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Wheat Self-sufficiency in Different Policy Scenarios and Their Likely Impacts on Producers, Consumers, and the Public Exchequer

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Every government faces a challenge to select an optimum policy to provide food supplies to the consumers at a reasonable price and maintain a reasonable nutritional standard. The alternative policy options available are an uninterrupted market, imports, input subsidies, price support, combined policy developed by the combination of input subsidy and price support, and investment on research and infrastructure development. This paper analyses the impact of these options on consumers' and producers' welfare, tax revenue, and foreign exchange requirement. The import and input subsidy give net return to the society while price support generates net loss. The triple combined policy option generates the highest net return to the society when each import and input subsidy component is combined with price support in the ratio of 40 and 20 percent, respectively. The best policies to provide higher wheat supplies at lower prices and to improve the welfare of consumers and producers were investment on agricultural research and development of irrigation infrastructure in the long run, but for the short run, the first and the second best option were respectively the combined and the input subsidy policy.

Each government faces the conflicting challenges of increasing the income of farmers and the nutritional status of urban and rural poor by providing food at reasonable prices. Although the best solution in the long-run would be to increase production through technological changes, the alternatives available in the short-term are an uninterrupted free market, imports, input subsidies, and price support.

In Pakistan, the main objectives of food policies in the past have been to achieve food security, provide low-price food to consumers, assure reasonable prices to producers, and boost agricultural production in the country. The policies adopted to achieve these objectives were assured minimum price to the producers through the floor price mechanism, providing wheat-flour to the consumer through ration shops and supplying fertiliser and irrigation to the producers at subsidised prices. However, the impact of these policies on different objectives and various sectors of the society might be self-defeating and internally inconsistent. The objective of this paper is to analyse the impact of the alternative food policy options adopted in the

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wheat sector in Pakistan on the welfare of consumers, producers, government revenue, and foreign exchange requirements. Such comparison would help policy-makers in giving benefit to a particular sector of the society by making optimal allocations of this scarce resource.

Wheat was selected in this analysis because of its significance in Pakistan's economy. It is a staple food, and provides more than half of all food calories. Grown on about 37 percent of the total cropped area, and 68 percent of the winter season cropped area, it accounts for 3.1 percent GDP of the country. Almost 10 percent of the total population is involved in its production, distribution, and processing activities [Pakistan (2000, 2000a)].

Section 1 discusses wheat availability in a historical perspective. Section 2 evaluates and compares alternative policy options and briefly outlines the methodology. Section 3 elaborates the limitation of the study, while Section 4 summarises the results.

1. WHEAT AVAILABILITY IN A HISTORICAL PERSPECTIVE

Before analysing the impact of alternative policies, a brief history of wheat production and marketing will be helpful in understanding the overall wheat policy environment in the country. Wheat production in Pakistan can be divided into three distinct periods: the pre-Green Revolution period, before the release of high-yielding wheat varieties (1948–66); the Green Revolution period, when modern inputs such as high-yielding varieties, fertiliser, and irrigation were rapidly adopted (1967–76); and the post-Green Revolution period, when additional gains of modern inputs slowed down considerably (1977–2000).

The growth in wheat production and the relative share of area and yield in production increase during the three periods are given in Table 1. The average annual growth rate of wheat production during the Green Revolution and in the pre-revolution, and post-revolution eras were 1.5 percent, 5.1 percent, and 3.3 percent,

Table 1

Rates of Growth of Wheat Area, Yield, and Production for Various Periods in Pakistan

	Growth Rate (%) in			Percentage Increase in Production Due to Yield
	Area	Yield	Production	
Pre-Green Revolution Era	1.5	0	1.5	0
Green Revolution Era	0.5	4.6	5.1	90
Post-Revolution Era	1.4	2.0	3.4	41

Sources: Pakistan (Various Issues) *Agricultural Statistics of Pakistan*.
SSD (1989) *Statistical Bulletin on Wheat in Pakistan*.

respectively. During 1948–1966, all the increase in wheat production was derived from area increase. That trend was sharply reversed between 1967 and 1976 when the growth rate of wheat yields rose at 4.6 percent per annum and contributed a major share in wheat production. Since 1977, however, the rate of yield increase slowed down to only 2 percent per annum, well below the population growth rate. Although growth in wheat production in the last period has been reasonable, area increase accounted for 41 percent of production growth.

There are two distinct periods with respect to government policies to assure wheat supply in the country. In the first period, until 1971, the prices were kept higher than the international market prices after converting the latter at wholesale level; since then it has turned the other way round (Table 2). There seemed to be two objectives of the government food policies during the 1970s and 1980s: (1) to keep domestic wheat prices low for the benefit of urban and rural landless poor, and (2) to discourage the private sector involvement in wheat services sector, such as wheat storage, transportation, and distribution.

Fixing wheat flour prices and protecting these prices by government involvement in wheat marketing were the mechanisms through which farm-gate prices were kept low, albeit the original purpose of these mechanisms was to provide a reasonable price to farmers. Government involvement in marketing was operated through a ration-shop network, public sector flour mills nationalised during the mid-seventies,[1] and direct involvement of Pakistan Agricultural Storage and Services Corporation (PASSCO).

To discourage the private sector involvement in wheat marketing, a narrow margin between farm-gate and release prices to flour mills was maintained, although this was never a set objective of these organisations. Furthermore, no difference in the release price in different regions and different times of the year was kept. The ultimate result was interdiction of the private sector to bid prices up to the equilibrium level, and it created an inefficient marketing system.

Below-equilibrium prices of wheat and wheat flour naturally created a gap between supply and demand, forced the government to import around one million tons of wheat per year to fill the gap, and bear subsidy for urban consumers equal to the difference in international and domestic prices. The import and the higher production caused by the Green Revolution improved the average per capita availability from domestic production of 82 kilograms in the pre-Revolution period (1961–67) to 123 kilograms in the post-Revolution period (1977–2000). The objective of this paper is to show that the same objective of increasing per capita consumption could have been achieved by alternative policies and with different implications for producers, consumers,

[1]Although small mills—less than a given capacity—were allowed to do the business, yet the government sector flour mills heavily dominated the market. In early 1980s, the government denationalised the flourmills but continued operating through ration shops to provide food to the poor at low prices. With the abolition of ration shop, the flour mills in the country were privileged to purchase any amount of wheat from the Food Department at the release price fixed by the government.

