.

2. Methodology

The study is based on primary data collected from farmers, pre-harvest contractors, commission agents, wholesalers, retailers and consumers. A list of major apple producing villages in sub division Pishin was obtained from the Extra Assistant Director of Agriculture, Pishin. Five villages in all were selected through random sampling technique. These were Manzai, Huramzai, Samzai, Kakazai, and Alizai. Apple growers from these villages were selected through stratified random sampling technique. In all, 45 apple producers were interviewed. Similarly, 30 pre-harvest contractors, 10 commission agents, 10 wholesalers and 30 retailers were selected randomly from Quetta market where the Pishin growers supply their apple. For calculating farmers' income their marketing costs and margins of various intermediaries, weighted arithmetic averages have been used.

3. Results

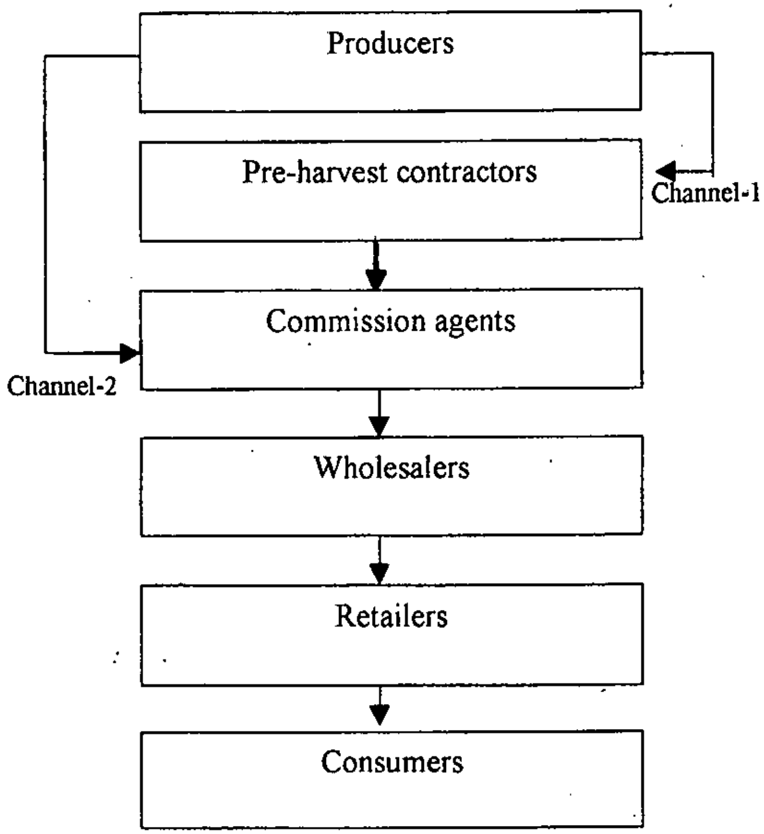
3.1 Marketing channels

Tor Kulu, the dominant apple variety, is grown over 57% of the total area allocated to apple. Two most common marketing channels observed are:

1. Producer - Pre-harvest contractor - Commission agent - Wholesaler - Retailer - Consumer
2. Producer - Commission agent – Wholesaler –Retailer - Consumer.

Henceforth, the first marketing channel will be called as channel-1 and second marketing channel as channel-2. Marketing channels are shown in the figure below:

Marketing Channels for Tor Kulu Apples in Pishin



3.2 Marketing margins

The marketing margin is the difference between the price paid by the ultimate consumer and the price received by the producer. It is also computed as the percentage share received by each marketing intermediary. There is a strong cumulative effect on the marketing margin resulting from the increasing number of intermediaries involved in the marketing process.

The overall net marketing margins were about 76% for channel-1 and 67% for channel-2. Marketing margins received by the farmer and various other market intermediaries in the two channels are briefly described below:

Farmer: For the produce marketed through channel-1, the farmer received 23.75 per cent of price paid by the final consumer. In this channel marketing costs were zero for the producer because he sold his orchard to the pre-harvest contractor who paid him and undertook the risk as well as responsibility of marketing. In Channel-2 the farmers received 32.72 per cent of price paid by the final consumer. The farmers' cost per crate (of 18 kgs) was Rs 99.20 and a net margin of Rs 117.80 per crate in this channel.

Pre-harvest Contractor: Pre-harvest contractor received 9.72% of the price paid by the final consumer when marketed through channel-1. The per crate cost incurred by him was Rs 185 and net margin was Rs 35. In channel-2, the pre-harvest contractors are not involved.

Commission Agent: In the Pishin and Quetta area, the commission agent charges a commission at the rate of 10 per cent of the auction price for the produce. However, the commission agent's share in the price paid by the final consumers was 6.12% and 6.04% for channel-1 and channel-2 respectively.

Wholesaler: For channel-1, the wholesaler obtained 6.76% share in the consumer's price. His per crate cost was Rs 237.65 and a net margin was Rs 24.35. Similarly, wholesaler's share in consumer's price was 7.60% and his total cost and net margin per crate were Rs 234.65 and Rs 27.35 respectively when marketed through channel-2.

