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**PUBLIC SECTOR STORAGE AND WHEAT PRICING POLICY IN PAKISTAN**

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## **ABSTRACT**

The results and policy recommendations in IFPRI Research Report 77 concerning wheat pricing and storage policy in Pakistan are confirmed and updated. Since there is no evidence that the variability of Pakistan's wheat production has increased, there is still no need for the country to hold interannual supply stabilization stocks. The seasonal analysis of the earlier report has been strongly confirmed by evidence of the last several years. Continued increases in the gap between the procurement and release prices will encourage increased private sector participation in wheat storage and trade. It is vitally important for the stability of the market, however, that stated government policies be followed explicitly; in particular, millers and market agents must be able to buy all the wheat they desire at the issue price. The import buffer stock analysis of the earlier report must be modified because of a change in the seasonal pattern and absolute level of offtake from government stock. Total required storage capacity in the public sector for wheat is estimated to be 4.5 million tons in 1991, possibly rising as high as 5.9 million tons by the year 2000. Assuming that the high offtakes in 1987/88 and 1988/89 will not be repeated, the required capacity in 2000 would be expected to be less than 5.0 million tons.

## **I: INTRODUCTION**

Under USAID contract 391-0491-C-00-5033-00 the Trade and Food Security Program of the International Food Policy Research Institute produced a series of reports between 1986 and 1989, primarily on the wheat sector.<sup>1</sup> During my three years at IFPRI, about three-fourths of my time was spent on Pakistan, and I was author or co-author of most of the Trade Program reports. In 1990, USAID/Islamabad and IFPRI asked me to

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<sup>1</sup> These include Hamid et al (1987), Pinckney (1988, 1989a PDF, 1989b RR, forthcoming), Pinckney and Valdes (1988), Pinckney et al (1988).

return to Pakistan for a brief visit to discuss changes in policy and in the policy context since my last visit to Pakistan in December 1987. The visit took place during October 1990.

The primary question to be addressed is, given present data, would I modify the policy advice and recommendations contained in the earlier reports? In this paper, I focus on updating the results contained in IFPRI Research Report 77 (Pinckney 1989b), particularly issues related to seasonal storage and the gap between the procurement and release prices. In addition, the recent attention given to that research report by the Asian Development Bank and the Storage Cell in MINFA concerning recommendations for the total size of public storage facilities warrants special attention. Since this requires some basic understanding of the earlier research, section II briefly reviews its methodology, assumptions, and policy recommendations. Sections III, IV, and V consider possible changes in recommendations on interannual, seasonal, and import buffer storage and price policy, respectively. Section VI concludes the report.

**II: REVIEW OF PREVIOUS RESEARCH<sup>2</sup>**

The research report makes an important conceptual distinction between three types of stocks: interannual, seasonal, and import buffer. Interannual stocks are those held from one market year to the next for the purpose of supplementing a future shortfall in production. Seasonal stocks are held from the harvest time into the months when no grain is harvested. Import buffer stocks are held both during market years and across market years in order to avoid disruptions in supply during the period between the ordering of imports and their arrival in the country. Note the important distinction between interannual and import buffer stocks; if Pakistan opened a market year with 1 million tons of interannual buffer stocks and had a 1 million ton shortfall in the next harvest, the stock would be depleted to make up the shortfall. On the other hand, if the 1 million tons were import buffer stocks, the wheat would be sold while imports were on order, but imports would be

<sup>2</sup> This section reviews research presented in Pinckney (1989a, 1989b) and Pinckney et al (1988). The research reported in Hamid et al (1987) was not the focus of the October 1990 trip, and is not discussed here.

sufficient to rebuild the stock to the earlier level. A different type of analysis is required to evaluate the appropriate size of each type of stock.

The remainder of this section discusses earlier results for interannual storage, seasonal storage, and import buffer stocks in turn.

### Interannual Storage

In a normal weather year, Pakistan is approximately self-sufficient in wheat at a market-clearing price somewhere between import and export parity. In the 1980's, the country both imported and exported wheat. Since there are large differences between import and export parity prices -- about US\$70 per ton in 1986 -- if the country has a bumper crop and knows that it will have to import the next crop year, it makes sense to store rather than export the surplus. Unfortunately, the future is never known with certainty, and if the next two crops are also large, the government would lose money through storage costs and losses in addition to losing access to the foreign exchange that would have accrued through exports. Thus, the decision concerning how to manage surplus production is complex for a country like Pakistan.