Table 2

Domestic and International Prices of Wheat ($/ton) in Pakistan

Years (a)	Wholesale Prices (b)	CIF International Prices (c)	International Prices +20% Handling Cost (d)	Difference in Prices (d)–(b)
1961	94.58	58.70	70	–22.14
1962	89.83	64.30	77	–12.67
1963	83.41	64.66	78	–5.82
1964	91.15	67.60	81	–10.03
1965	100.40	59.52	71	–28.98
1966	90.78	62.83	75	–15.39
1967	136.23	65.77	79	–57.31
1968	122.12	62.83	75	–46.73
1969	95.92	58.42	70	–25.81
1970	106.69	62.83	75	–31.29
1971	108.77	62.30	75	–34.01
1972	100.87	69.10	83	17.95
1973	58.50	136.60	164	105.42
1974	76.52	178.00	214	137.08
1975	119.92	138.40	166	46.16
1976	106.71	122.70	147	40.53
1977	112.14	98.70	118	6.30
1978	133.26	124.90	150	16.62
1979	139.86	155.20	186	46.38
1980	145.72	168.30	202	56.24
1981	158.66	154.60	186	26.86
1982	138.52	132.60	159	20.60
1983	142.82	137.30	165	21.94
1984	147.82	140.20	168	20.42
1985	145.13	128.70	154	9.31
1986	132.03	118.40	142	10.05
1987	120.60	112.10	135	13.92
1988	114.55	140.70	169	54.29
1989	117.43	161.30	194	76.13
1990	122.40	129.10	155	32.52
1991	124.17	126.10	151	27.15
1992	138.97	145.10	174	35.15
1993	124.62	135.00	162	37.14
1994	147.07	135.00	166	19.25
1995	100.82	146.00	175	74.38
1996	107.77	210.67	253	145.03
1997	121.80	165.33	198	76.60
1998	102.84	136.00	163	60.36
1999	111.68	112.67	135	23.52
2000	116.27	104.33	125	8.93

Sources: Government of Pakistan, International Monetary Fund, and Asian Development Bank.

and government revenue. Recently, Ashfaq, *et al.* (2001) estimated producer's loss, consumer's gain, cost to the government, and net welfare loss to the society over time by employing the static and dynamic welfare analysis approach. That paper analyses the impact of only the price policy on different groups of the economy but does not include analysis and discussion for other alternative policies such as import, input subsidy, and combined policy options, so as to take care of the interest of all groups in the society. The present study aims to fill this gap. We follow the work of Barker and Hayami (1976), Ahmed (1979) and Bayes, *et al.* (1985) to discuss different policy options.

2. ALTERNATIVE POLICY OPTIONS

In the following sections, we evaluate and compare different policy options that can be adopted to ensure reasonable wheat consumption. In Figure 1, S_0 represents the domestic supply of wheat at the existing prices of fertiliser. The producers used at home was assumed to be 52 percent of the total production [Hamid, Pinckney, and Valdes (1988)]. The line DD represents total demand corresponding to each level of price, and the horizontal distance between Hh and DD vertical line Hh indicates the producer's demand for home consumption (the amount of wheat that producers kept at home for their own family consumption) implying that OH amount of total production is not sold in the market. The amount

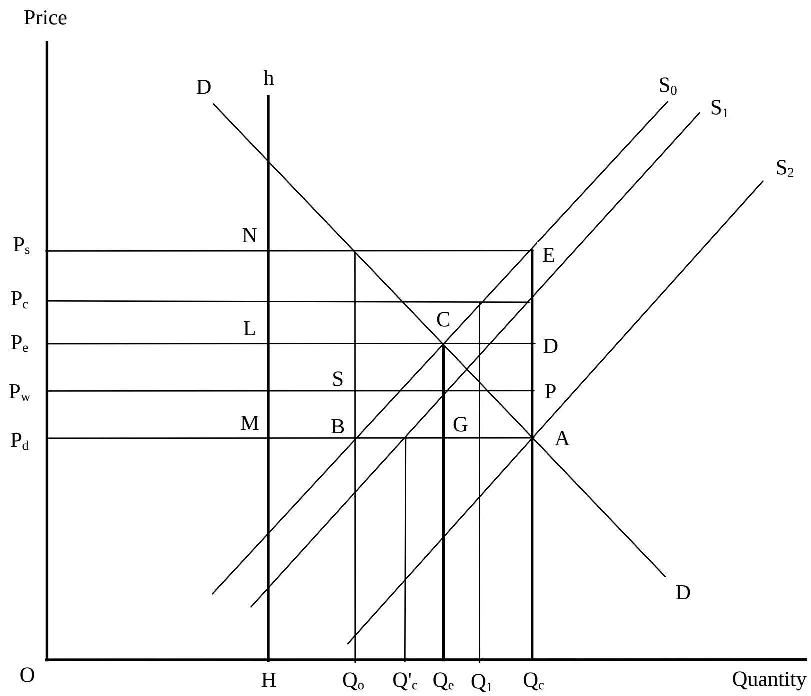

Fig. 1. Analysis of Wheat Import and Price Support Policy.

that lines measures the total quantity of wheat marketed in the country by local producers.[2] The domestic price P_d in the figure is lower than the equilibrium price P_e. Domestic supply at P_d is Q_0 but the total demand is Q_c. This difference in supply and demand of wheat at the price P_d creates a gap of $(Q_c–Q_0)$ in the country. At least five alternatives are available to fill this gap: (1) Free market option, (2) import wheat equivalent of the gap, (3) price support that requires government to buy output from wheat producers at a higher price and sell it to consumers at a lower price, (4) input subsidy to shift the supply curve by encouraging input use, and (5) a combination of import, price support, and input subsidy with different proportions.