Retailer: Retailers received a margin of Rs 46.92 per crate or 13.03% share in the price paid by the final consumer in both the channels.

Other costs: Other marketing costs including orchard management, picking, packing, sorting, grading, taxes, transport, rents, labour, haulage and cold storage expenses, losses and wastage cost are 40.62 per cent of consumer price under both the channels. Per crate, these costs are Rs 146.23. Detail of these costs are given in Table-1.

Table-1: Marketing Costs and Margins for Tor Kulu (Rs/Crate)

Trade level	Net margins/costs in Channel-1		Net margins/costs in Channel-2	
	Total	Per cent of consumer price	Total	Per cent of consumer price
	Rs/crate	Per cent	Rs/crate	Per cent
Farmer	85.50	23.75	117.80	32.72
Pre-harvest contractor	35.00	9.72	-	-
Commission agent	22.00	6.12	21.70	6.04
Wholesaler	24.35	6.76	27.35	7.60
Retailer	46.92	13.03	46.92	13.03
Other costs	146.23	40.62	146.23	40.62
Consumer price	360.00	100.00	360.00	100.00

Source: Annex .-I and II.

4. Shortcomings and Limitations

1. Due to financial constraints the sample size was kept small, thus the results may not be generalized.

2. The capital and managerial investment of the market intermediaries has not been accounted for. If these were included in the analysis, their net margins would have been less than what have been calculated.

3. The respondents did not have written record for the business, and were also reluctant to give information regarding their earnings. So, the information provided by them may have some element for under estimation of net margins.

4. The intermediaries were simultaneously busy in marketing business of several other commodities. They were not exclusively confined to apple marketing. So, it was difficult to sort out the cost incurred only on the specific variety of apple, i.e. Tor Kulu.

5. The selling price of one intermediary was not equal to the purchase price of the other which should have been so theoretically at least. To solve this problem average prices were used at every marketing stage.

6. The production cost of the pre-harvest contractor or the producer has not been accounted for in the analysis.

5. Conclusions, Policy Implications and Recommendations

Though various marketing intermediaries are performing useful role in the marketing of apple, but currently, the marketing margins are very high. They range from about 67 per cent to 76 per cent. There is a need to reduce this gap. To reduce the margins and for the overall improvement of marketing, the following measures are recommended:

1. Due to financial constraints, the farmers of the area are forced to dispose of their produce at an early stage to pre-harvest contractors. They can not wait for improved prices and also they can not bear the expenses of marketing themselves. Providing credit facility may help to encourage farmers to market the apples directly and avoid the pre-harvest contractor because it will increase their farm gate price by about 9 per cent.

2. There is a need to develop proper mechanism for marketing intelligence through relevant agencies for farmers. Due to lack of information, they are at the mercy of commission agents. On the whole commission rate is too high i.e. 10% of auction price.

3. Wooden crates are still used for the packing. These are costly and are overstuffed. As a result, a part of the produce gets injured and the shelf life is reduced. Thus, some cheap and durable packing materials need to be developed and introduced for reducing the cost and maintaining the quality during storage and transportation.

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Annex-I

DETAIL OF MARKETING COSTS AND MARGINS FOR TOR KULU APPLE IN CHANNEL 1

Trade level	Margins/costs Rs/crate	Net margins Per cent
1. **Farmer**		
- Contracted price	85.50	23.75
2. **Pre-harvest Contractor**		
i. Purchase price	85.50	
ii. Orchard management costs	8.50	
iii. Picking, sorting, grading, packing costs	15.00	
iv. Packing material	25.00	
v. Transport including loading/unloading charges	12.00	
vi. Cold storage charges	12.00	
vii. Commission agent fee	22.00	
viii. Value of physical losses	2.00	
ix. Zilla tax and octroi etc.	2.00	
x. Other costs	1.00	
xi. Total cost (add i through x)	185.00	
xii. Gross income (selling through auction)	220.00	
xiii. Net margin (xii minus xi)	35.00	9.72
3. **Commission agent**		
i. Auction price	220.00	
ii. Net margin @ 10% of auction price	22.00	6.12
4. **Wholesaler**		
i. Purchase price	220.00	
ii. Transport charges	1.20	
iii. Rent of shop	7.73	
iv. Sorting and repackaging charges	3.00	
v. Wastage	5.72	
vi. Total cost (add i through v)	237.65	
vii. Gross income (sale price)	262.00	
viii. Net margin (vii minus vi)	24.35	6.76
5. **Retailer**		
i. Purchase price	262.00	
ii. Rent of shop	2.43	
iii. Sorting	1.63	
iv. Repackaging	1.50	
v. Transport	4.75	
vi. Labour charges	7.15	
vii. Other costs	3.46	
viii. Wastage	30.16	
ix. Total cost (add i through viii)	313.08	
x. Gross income (sale price)	360.00	
xi. Net margin (x minus ix)	46.92	13.03
6. Consumer Purchase price	360.00	

* Standard weight per crate = 18 kgs.

Annex-II

DETAIL OF MARKETING COSTS AND MARGINS FOR TOR KULU APPLE IN CHANNEL 2

Trade level	Margins/costs Rs/crate	Net margins Per cent
1. Farmer		
i. Sale price (auction price)	217.00	
ii. Orchard management costs	8.50	
iii. Picking, sorting, grading, packing costs	15.00	
iv. Packing material	25.00	
v. Transport including loading/unloading charges	12.00	
vi. Cold storage charges	12.00	
vii. Commission agent fee	21.70	
viii. Value of physical losses	2.00	
ix. Zilla tax and octroi etc.	2.00	
x. Other costs	1.00	
xi. Total cost (add ii through x)	99.20	
xii. Net margin (i minus xi)	117.80	32.72
2. Commission agent		
i. Auction price	217.00	
ii. Net margin @ 10% of auction price	21.70	6.04
3. Wholesaler		
i. Purchase price	217.00	
ii. Transport charges	1.20	
iii. Rent of shop	7.73	
iv. Sorting and repackaging charges	3.00	
v. Wastage	5.72	
vi. Total cost (add i through v)	234.65	
vii. Gross income (sale price)	262.00	
viii. Net margin (vii minus vi)	27.35	7.60
4. Retailer		
i. Purchase price	262.00	
ii. Rent of shop	2.43	
iii. Sorting	1.63	
iv. Repackaging	1.50	
v. Transport	4.75	
vii. Labour charges	7.15	
vii. Other costs	3.46	
viii. Wastage	30.16	
ix. Total cost (add i through viii)	313.08	
x. Gross income (sale price)	360.00	
xi. Net margin (x minus ix)	46.92	13.03
5. Consumer		
Purchase price	360.00	

* Standard weight per crate = 18 kgs.

MILK PRICING AND DILUTION IN PESHAWAR

By
Munir Khan*

And most certainly there is a lesson for you in the cattle: WE give you a drink out of what is in their insides: From betwixt the contents of the bowels and the blood: Pure milk delicious to those who drink .... Al-Quran

The paper reports the results of an investigation into the relationship of the price charged for milk, and its quality in Peshawar city. Milk quality i.e. composition, is mainly described in terms of total solids (TS) i.e. a mix of fats, proteins and carbohydrate. The price is linked to the quality in terms of value of these constituents to the consumers. The parameters analyzed were fat, solids not fat (SNF), total solids and acidity. The results show that in compositional terms, the average fat, SNF and TS contents of samples analyzed are 4.17%, 5.96% and 10.13% as compared to levels of pure buffalo milk which are 7.50%, 9.61% and 17.11% respectively. Since, none of the samples analyzed met the quality parameters prescribed for pure milk, it can be concluded that all samples had been diluted or constituents removed. Price administration or fixing maximum consumer price of milk encourages dilution and poorer are the consumers, the more they are exploited by charging higher prices per unit of fat; NFS and TS.

1. Introduction

The contribution of Livestock sub-sector to agricultural output for 1997-98 was estimated at 34 per cent and to GDP at 8 per cent [Pakistan Economic Survey (1997-98)]. In the NWFP during 1995-96, the value of livestock production stood at Rs 47 billion as against 38 billion for total crops. In terms of volume and retail value, milk is the

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major livestock product and in the food group it is second only to cereals. An average consumer spends one fourth of his food budget on milk [Anjum, *et al* (1989)]. Yearly value of milk produced in the country is more than the value of wheat, whereas there is no comparable organization to procure surplus milk – a perishable commodity [Bhatti (1992)].

The long standing complaint against milk handlers in Pakistan concerns the serious and widespread problem of milk adulteration [Mahmood (1993); Hanjra et al (1989); Pirzada (1981) and Ahmad (1962)]. Milk is adulterated and diluted to such an extent that often very little nutritive value is left [Anjum (1978)]. The evidence shows that adulteration of milk is a common practice in the liquid milk supply system of Pakistan at all stages along the marketing chain, even the milk sold by producers does not match the composition of pure milk [Khan, *et al* (1999), Hanjra, *et al* (1989)].

Milk production and marketing systems in Pakistan have not been adequately researched because of the priority given to improving the output of essential crops such as wheat, cotton and rice [Aijazuddin (1998)]. Quality, it seems, has consequently become the most forgotten aspect in milk marketing at all stages (i.e. production, processing, distribution, retailing and consumption). Additionally, studies by previous researchers [Haq (1989), Anjum (1978) and Mahmood (1993)] have clearly reported on the major problem of dilution, but not described any method for measuring the relationship between the degree of dilution and price in terms of value to supply chain members or to the consumer.

The objectives of this study therefore, were to: (i) assess compositional quality of the milk sold in the market and (ii) analyze the relationship between price and total solids in the milk.