2.1. Free Market Option

One of the options available to the government is to leave the market uninterrupted. In periods of acute shortfalls in domestic production or imports, consumer prices may become intolerably high if the situation is left entirely to the free market-mechanism, which will balance the excess demand with supply through the device of high prices. High prices are particularly harsh on the low-income consumers because the high-income affluent consumers may bid the limited supply away from them. To understand its implications on production and consumption, we estimated the equilibrium price and quantity given the supply and demand elasticities of wheat.

Irrespective of methodology and type of data, the short-run supply elasticity of wheat is estimated by different researchers and varies from 0.06 to 0.47, and the detail is given in Farooq and Iqbal (2000). The demand and supply curves in Figure 2 are drawn assuming the wheat demand and supply elasticities of –0.31 and 0.23, respectively.[3] The intercept of supply curve was adjusted to show a total production of 16.07 million tons (t) while the intercept of demand curve was adjusted to show a total demand of 19.37 million t (16.07 million t production + 1.8 million t imports + 1.5 million t change in government stock) at the existing wholesale price of 7974 rupees per t in 1999-2000 [Pakistan (2000)].[4] The demand and supply equations with these assumptions are $Q^d_0 = 313.8(P_0)^{-0.31}$ and $Q^s_0 = 2.04(P_0)^{0.23}$, respectively. Solving these equations simultaneously gave the equilibrium price at Rs 11269 per ton and equilibrium quantity at 17.40 million tons for 1999-2000. Had the government fixed support price proportionately higher (41 percent higher,

[2]The demand curve representing the quantity sold in the local market is not drawn separately. It would run parallel to the demand curve (DD) at its left at a distance equal to the difference between Hh and DD.

[3]The supply elasticity of wheat was taken from Ali (1990), and the demand elasticity from Alderman (1988). Both the figures referred to the short-run elasticities.

[4]One-year lag has been taken between consumption and production, as production for this year will last until the end of next year.

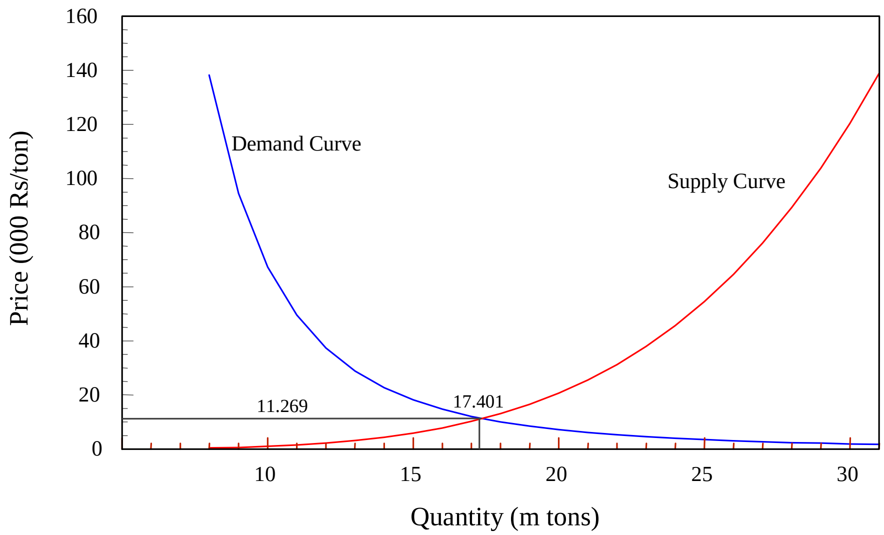

Fig. 2. Equilibrium Quantity and Price of Wheat.

keeping all the marketing subsidies as such), there would not have been any import of wheat during the year. Higher prices would have encouraged wheat supply and discouraged wheat consumption to match supply and demand at the equilibrium price.

However, the equilibrium price may be undesirable either because the equilibrium quantity thus produced is still too small to supply enough food or, even if it result in the production of enough food, it may be beyond the reach of the urban and landless rural poor. To take care of the second concern, lower than equilibrium price was fixed at Rs 7974 per t, which encouraged consumption but discouraged production and thus created a gap of 3.3 million t between supply and demand.

In the following section, the implications of the other four policy options are compared to the free market option with respect to the welfare of consumers, producers, government revenues, and foreign exchange requirements. Comparing the policy interventions to the free market equilibrium option does not imply that we prefer the latter option to advocate self-sufficiency. This is simply a reference point for the purpose of comparing the alternative policy options.

2.2. Welfare Implications of Imports

Since 1971, wheat prices in Pakistan have been kept lower than the equilibrium and import parity prices in the international market (Table 2). To fill the gap thus created, government has had to import 5–20 percent of the demand. Figure 1 was drawn to explain the welfare implication of this policy in one year. During

1999-2000, the controlled price (P_d), the import parity prices (P_w), and the equilibrium price (P_e) were respectively Rs 7974, Rs 8586, and Rs 11269 per ton, while wheat consumption (Q_c) and production (Q_0) were 19.37 and 16.07 million tons, respectively [Pakistan (2000)]. The difference in Q_c and Q_0 was met from import (1.8 million tons) and stock adjustment (1.5 million tons). The welfare implication of this policy is documented in Table 3.

Only consumers gained through this policy. All other parties, i.e., the government and the producers have to pay for it. Consumers' gain was higher than the total loss paid by the producers and the government together. Therefore, the policy produced net gain to the society and the rate of return on the policy was 58 percent (Table 3).

The government cost would be lower, if the import is a food-aid. In the above example, if 50 percent of the imports were food-aid, then government had to incur only half of the cost, and net return to the society would be higher than that resulting from the absence of food-aid.

2.3. Input Subsidy

The gap between consumption and production could be filled by shifting the supply curve from S_0 to S_2 (in Figure 1). Since a supply curve represents the rising portion of the marginal cost curve, one of the options to shift the supply curve to the right is to be exercised by lowering the input prices. Given the production elasticity of fertiliser in wheat, we can determine how much fertiliser is required to obtain the target increase in output. Then, knowing the price elasticity of demand for fertiliser, one can calculate the decline in price that will induce the additional required fertiliser consumption.