2. Materials and Method

A total of 51 samples of buffalo milk were randomly collected in the morning from retailers in Peshawar city and transported to the laboratory at NWFP Agricultural University, in an insulated box with ice during June 1996. The samples were placed in the refrigerator and analyzed within 3-5 hours of receipt. The fat contents of milk were determined by the Babcock test as described by Bartley, *et al* (1963) and the SNF contents were estimated using both the lactometer and Babcock test. Since the Babcock test for butterfat is widely used [Harrman, *et al* (1954)] in most of the developing countries, the freezing point depression method used in developed world to test added water was not used.

3. Results and Discussion

3.1 Composition of milk

The results (composition of the samples analyzed) in Annex-I show that on an average the fat, SNF, and TS levels of the samples analyzed are 4.17%, 5.96% and 10.13% respectively. It is clear that none of these market samples reached the levels for pure buffalo milk where typical figures are 7.50%, 9.61%, and 17.11% respectively [Khan, *et al* (1999)]. It can be concluded that all samples had been diluted. The range for fat, SNF and TS contents found in these samples was 2.00-7.00, 3.90-9.32 and 5.90-15.95 per cent respectively.

Annex-I further shows that 45 samples out of 51 i.e. 88% failed to meet the minimum specification for standardized milk of 14% TS. Despite the fact that Pakistan's Federal Food Laws specify the minimum compositional level for milk, the majority of market milk samples are seen to be well below these compositional minima. Indeed, even those that satisfy the specification show considerable variance. The evidence suggests that the major reason for such a wide variation in milk composition is dilution i.e. added water.

3.2 Price of marketed milk

Like many other food products, the price of retail milk is determined by the District Administration. According to Mukhtar (1990), the intervention of the government is substantial in the form of fixing floor/procurement prices of products and supplying food items to consumers at affordable prices. He adds that the local administrative authorities fix the retail prices of livestock products such as milk, meat and eggs etc., in order to safeguard the interest of the consumers. However, during the period of this study when the official price for fresh raw milk in Peshawar was Rs 13 per kg, there was a great variation in the price of milk at the retail level, typically, between Rs 12 to Rs 18 per kg. According to one press report milk retailers had increased the price unilaterally in violation of the official instructions.

3.3 Relation between price and composition of milk

Table-1 shows the relationship between the price and the composition of milk. Two types of relations between these variables can be seen from the data given in Table-1. First, for higher percentage of total solids in the milk higher price is charged. The milk on an average, possessing 6.4 per cent total solids was selling at Rs 12 per kgs while that having 15.9 TS was being sold at Rs 18 per kgs. Second, price per percentage point of fat, SNF or TS is not constant. It decreases with the increase in nominal milk price of fat, SNF or TS percentage point. At the price of Rs 12 per kg or at TS percentage point of 6.4, the price per percentage point of TS is calculated at Rs 1.88. This went on declining as prices or TS increased and reached the lowest bound of Rs 1.05 at the milk price of Rs 16 per kgs or at 15.3 per cent TS. The same is true for Fat% and SNF%.

Table-1: Price of Fresh Buffalo Milk and its Quality Parameters in Peshawar during 1996

Group	Price Rs/kgs	Average Fat%	Price per Fat %age Point	Average SNF(%)	Price per SNF %age point	Average TS (%)	Price per TS %age point
I	12	2.3	5.22	4.1	2.93	6.4	1.88
II	13	2.8	4.64	4.7	2.77	7.5	1.73
III	14	4.5	3.11	6.1	2.30	10.6	1.32
IV	15	5.5	2.73	7.1	2.11	12.7	1.18
V	16	6.5	2.46	8.8	1.82	15.3	1.05
VI	18	7.0	2.57	8.9	2.02	15.9	1.13

Source: Calculated from the data given in Annex-I.

4. Conclusion

It would appear that since consumers do not know the fat and SNF levels that are in any milk, sellers charge what the market pays. It may also be concluded, that since most milk is used as tea whitener, consumers do not really mind about the quality. The figures in Table 1 reveal that those who sell milk at the minimum nominal price, are in fact receiving the maximum real price. Consumers paying nominal price of Rs 12 per kg actually paid Rs 5.22 per fat percentage point, Rs 2.93 per SNF percentage point and Rs 1.88 per TS per centage point as compared Rs 2.46, Rs 1.82 and Rs 1.05 respectively for the consumers paying nominal price of Rs 16 per kgs. In other words consumers paying nominal price of Rs 12 per kg actually paid Rs 34 per kg on the basis of 6.5 per cent fat or Rs 26 per kg on the basis of 8.8 per cent SNF or Rs 29 per kg on the basis of 15.3 per cent TS in milk of the type sold at Rs 16 per kg. Therefore, it can be inferred that administration of milk prices do not benefit the consumers. They are rather exploited by price fixation and the poorer are the consumers, the more they are exploited because they pay high prices per unit of Fat, SNF and TS.