It is assumed that 80 percent of total consumption of fertiliser in the *rabi* season is being used in wheat production and the remaining in the minor crops. The demand curve of fertiliser for wheat is D_{f0} D_{f0} (Fig. 3), and the quantity demanded for wheat production at the existing prices of P_{fd} is X_0. The demand will increase to X_S in Figure 3 if the government decides to subsidise fertiliser use in wheat production for the purpose of shifting the wheat supply curve from S_0 to S_2 in Figure 1, to fill the present gap in its production and consumption. The supply curve of fertiliser is assumed to be infinitely elastic at the world price level. Consideration of an upward sloping domestic supply curve has been avoided because it will involve subsidising of the fertiliser industry.

Assume that government decides to produce $(Q_e–Q_0)/Q_e$=11 percent deficient wheat within the country. Further assume the short-run supply elasticity of wheat with respect to fertiliser price is –0.185 [Ali (1990) a mean of –0.25; Tweeten (1982)] –0.12, and the price of fertiliser would have to be reduced by (1/0.185)*11 = 61 percent to produce an additional 11 percent wheat. This will reduce the nitrogen and phosphorus fertiliser prices to 4.38 and 10.63 rupees per kilogram, respectively,

Table 3

Costs and Benefits of Import, Input Subsidy and Price Support Policies

Policy	Formula Used to Estimate the Corresponding Component	Gain or Loss in Million Rupees
Import		
(a) Consumers' Gain	$(Q_e - H)*(P_e - P_d) + 0.5*(Q_c - Q_e)*(P_e - P_d)$ (fig 1)	33046
(b) Producers' Loss	$(Q_e - H)*(P_e - P_d) - 0.5*(Q_e - Q_0)*(P_e - P_d)$ (fig 1)	27610
(c) Government Cost	$(Q_c - Q_0)*(P_w - P_d)$ (fig 1)	2020
(d) Foreign Exchange Requirement	$(Q_c - Q_0)*P_w$ (fig 1)	28335
(e) Cost of Engaging Foreign Exchange for 6 Months at the Rate of 10% Per Annum (Interest)		1417
(f) Total Cost of the Policy	(c+e)	3437
(g) Net Gain (+) or Loss (–) to the Society	(a–b–f)	2000
(h) Rate of Return of the Policy	$((g/f)*100)$	58%
Input Subsidy		
(a) Consumers' Gain	$(Q_e - H)*(P_e - P_d) + 0.5*(Q_c - Q_e)*(P_e - P_d)$ (fig 1)	33046
(b) Producers' Loss	$(Q_c - Q_e)*P_d - (Q_e - H)*(P_e - P_d)$ (fig 1) $- [P_{fS}*(OX_S - OX_0) - (P_{fd} - P_{fS})*(OX_0)]$ (fig 3)	6061
(c) Fertiliser Cost to Govt.	$((P_{fd} - P_{fs})*(OX_0) + (P_{fw} - P_{fs})*(X_s - X_0))*1000$ (fig 3)	20706
(d) Foreign Exchange Requirement to Import Fertiliser	$(X_S - X_0)*P_{fw}$ (fig 3)	9071
(e) Interest Cost on Foreign Exchange Engaged in Fertiliser Import for 6 Months at the Rate of 10% Per Annum		454
(f) Total Cost to the Government	(c+e)	21160
(g) Net Benefits to the Society	(a–b–f)	5825
(h) Rate of Return of the Policy	$((g/f)*100)$	28%
Price Support		
(a) Consumers' Gain	$(Q_e - H)*(P_e - P_d) + 0.5*(Q_c - Q_e)*(P_e - P_d)$ (fig 1)	33046
(b) Producers' Gain	$(Q_c - H)*(P_S - P_e) - 0.5*(Q_c - Q_e)*(P_S - P_e)$ (fig 1)	67121
(c) Cost to the Government	$(Q_c - H)*(P_S - P_d)$ (fig 1)	110002
(d) Foreign Exchange Required to Import Fertiliser	$(X_S - X_0)*P_{fw}$ (fig 3)	9071
(e) Interest on the Foreign Exchange for 6 Months		454
(f) Total Cost to the Government	(c+e)	110456
(g) Net Benefits (+) or Loss (–) to the Society	(a+b–c)	–9835
(h) Rate of Return of the Policy	$((g/f)*100)$	–9%

instead of the current prices of 11.27 and 27.38 rupees per kilogram and thus create an additional demand of nitrogen and phosphorus.[5] Under the assumption that government will fill the additional demand of fertiliser (nitrogen and phosphorus) by purchasing from the international market, the level of subsidy in nitrogen and phosphorus will be (20.04– 4.38) = 15.7 and (19.20–10.63) = 8.6 rupees per kilogram, respectively.[6] Assuming fertiliser demand elasticity equal to 0.50 [Salam (1982)], the 61 percent reduction in fertiliser prices will stipulate the current use of soil nutrients in wheat from 1.2 million ton [Pakistan (2000)] to 1.56 million ton. Multiplying the new nutrient levels with per unit fertiliser subsidy will give a total cost of the policy.[7]

The additional fertiliser requirement can be met either by expanding the domestic industry or by importing from the international market, both having the same cost under a competitive market situation. However, local industry cannot meet the additional demand in the short term. Therefore, government decides to bring all the additional fertiliser from import. The foreign exchange requirements will be worth of 9071 million rupees, to import 0.46 million tons of additional soil nutrients.[8] The net return to the producer is negative because of loss to the producer (due to the lower domestic price of wheat than the equilibrium price as represented by the area LMGC in Figure 1) and is more than double the benefit obtained due to the increase in output value (due to higher level of fertiliser use) equal to the area AQ_cQ_eG. However, net saving from fertiliser use because of low fertiliser price as represented by the area $IP_{fd}P_{fS}K$ (P_{fd} is the present farm level price for fertiliser) minus additional fertiliser cost equal to the area LX_SX_0K in Figure 3 is positive. The welfare implications of the policy to all concerned parties are reported in Table 3. The consumer's gain is higher than the sum of the loss to producer and cost to the government and, therefore, it generates a net benefit to the society. The net rate of return of the policy is 28 percent.