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ANNEX-I

COMPOSITION OF MILK SAMPLES ANALYSED IN PESHAWAR, DURING 1996

Sample No.	Price per kg	Fat (%)	SNF (%)	Total solids (%)	Acidity (%)
1	12.00	2.20	4.19	6.39	0.107
2	12.00	2.10	4.17	6.27	0.059
3	15.00	5.30	6.86	12.16	0.153
4	14.00	4.30	5.86	10.16	0.092
5	13.00	2.90	4.83	7.73	0.090
6	12.00	2.00	3.90	5.90	0.057
7	12.00	2.30	4.21	6.51	0.066
8	13.00	2.80	4.81	7.61	0.092
9	14.00	4.40	5.88	10.28	0.089
10	16.00	6.80	8.41	15.21	0.159
11	12.00	2.30	4.01	6.31	0.103
12	15.00	6.30	8.26	14.56	0.155
13	15.00	5.80	7.16	12.96	0.123
14	15.00	6.00	7.70	13.70	0.138
15	15.00	5.00	6.25	11.25	0.125
16	13.00	2.70	4.54	7.24	0.093
17	16.00	6.40	8.78	15.18	0.127
18	15.00	5.30	6.56	11.86	0.086
19	13.00	2.30	4.21	6.51	0.109
20	14.00	4.70	6.44	11.14	0.122
21	12.00	2.20	3.94	6.14	0.117
22	16.00	6.80	8.61	15.41	0.160
23	16.00	6.60	9.32	15.92	0.192
24	14.00	4.90	6.23	11.13	0.272

Contd........ ANNEX-I

25	15.00	5.00	7.00	12.00	0.165
26	13.00	2.80	4.31	7.11	0.110
27	15.00	5.10	6.52	11.62	0.106
28	13.00	2.40	4.23	6.63	0.117
29	12.00	2.50	4.25	6.75	0.110
30	13.00	3.00	5.10	8.10	0.080
31	13.00	2.80	4.56	7.36	0.121
32	13.00	2.70	4.54	7.24	0.106
33	14.00	4.60	5.42	10.02	0.104
34	15.00	5.50	6.85	12.35	0.102
35	13.00	2.90	4.58	7.48	0.116
36	14.00	5.00	6.00	11.00	0.142
37	13.00	3.10	5.12	8.22	0.104
38	14.00	4.50	6.45	10.95	0.158
39	14.00	3.10	5.37	8.47	0.123
40	16.00	6.00	8.70	14.70	0.131
41	12.00	2.70	4.54	7.24	0.123
42	14.00	4.40	6.13	10.53	0.106
43	14.00	4.50	6.03	10.53	0.147
44	14.00	4.80	6.46	11.26	0.122
45	14.00	4.20	6.84	11.04	0.165
46	14.00	4.90	6.23	11.13	0.116
47	15.00	6.00	8.20	14.20	0.138
48	14.00	5.10	6.27	11.37	0.096
49	13.00	3.00	5.35	8.35	0.114
50	13.00	2.70	5.04	7.74	0.090
51	18.00	7.00	8.95	15.95	0.162
Average	13.90	4.17	5.96	10.13	0.121

AN ECONOMETRIC MODEL OF WHEAT MARKET IN PAKISTAN

By

Muhammad Ashfaq, Garry Griffith and Kevin Parton*

To meet the food needs of a burgeoning population, wheat availability will have to be increased. The present paper identifies the relevance and importance of various factors that have affected wheat market of Pakistan during the period of 1971-96. The study is an improvement on earlier ones as it includes all important activities of the wheat economy of Pakistan and as a larger time period is covered for the analysis. Various types of elasticities estimated in the study were found to be consistent with the results obtained by other researchers. The in-elastic supply of wheat suggests that in the future, an increase in the supply of wheat will occur if price incentives are given along with other institutional supports like research and extension, timely availability of inputs and development of infrastructure like irrigation facilities. Price and income elasticities of demand are positive and fairly large implying that with the increase in wheat price consumers substitute wheat with other food grains and consume more of it with the increase in their incomes.

1. Introduction

Agriculture contributes 26 per cent to GDP, employs 44 per cent of the labour force and provides about 80 per cent of export earnings [Government of Pakistan (2000a) and Malik, *et al* (1994)]. Wheat is the staple food of the population and occupies a central position in farm policy. Its share in total cropped area is around 36 per cent [Government of Pakistan (2000b)]. It is grown on both irrigated and un-irrigated areas in all the four provinces. It is an item of daily consume. In 1998-99, per capita availability of wheat was 141 kgs per annum as compared to 20 kgs in the case of rice [Government of Pakistan (2000b)].

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The population of Pakistan is estimated to be 137.5 million and it is increasing at an annual rate of about 2.6 per cent [Government of Pakistan (2000a)]. To meet the food needs of this burgeoning population, wheat availability will have to be increased. Despite increases in yield and production, sustained self sufficiency could not be attained as yet and the country has been a regular importer of wheat upto 1998-99. Pakistan has the potential for yield and productivity improvement for food grains. It is thought that in the long-run new technologies, gradual development of irrigation and drainage facilities, reclamation of water-logged and saline soils, and institutional services such as credit and extension will bring about substantial increases in output. In the short-run, however, price policy has to provide incentives to farmers to expand wheat production. The government has tried to keep the price of wheat below its import parity price in the country to subsidize domestic consumers, thus involving a substantial cost to government [Hamid, *et al* (1991)]as well as loss to the growers which discouraged the domestic wheat production, and self-sufficiency remained beyond our reach.