Similarly, the rate of return of government subsidy on irrigation water can also be estimated. Actually, government should evaluate subsidy on different inputs, and then their decision should be based on the rate of return of the policy. For example, 55 percent additional water will be required to produce 11 percent wheat, assuming production elasticity with respect to irrigation water 0.2 [Hussain and

[5]The weighted average fertiliser prices were estimated as the weighted average price of N and P with relative share of each nutrient in the total nutrient (N+P) consumption. The N price was estimated from urea, while P price was estimated from DAP after deducting the N cost evaluated at N price from urea and N content in DAP.

[6]The international prices are taken from the World Bank publication *Commodity Trade and Price Trends* (various issues). Baltimore and London: The Johns Hopkins University Press for the World Bank.

[7]Due to the difficulties of controlling fertiliser subsidy exclusively for wheat crop, some of the advantage of the policy will be seen in other crops grown in the *rabi* season.

[8]It can be assumed that the domestic fertiliser industry can produce the additional fertiliser needed to implement the policy at the same cost in the long term. In this case, foreign exchange requirement to import fertiliser will cease, but foreign exchange requirement to import machinery will increase.

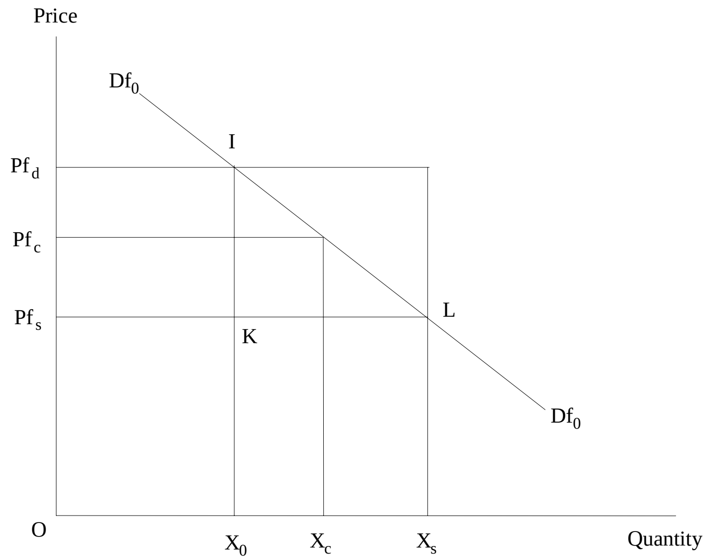

Fig. 3. Effect of Fertiliser Subsidy on Price and Demand.

Young (1985)]—the *rabi*-season water availability has to increase from the current level of 56 million acre feet to 87 million acre feet to produce deficient wheat. The cost of producing 31 million acre feet of water will be 10850 million rupees, assuming the additional water cost (net of additional water recoveries) is equal to 350 rupees per acre feet.[9] The increase in consumers' and producers' surplus will be (b+c) 15214 million rupees, giving a net gain of 4364 million rupees or rate of return of 40 percent. Similarly, the joint effect of increase in fertiliser and irrigation water can also be analysed. Combining the input subsidy policies can improve the production elasticity of each input due to the complementary effect. Thus further improvement is expected in net benefit and rate of return.

2.4. Price Support

The purpose of price support policy is to encourage production (above the equilibrium level) within the country so that the consumption could be supported from the local supply at a higher level than equilibrium because the equilibrium level of consumption is too low and is not enough to provide the required necessary calories for the human body. This can be achieved by offering a higher (than equilibrium) price to the farmers to produce enough wheat quantities for consumers'

[9]It should be noted that, unlike in fertiliser, water prices need not be changed to induce additional water demand, because canal water prices are already very low and high potential demand exists at the existing canal water prices.

demanded at a lower (than equilibrium) price. Both producer and consumer will benefit in this case, but the government has to bear the cost.

Assuming a fixed domestic supply curve S_0, an increase in the production of wheat to the desired level of OQ_c can be achieved by supporting the producer price at OP_S level in Figure 1. Since the government maintains the consumers' price at P_d level, increase in the production of wheat would involve a cost to the government equal to the area AENM. Area CENL represents an increase in the income of wheat producers, and CLMA represents an increase in consumers surplus at a cost to the government.

The government encouraged wheat consumption during 1999-2000 by fixing a lower price (P_d) at Rs 7974 than the equilibrium price (P_e) of Rs 11269 per ton. This resulted in more than equilibrium consumption. Now if the government had decided to give a higher wheat price to their own producers, so that they could produce (Q_c) amount of wheat within the country rather than import it from outside, it had to offer (P_s) prices to the producer. The P_s was estimated from the supply response function by substituting the required quantity on the left-hand side of the equation and solving for price. This gave the support price (P_s) of Rs 17962 per ton. The welfare implications of this policy against the policy of completely relying on market forces were estimated and the results are reported in Table 3. This policy has generated a negative return to the society because of the higher cost to the government than the sum of the benefits to the consumers and producers.

The additional production (Q_c–Q_0) required additional input use. If additional production was planned to be obtained from higher fertiliser use, this would require import adjustments to keep domestic fertiliser prices constant. In this case the demand curve for fertiliser will shift rightward, such that more fertiliser will be used at the given fertiliser prices. As estimated in the previous section, fertiliser import requirement would be 0.46 million tons of nutrients, requiring Rs 9071 million worth of foreign exchange. However, all cost of fertiliser imports will be recovered from farmers, as there is no subsidy on fertiliser use.

2.5. Combined Policy Options

In practice, government rarely adopts a single policy option. Generally, different policies are combined to achieve alternative goals. Therefore, any attempts to derive optimal policy will be incomplete without incorporating the combined policy options. Optimum combinations of alternative policies are determined using net benefits to the society as criteria. The following section discusses how these combinations affect different sectors of the society. Different combinations evaluated are: (1) import and input subsidy, (2) import and price support, (3) input subsidy and price support, (4) import, input subsidy, and price support.

The eight different scenarios of combined policies were evaluated when two policies were combined at the ratio of 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, and 20:80. As can be seen in import, input subsidy case, or price support, the consumer gain remains the same in all these policies, as these do not affect equilibrium and domestic prices. Therefore, in the combined policy options, the effect on consumer's surplus is not discussed.

The fertiliser component of the policy shifts the supply curve to the right from S_0 to S_1 (Figure 1), while price support component creates an incentive for producers and attracts them to produce at a higher level along the new supply curve. The fertiliser subsidy component yields additional output of (Q'_c–Q_0) at the given price P_d and the remaining gap of (Q_c–Q'_c) is filled by the price support component of the policy by giving higher prices to farmers at P_c. In the combined policy, a lower support price P_c than in the single price-support policy P_s is required. Similarly, a relatively low shift in demand for fertiliser (X_0 to X_c) and reduction in fertiliser prices (P_{fd} to P_{fc}) will be required in this case. The combined policy induced the fertiliser use in wheat production from X_0 to X_c (Figure 3).

2.5.1. Input Subsidy and Price Support

Among various combinations available in the combined policy, producer gain increases as the share of input subsidy decreases, or the share of price support increases. The cost to the government increases with the increase in price support component in the combined policy option. Both net benefit and rate of return for each policy option are moving parallel to each other. First both are increasing, and then decreasing with the increase in price support component. The maximum benefit to the society (4520 million rupees) is observed when input subsidy and price support components are combined in the ratio of 70:30, which is different than the policy where the highest rate of return, 13.4 percent, is observed at the ratio of 80:20 (Table 4).

2.5.2. Import and Input Subsidy

When import and input subsidy are combined, producer's gain continuously increases with the increase in input subsidy component but remains negative for all possible combinations of the two policies. The cost to the government increases with the increase in input subsidy and the decrease in import component in the combined policy option. The net benefit to the society is found to be optimal (6593 million rupees) when import and input subsidy components are combined in the ratio of 50:50 (Table 4). The rate of return on the policy is optimal 71 percent for the second policy option (where import and input subsidy are in the ratio of 80:20), which is different than the policy where net benefit to the society becomes optimal 50:50.

2.5.3. Import and Price Support

The producer's gain continuously increases (from negative to positive) with the decrease in import and the increase in price support components of the combined

Table 4

Costs and Benefits of Combined Input Subsidy, Import, and Price Support Policies
(Million Rupees Per Annum)

Policy Criterion I+II[a]	1 90+10	2 80+20	3 70+30	4 60+40	5 50+50	6 40+60	7 30+70	8 20+80
Combined Input Subsidy and Price Support								
Consumers Benefit	33046	33046	33046	33046	33046	33046	33046	33046
Producers' Loss (–) or gain (+)	–6137	–276	6002	12757	20054	27960	36545	45882
Cost to the Government	24311	28893	34528	41292	49267	58539	69197	81336
Net Benefit to the Society	2598	3877	4520	4512	3834	2468	394	–2408
Rate of Return on the Policy (%)	11	13.4	13.1	11	8	4	1	–3
Combined Import and Input Subsidy Policies								
Consumers Benefit	33046	33046	33046	33046	33046	33046	33046	33046
Producers Loss (–)	–24791	–22236	–19935	–17899	–16137	–14653	–13456	–12551
Cost to the Government	4846	6331	7888	9518	11217	12984	14818	16717
Net Benefit to the Society	3403	4480	5223	5629	5693	5409	4772	3779
Rate of Return on the Policy (%)	70	71	66	59	51	42	32	23
Combined Import and Price Support								
Consumers' Benefit	33046	33046	33046	33046	33046	33046	33046	33046
Producers' Loss (–) or Gain (+)	–21040	–13978	–6371	–1836	10702	20285	30651	41865
Cost to the Government	9067	15613	23147	31746	41488	52459	64746	78442
Net Benefit to the Society	2939	3455	3528	3137	2260	873	–1049	–3531
Rate of Return on the Policy (%)	32	22	15	10	5	2	–2	–5

[a] Policies 1 to 8 are all combined policies, such that policy 1 has 90 percent component of the first policy and 10 percent component of the second policy in each case, while policy 2 contains 80 percent component of the first policy and 20 percent component of the second policy, and so on.

policy. Producer's gain remains negative until price support component is equal to or less than 30 percent in the combined policy option. The cost to the government continuously increases with the decrease in import and increase in price support component of the two combined policies. The net benefit to the society is optimal (3528 million rupees) when 70 percent of extra demand is imported and 30 percent is contributed by the price support component. The rate of return on the policy is found to be optimal when import and price support policies are combined in the ratio of 90:10 (Table 4).

If the objective is to maximise the benefit of the whole society, but not any particular group of the society, then under 3 combined policy scenario and 8 available options under each scenario, the best policy option is the 5th policy under scenario 2, when import and input subsidy component are combined in the ratio of 50 and 50. However, if the preference is to protect the Government by taking care of other groups in the society as well, then the best policy option is the 1st policy of scenario 2, when import and input subsidy components are combined in the ratio of 90 and 10.

2.5.4. Combination of Three Policies

Import, fertiliser input subsidy, and price support are combined in different proportions and the distribution of loss and benefits among consumers, producers, and government are reported in Table 5. The optimal net benefit (6402 million rupees) to the society is observed under the policy where each of the import and fertiliser subsidy components is 40 percent and price support component is 20 percent (i.e., policy 3 in Table 5). The producer's loss under this option amounts to 4950 million rupees, and cost to the government is 21694 million rupees. The government can reduce its cost by (21694–10477) = 11217 million rupees if it decides to fill the total gap in demand and supply in such a way that each input subsidy and price support component contributes 10 percent, and if the remaining 80 percent is contributed by import component. This policy also generated the highest rate of return of 35 percent among all three combined policy options. However, producer's loss increases in this case by (18313–4950) = 13363 million rupees, and net gain to the society will be 2146 million rupees less than the earlier policy where the net return was maximum (i.e., policy 3 in Table 5). Similarly, if import, input subsidy, and price support are combined in the proportion of 30:30:40, rather than selecting an optimum policy in terms of the highest net benefit to the society or the highest rate of return, the producers' benefits will be turned to a positive of 8489 million rupees. However, it will impose an extra burden of (36197–21694) = 14503 million rupees on the public exchequer, and at the same time net benefit to the society will decrease by (6402–5339) = 1063 million rupees. Now, under the assumption that the policy-maker's objective is to maximise the net benefit to the society, the best policy under all possible triple combined policy options is policy 3. However, if the objective is