The main objective of this paper is to develop an econometric model of wheat economy of Pakistan and to analyse the relevance and importance of various factors that affected various components of this market during the period of 1971-96.

2. Model Specification

Due to the annual nature of wheat production and the characteristics of the data available on variables included in the model, an annual model was constructed. The model consists of ten equations and four identities. The specification of the model is given below:

Model of Pakistan's Wheat Economy

Supply	
$A_t = f(A_{t-1},\ PC_{t-1},\ W/F_t,\ e_{t1})$	……Equation (1)
$Y_t = f(QFD_t,\ W_t,\ D_{87},\ e_{t2})$	……Equation (2)
$TQS_t \equiv A_t * Y_t$	……Identity (I)
$MS_t \equiv TQS_t - HC_t - QDF_t - QDS_t$	……Identity (II)
$QFD_t = f(PP_t,\ AH_t,\ TR_t,\ e_{t3})$	……Equation (3)
Demand	
$QDHS_t = f(W/G_t,\ GNP_t,\ RP_t,\ D_{87},\ e_{t4})$	……Equation (4)
$QDF_t = f(LS_t,\ PW_t,\ e_{t5})$	……Equation (5)
$QDS_t = f(A_t,\ e_{t6})$	……Equation (6)
Price	
$PP_t = f(S_{t-1},\ PI_t,\ PP_{t-1},\ e_{t7})$	……Equation (7)
$PP_t \equiv PW_t - PST_t$	……Identity (III)
Imports, Stocks and Release	
$M_t = f(M_{t-1},\ PI_t,\ QP_t,\ D_{8896},\ e_{t8})$	……Equation (8)
$S_t = f(PP_t,\ QP_t,\ e_{t9})$	……Equation (9)
$QR_t = f(QP_t,\ M_t,\ D_{8896},\ e_{t10})$	……Equation (10)
Market Clearing Identify	
$QDHS_t \equiv MS_t - QP_t + QR_t$	……Identity (IV)

The variables included in the above model are defined as under:

Endogenous Variables

A_t	=	Area under wheat crop in year t
Y_t	=	Yield of wheat in year t
TQS_t	=	Total quantity supplied of wheat in year t
MS_t	=	Marketed surplus of wheat in year t
QFD_t	=	Quantity of fertilizer demanded for wheat in year t
$QDHS_t$	=	Quantity of wheat demanded at wholesale level for human consumption in year t
QDF_t	=	Quantity of wheat demanded for feed in year t
QDS_t	=	Quantity of wheat demanded for seed in year t
PP_t	=	Procurement price of wheat in year t
PW_t	=	Wholesale price of wheat in year t
M_t	=	Total import of wheat in year t
S_t	=	Stock of wheat held by government in year t
QR_t	=	Quantity of wheat released to millers by the government in year t
QP_t	=	Quantity of wheat procured in year t
HC_t	=	Quantity of wheat kept by farmers for home consumption in year t

Pre-determined Variables

A_{t-1}	=	Area under wheat crop in year t-1
PC_{t-1}	=	Price of cotton in year t-1
W/F_t	=	Wheat - fertilizer price ratio in year t
W_t	=	Total rainfall during the sowing and growing period in year t

AH_t	=	Area under high yielding varieties in year t
TR_t	=	No. of tractors in year t
W/G_t	=	Price ratio of wheat to grains at wholesale level in year t
GNP_t	=	Gross national product in year t
RP_t	=	Release price of wheat to miller in year t
LS_t	=	Total Livestock units in year t
S_{t-1}	=	Stocks of wheat held by government in year t-1
PP_{t-1}	=	Procurement price of wheat in year t-1
PI_t	=	International price of wheat in year t
M_{t-1}	=	Total import of wheat in year t-1
D_{87}	=	Dummy variable for abnormal year, 1987
D_{8896}	=	Dummy variable for policy change i.e. period after deregulation of flour market, 1988 to 1996
PST_t	=	Price of storage and transportation in year t.

3. Data and Model Estimation

Time series data from 1971-1996 on the variables included in the model were collected from the Federal Bureau of Statistics, Ministry of Food, Agriculture and Cooperatives, Agricultural Prices commission, Provincial Departments of Agriculture and from the files and publications of other departments. The estimates on farmers home consumption, seed and feed were only available as percentages. Total rainfall was calculated by adding the monthly rainfall in various cities during the sowing and growing period. These data were obtained from various issues of Pakistan Statistical Year Book. In calculating the wheat fertilizer price ratio, the price of urea was used. The quantity of wheat demanded at the wholesale market was estimated as the marketed surplus plus the quantity released by the government minus the quantity procured. This method takes into account the imported/exported wheat surplus plus the quantity released by the government minus the quantity procured. This method takes into account the imported/exported wheat in the government stocks. The marketed surplus was obtained after deducting from the gross production, the home consumption of producers and quantity required for seed and feed. Data on the release price were taken from three different sources. For 1971-72 to 1976-77, data were taken from Ryan and Khan (1992), for 1977-78 to 1987-88 from Landes and Ash (1993) and for 1988-89 to 1995-96 from the files of the Ministry of Food and Agriculture, Government of Pakistan. The quantity of wheat demanded for feed was calculated as 2 per cent of the output. Similarly, the quantity of seed was calculated as 6.5 per cent of the total production. The allowance for home consumption was given @ 51.5 per cent of the output. The government stocks at the end of year were assumed as the stocks in the beginning of the year plus total imports plus quantity procured of wheat from the domestic production minus quantity of wheat released to the millers. The model was estimated simultaneously using the TSP package.

4. Results

Estimated results for the stochastic equations in the model are shown in Table-1. The 't' values are given in parentheses. Summary statistics provided for each equation are the coefficient of determination (R^2), Durbin-Watson statistic (D.W) and where appropriate the Durbin-H statistic (D.H). The estimated results seem quite reasonable and rational. Signs of all the parameter estimates are consistent with a priori expectations. Thus, the model conforms to economic theory.

Table-1: The Estimated Wheat Model for Pakistan

	R^2	D.W	D.H.
Supply $Y_t = 1.07 + 0.00077\ QFD_t + 0.00086\ W_t - 0.25\ D_{87}$ (16.18) (3.20) (4.73)	0.93	2.45	
$A_t = 1630.43 + 0.79\ A_{t-1} - 0.12\ PC_{t-1} + 444.79\ W/F_t$ (14.05) (3.13) (1.90)	0.92	2.49	-1.22
$QFD_t = -600.58 + 0.47\ PP_t + 0.15\ AH_t + 0.79\ TR_t$ (3.11) (16.44) (8.37)	0.98	1.19	
Demand $QDHS_t = 7401.93 - 7236.94\ W/G_t + 0.035\ GNP_t - 7.36\ RP_t$ (1.76) (7.53) (1.63) $- 3570.64\ D_{87}$ (5.67)	0.79	2.39	
$QDF_t = -28.22 + 5.43\ LS_t - 0.023\ PW_t$ (25.75) (0.75)	0.97	1.12	
$QDS_t = -1077.12 + 0.26\ A_t$ (22.48)	0.94	1.41	
Price $PP_t = 297.55 - 0.0019\ S_{t-1} + 0.094\ PI_t + 0.19\ PP_{t-1}$ (0.26) (2.01) (1.28)	0.36	1.66	1.15
Imports, Stocks and Release $M_t = 2040.03 + 0.28\ M_{t-1} - 0.47\ PI_t - 0.42\ QP_t$ (4.31) (1.13) (5.25) $+1194.32\ D_{8896}$ (9.83)	0.65	2.27	-0.68
$S_t = 2069.61 + 0.32\ QP_t - 4.03\ PP_t$ (2.48) (1.60)	0.30	1.94	
$QR_t = 1555.81 + 0.47\ QP_t + 0.28\ M_t + 1509.40\ D_{8896}$ (5.47) (2.23) (6.38)	0.93	1.57	

Note: Critical value at 0.05 = 1.717 and at 0.10 = 1.321 for df, 22.

The price elasticities associated with components of supply and demand were computed at the mean points of the data sample. The short-run price elasticity of wheat supply (area) was calculated as 0.09. Similar in-elastic supply relationship was reported by all other previous studies as is given in Table-2. A highly in-elastic supply elasticity of wheat suggests that in the future if the government wants to increase the supply of wheat, institutional support like research and extension and development of irrigation facilities are needed alongwith price incentives. The in-elastic supply elasticity, however, does not mean low supply response for major crops such as wheat, because, here a 10 per cent increase in wheat production would mean an increase of 2 million tonnes in national wheat production which is not a low response, any how. The long-run price elasticity of area was calculated as 0.20.

Table-2: Short-run Own and Cross Price Elasticities of Wheat Acreage

References	Price of Wheat	Price of Cotton
Cummings (1975)	0.10	-
Scandizo and Bruce (1980)	0.07	-
Bale and Lutz (1981)	0.17	-
Tweeten (1986)	0.15	-0.02
Cornlisse and Kuijpers (1987)	0.07	-
Ali (1990)	0.22	-0.15
Ashiq (1992)	0.17 to 0.18	-0.07 to –0.11
Present Study	0.09	-0.08

The price elasticity of demand for wheat for food was calculated as –0.44. This price elasticity of wheat demand was at the wholesale level and expected to be lower than the retail demand elasticities as estimated in other studies. A comparison of demand elasticities reported by other studies is presented in Table-3. The price elasticity of wheat demand shows that there will be decrease in the consumption of wheat with an increase in its price. Consumers will substitute wheat with other food grains. The income elasticity of wheat is fairly elastic (0.75), implying that consumers increase their wheat consumption by 0.75 per cent with one per cent increase in their incomes.