Table 5

Costs and Benefits of Combined Import, Input Subsidy and Price Support Policies
(Million Rupees Per Annum)

I+II+III[b]	1 20+20+60	2 30+30+40	3 40+40+20	4 20+60+20	5 30+40+30	6 40+20+40	7 80+10+10	8 60+20+20	9 40+30+30[a]
Consumers' Benefit	33046	33046	33046	33046	33046	33046	33046	33046	33046
Producers' Gain (+) or Loss (–)	24638	8489	–4950	–2043	2317	6527	–18313	–8947	536
Cost to the Government	55352	36197	21694	25160	29228	34639	10477	18507	27598
Net Benefit to the Society	2332	5339	6402	5844	6136	4935	4257	5593	5984
Rate of Return on the Policy (%)	4	13	26	20	18	12	35	26	19

[a] Policies 1 to 9 are all combined policies, such that policy 1 has 20 percent of import component, 20 percent of fertiliser input subsidy component, and 60 percent of price support component.

[b] I, II, and III represent wheat import, fertiliser input subsidy, and price support component of the combined policy respectively.

to seek the maximum rate of return, then the best option is policy 7. Similarly, policy-makers can choose the policy where producers are gaining at the cost to the government, such as policy 1, 2, or 6 in Table 5.

3. LIMITATION OF THE STUDY

It should be pointed out that the partial equilibrium model was used to evaluate the effect of alternative policies subject to a number of limitations. While the model does have some value, there is also a risk of drawing unwarranted assessment and policy conclusions from it.

First of all, the analysis is "excessively" partial. For instance, an introduction of modern technology can shift the supply curve towards right and it may reduce producers' surplus from the crop under consideration. However, yield-increasing and price-reducing technology may mean that less land has to be used for the production of the same quantity of crop. This will enable use of more land for producing crops other than wheat. One can conceive of cases where producers' surplus increases, since resources are released that are used to expand supplies of other crops. The outcome depends on the degree of substitution of one crop for another in the cultivation process.

Second, technological change can cause a supply curve to shift in diverse ways, and the supply curve may not be of the mathematical form assumed in this model. The analysis in this paper, in parallel to Hayami and Herdt (1977), considers only one type of shift. The nature of supply shift can significantly influence the distribution of benefit between consumers and producers. This has been widely discussed in the recent literature. Duncan and Tisdell (1971) demonstrated that the nature of the supply shift is a critical determinant of the distribution of benefits between producers and consumers, and the studies by Lund, *et al.* (1980); Wise (1978,1981); Krishna (1984) and Sukhatme and Abler (1997) also underlined this.

Third, the demand curve in this analysis is fixed. This implies that the effects of policies are not closed. For example, if the per capita income rises due to technological change, its effects on per capita wheat consumption and population growth are not predicted. Unlike the Malthusian or Ricardian models, population and per capita consumption are exogenous variables in this model. These could be endogenous variables. The possibility that technological change could, in the case of an important subsistence crop, increase income and population—as well as the shift in demand for the product—is not considered. For instance, the following equation shows the effect of population growth on demand [Johnston and Mellor (1961)].

$$D = n+eg$$

where D, n and g are annual growth rates in food demand, population and per capita income, respectively, while e is the income elasticity of demand. The second term on the right-hand side is likely to be technology-induced, while the growth of population could contain both endogenous and exogenous elements.

Fourth, this model does not consider variability in production, which is expected to have some influence on welfare. If some policy leads to greater variability in production and hence the supply food grains, their prices become more unstable. In the LDCs this can have an important welfare implication for low-income earners and can increase the fluctuation in incomes received by the grain producers [Mellor (1978)]. Furthermore, the question of sustainability is an important aspect of policies, which is not considered here.

4. CONCLUSIONS

Each government faces a conflicting challenge to improve the nutrition status of population, to increase the income of the farmer, and to provide food to the urban population and the landless rural poor at a reasonable price. The options available are uninterrupted free markets, import, price support, investment on technological innovation, input subsidy, and some mix of these policy options. The effect of these options on consumers' and producers' welfare, government cost, and foreign exchange and input requirements are quantified, and compared with an alternative policy of free market mechanism.

If wheat was imported, only consumers gained while other parties, i.e., government and producer, had to pay for it. The consumer's gain was higher than the total loss to the government and producer together. Therefore, a positive rate of return of 58 percent was generated by the policy. Under input subsidy, again consumers gained at the cost to both producers and government. The consumer's gain is higher than the total loss to the government and producers together. Again, the policy resulted in a positive rate of return of 28 percent on government's investment, but it is less than half of the rate of return as compared to the import option. However, net gain to the society is higher in the latter case. In case of price support, both producer and consumer benefitted at the government cost, and the policy produced a negative rate of return to the society. A dilemma in combining the price support and input subsidy policies with a different proportion is: Who should benefit at what cost? The highest rate of return is obtained when only the import option is followed, but producer's benefits are negative. On the other hand, negative return is obtained when only price support is implemented, but producers' share is the highest in the surplus generated by the policy. However, net benefits to the society are the highest when each import and input subsidy is expected to generate 50 percent of the deficit, but the highest rate of return is observed when the deficit is filled by importing 80 percent—and the remaining 20 percent by input subsidy (Table 4). In case all three policies are combined together in different proportions, the maximum benefits to the society is observed when each import, input subsidy, and price support policy contributes 40 percent and 20 percent, respectively, of the deficit (Table 5) while the highest rate of return takes place when the import and each input subsidy and price support policy contributes 80 percent and 10 percent respectively. The appropriate combination depends on the welfare function faced by the government for various sections of the society. The technological change, which is purely based on research, is expected to generate benefits to all groups of the society and is likely to produce the highest rate of return to all the policy options, specifically in the long run. Nagy (1991) and Azam, *et al.* (1991) estimated the rate of return to investment on wheat research as 60 percent and 76 percent, respectively, in Pakistani environment.