Table-3: Short-run Price and Income Elasticities of Wheat Demand

References	Price	Income
Chaudhry, *et al* (1987)	-0.41	0.51
Cornelisse and Kuijpers (1987)	-	0.42
Ahmad, *et al* (1987)	-0.84	-
Alderman (1988)	-0.96	-
Deaton and Grimard (1991)	-0.51	-
Hamid, *et al* (1991)	-0.25	-
Bouis (1992)	-0.32	
Idrees (1994)	-0.34	0.18
Riaz (1994)	-0.71	-
Present Study	-0.44	0.75

Table 4 shows various other calculated price elasticities. The elasticity of the demand for fertilizer with respect to wheat price was 0.31 which indicates that if price of wheat is increased by one per cent, fertilizer demand for wheat goes up by 0.31 per cent.

Table-4: Other Estimated Price Elasticities

Type of elasticity	Value
Elasticity of fertilizer demand with respect to wheat price	-0.31
Release price elasticity of wheat demand	-0.49
Price elasticity of quantity demanded for feed	-0.05
Elasticity of procurement price with respect to international price	0.14
Elasticity of imports with respect to international price	-0.23
Price elasticity of stocks	-1.40

The release price elasticity for wheat demand was estimated as -0.49. This shows that millers' demand for wheat decreases with an increase in release price – one per cent increase in issue price decreases the wheat demand of the flourmills by 0.49 per cent. The price elasticity of quantity demanded for feed was –0.05 (highly in-elastic). The low price elasticity for feed suggests that feed producers consider wheat a cheap source of grain as compared to other grains like maize and they use wheat for livestock feed irrespective of its price.

The procurement price was also in-elastic relative to the international price. The value was estimated as 0.14, which shows that a change in international price brings a much smaller change in procurement price.

The elasticity of imports with respect to international price was estimated as –0.23. the price elasticity of stocks was elastic with a value of –1.4. A change in procurement price brings a significant change in the stock situation.

5. Conclusions

The estimated price elasticities of demand and supply, and the income and other relevant price elasticities, were found to be consistent with economic theory and the results obtained by other researchers. The supply response elasticity was estimated to be 0.09 and the demand response elasticity was estimated to be –0.44. The highly inelastic supply of wheat suggests that in the future, substantial increase in the supply of wheat will only occur if price incentives are given along with other institutional supports like research and extension, timely availability of inputs and development of infrastructure like irrigation facilities which will bring additional land into cultivation. The price elasticity of demand shows that there will be decrease in the consumption of wheat with an increase in its price. The income elasticity of wheat was 0.75, which indicates that with an increase in income, consumers might shift to other high-value food like meat, fruit, milk, and oil. Household Income and Expenditure Survey (HIES) showed that the consumption of the above mentioned food items has been increasing with the increase in per capita income [Ender, *et al* (1992)].

The wheat price elasticity with respect to fertilizer demand was 0.31. The inelastic price response indicated that farmers have to use a certain quantity of fertilizer for wheat production. An increase in wheat price will bring a positive change in fertilizer use and hence increases production but only to limited extent. The value of the release price elasticity for wheat demand was estimated as –0.49. The relative release price elasticity shows that millers demand for wheat decreases with an increase in release price but may not be very significantly. The price elasticity of quantity demanded for feed was –0.05. The in-elastic price elasticity of quantity demanded of wheat for feed shows that wheat is a cheap source of grain as compared to other grains like maize. The international price elasticity for the procurement price was also in-elastic. The value is estimated as 0.14, which shows that a change in international price brings a much smaller change in procurement price.

The international price elasticity of imports was estimated as –0.23. The in-elastic international price elasticity of imports shows that government has to import wheat to fill the gap between domestic supply and demand. Increase in the international price does have some adverse effects on imports but those are insignificant. The price elasticity of stocks was elastic with value of –1.4. It means that a small change in procurement price brings a significant change in stocks situation.

The present study suggests that more emphasis be given on technology and infrastructure development for achieving self-sufficiency along with support price policy to play a secondary role. The results of the model can be used to measure the welfare effects of government interventions in the wheat economy of Pakistan [Ashfaq, Griffith and Parton (1999)].

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1. Manuscripts of articles, comments and reviews should be in English only and sent in triplicate preferably accompanied with 1.44 MB diskette in MS Words to the Editor, Pakistan journal of Agricultural Economics. Comments and Reviews should be submitted alongwith two copies of relevant book or paper.

2. All the articles should possibly be arranged into sections on (1) Introduction, (2) Hypotheses, (3) Methodological and Analytical Framework, (4) Results, (5) Shortcomings and Limitations, (6) Policy Implications, (7) Conclusions and (8) Recommendations. An extract should also be prepared and given in the beginning of the article.

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