The import at the existing international prices and the input subsidy generates net benefit to the society, while price support gives net loss to the society. The best policy to provide higher wheat supplies at lower prices and to improve the welfare of both consumers and producers is to invest on agricultural research and irrigation infrastructure in the long run; but for the short run, the best policy is the combined policy. The input subsidy can be selected as a second-best option for the short run because of a higher net return as compared to import and prices support option.

Governments of developing countries like Pakistan operate under budgetary constraints and the policy-makers have to consider the government's budgetary situation before picking any policy among the available options. In case of serious budgetary constraint, it is not rational to fill the total gap between supply and demand through price support policy; but at the same time, it is also important to consider the distribution of benefits among consumers and producers. This problem can be handled with the help of a combined policy option (Tables 4 and 5), by selecting the most desirable combination of two or three combined policy options.

REFERENCES

Ahmed, R. (1979) Foodgrain Supply, Distribution, and Consumption Policies with a Dual Pricing Mechanism: A Case Study of Bangladesh. International Food Policy Research Institute, Washington, D. C. (Research Report No. 8.)

Alderman, H. (1988) Estimates of Consumer Price Response in Pakistan Using Market Prices as Data. *The Pakistan Development Review* 27:2, 89–107.

Ali, M. (1990) The Price Response of Major Crops in Pakistan: An Application of Simultaneous Equation Model. *The Pakistan Development Review* 29:3&4, 305–325.

Ashfaq, M., G. Griffith, and K. Parton (2001) Welfare Effects of Government Interventions in the Wheat Economy of Pakistan. *Pakistan Journal of Agricultural Economics* 4:1.

Asian Development Bank (ADB) (Various Issues) *Key Indicators of Developing Member Countries of ADB.* Manila: Philippines.

Azam, Q. T., E. A. Bloom, and R. E. Evenson (1991) *Agricultural Research Productivity in Pakistan.* Islamabad: Pakistan Agricultural Research Council, Pakistan.

Barker, R., and Y. Hayami (1976) Price Support Versus Input Subsidy for Food Self-sufficiency in Developing Countries. *American Journal of Agricultural Economics* 68:45, 617–628.

Bayes, A. M., K. A. Parton, and R. P. Piggot (1985) Combined Price Support and Fertiliser Subsidy Policies for Food Self-sufficiency: A Case Study of Rice in Bangladesh. International Food Policy Research Institute. (Research Report 10:3, 225–236.)

Duncan, R., and C. A. Tisdell (1971) Research and Technical Progress: The Returns to Producers. *Economic Record* 47, 124–129.

Farooq, U., and M. Iqbal (2000) Attaining and Maintaining Self-sufficiency in Wheat Production: Institutional Efforts and Farmers' Limitations. *The Pakistan Development Review* 39:4, 487–514.

Hamid, N., T. Pinckney, and A. Valdes (1988) *The Wheat Economy of Pakistan*. Washington, D. C.: International Food Policy Research Institute.

Hayami, Y., and R. W. Herdt (1977) Market Price Effects of Technological Change on Income Distribution in Semi-subsistence Agriculture. *American Journal of Agricultural Economics* 59:2, 245–256.

Hussain, R. Z., and R. A. Young (1985) Estimates of the Economic Value of Productivity of Irrigation Water in Pakistan from Farm Survey Data. *Water Resources Bulletin* 21:6, 1021–1027.

International Monetary Fund (IMF) (Various Issues) *International Financial Statistics.* Washington, D. C.

Johnston, B. F., and J. W. Mellor (1961) The Role of Agriculture in Economic Development. *American Economic Review* 51, 566–593.

Krishna, R. (1984) Price and Technology Policies. In Carl Eicher and John Staatz (ed.) *Agricultural Development in the Third World*. Baltimore: Johns Hopkins University Press.

Lund, P. J., R. W. Irvin, and W. G. Chapman (1980) The Economic Evaluation of Publicly Funded Agricultural Research and Development. *Oxford Agrarian Studies* 7, 397– 422.

Mellor, J. W. (1978) Food Price Policy and Income Distribution in Low Income Countries. *Economic Development and Cultural Change* 27, 1–26.

Nagy, J. G. (1991) Returns from Agricultural Research and Extension in Wheat and Maize in Pakistan. In R. E. Evenson and C. E. Pray (eds.) *Research and Productivity in Asian Agriculture*. Ithaca, New York: Cornell University Press.

Pakistan, Government of (2000) *Agricultural Statistics of Pakistan (1999-2000).* Islamabad: Ministry of Food, Agriculture and Livestock, Economic Wing.

Pakistan, Government of (2000a) *Economic Survey (1999-2000).* Islamabad: Finance Division, Economic Adviser's Wing.

Pakistan, Government of (Various Issues) *Agricultural Statistics of Pakistan.* Islamabad: Ministry of Food, Agriculture and Livestock, Economic Wing.

Salam, A. (1982) Fertiliser Demand Elasticities in Pakistan: A Review. *The Pakistan Development Review* 21:2, 215–230.

SSD (1983) *Statistical Bulletin on Wheat in Pakistan.* Islamabad: Social Sciences Division, Pakistan Agricultural Research Council.

Sukhatme, V. A., and D. G. Abler (1997) Economist and Food Price Policy Distortions: The Case Study of India. *Economic Development and Cultural Change* 46:1, 79–96.

Tweeten, A. (1982) Supply Response in Pakistan. Department of Agricultural Economics, Oklahoma State University and Abt Associates, Inc., Washington, D. C. (Contract No. DAN-4084-C-00-3087-00 US AID).

Wise, S. (1978) The Economic Analysis of Agricultural Research. *Research Development and Management* 8, 185–189.

Wise, S. (1981) The Theory of Agricultural Research Benefits. *Journal of Agriculture Economics* 32, 147–157.