IFPRI Research Report 77 analyzes this problem with the help of a dynamic programming model of the wheat sector. In any given year, production and the world price are random variables, while the opening stock is determined as the closing stock of the previous year. The government has control over domestic purchases and sales and foreign trade. The model calculates the "most efficient" response of the government to every combination of world price, opening stock, and production; "efficiency" is defined as achieving a given level of price stability at the least fiscal cost.

Assumptions and limitations of the model are discussed at length in the report and in the earlier study on which this model is based (Pinckney 1988). The key parameters that may have changed since this research was conducted are the inherent variability of wheat production and whether or not Pakistan is still self-sufficient in a normal production year.

Some analysts suggest that variability has increased, and that Pakistan today should not be considered self-sufficient, even in a normal production year.

The major policy recommendations of the earlier work are: (1) that the government should not hold any interannual stocks unless the world price for wheat should fall to a record low US\$90 per ton; (2) that it would be inadvisable for the government to build additional storage facilities at this time just in case the world price were to fall to that level; and (3) there could be significant cost savings to the government from instituting some responsiveness of the official procurement and release prices to changes in domestic production and the world price. Result (2) has been the focus of the correspondence between the MINFA Storage Cell and the Asian Development Bank; this will be discussed below, but note that the result pertains only to interannual stocks, not seasonal or import buffer stocks.

### Seasonal Stocks

The seasonal storage section of the earlier reports grew out of decontrol and the institution of a new policy regime. In the earlier period, the government sold specified quantities at the issue price; under the new system, the government stated that it would sell all that was demanded at the issue price. In a freely-functioning market, such behavior should cap the wholesale price of wheat at a level close to the issue price, thus limiting the seasonal price rise approximately to the gap between the procurement and issue prices. If private storage were to respond to the lower expected seasonal price rise -- as it should -- this change in policy could have serious ramifications for procurement, stock size, and fiscal cost.

The report attempts to estimate the impact of different sized gaps between procurement and release prices for wheat. Regression analysis is used to estimate the past relationship between private storage and the expected price rise; this relationship is then used to formulate private storage and demand equations for 13 consecutive months, and these equations are solved to produce the results. There are two key assumptions: first, that

the relationship between private stocks and expected price changes estimated in the regression is a causal relationship, and not a spurious one caused by some excluded variable; second, the private storage behavior in Pakistan responds smoothly to changes in expected price, as Working (1949) described for the U.S. In this case, the policy change in 1987 allows us to test whether or not the predictions of the model are close.

Primary recommendations of this part of the study are that the gap between the procurement and release prices has a profound effect on fiscal cost and private storage. Under the ration shop system, the average seasonal price rise had been about 18 percent; a system with a 15% gap should be no worse for consumers and cost the government over 2 billion rupees less per year than a policy with a 4 percent gap. Furthermore, the total required public storage capacity is quite sensitive to the size of the gap, with a small gap requiring considerably larger amounts of storage.

#### Import Buffer

The analysis of the size of the import buffer stocks is the least sophisticated of the three in the report, and yet vitally important to any analysis of the appropriate total storage requirements of the government. Three important assumptions were made for this analysis: first, that imports would arrive and be available in the market within four months of the placing of an order; second, that the seasonal pattern of offtakes in the future -- and in particular the maximum offtake per capita demanded in any one month -- would follow past seasonal patterns; and third, that an opening stock on May 1 equal to expected offtake during May would be sufficient to keep the domestic market functioning smoothly. These will be discussed in turn.

Much depends on the assumption regarding the length of the time between the placement of an order for imports and their arrival in the country. A reviewer of the manuscript related the story of an American converted oil tanker bound for Pakistan that took much longer than this; nevertheless, four months seems an adequate period in the vast majority of cases for wheat.

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Of greater concern is the assumption in the earlier report that future seasonal patterns of offtakes will follow past patterns. Although the analysis of seasonal stocks suggested that the seasonal pattern of offtakes could change, with less being demanded close to harvest time and much more in December through February, that model was not considered to be robust enough to use for the calculation of import buffer stocks. There was thus at the time little alternative to using past patterns.

The final assumption, that one-month's expected offtakes in storage on May 1 would keep the market functioning smoothly throughout the month, seemed inherently plausible. Historically, the government had held less than this amount with no recorded problems many times in the 1970's.

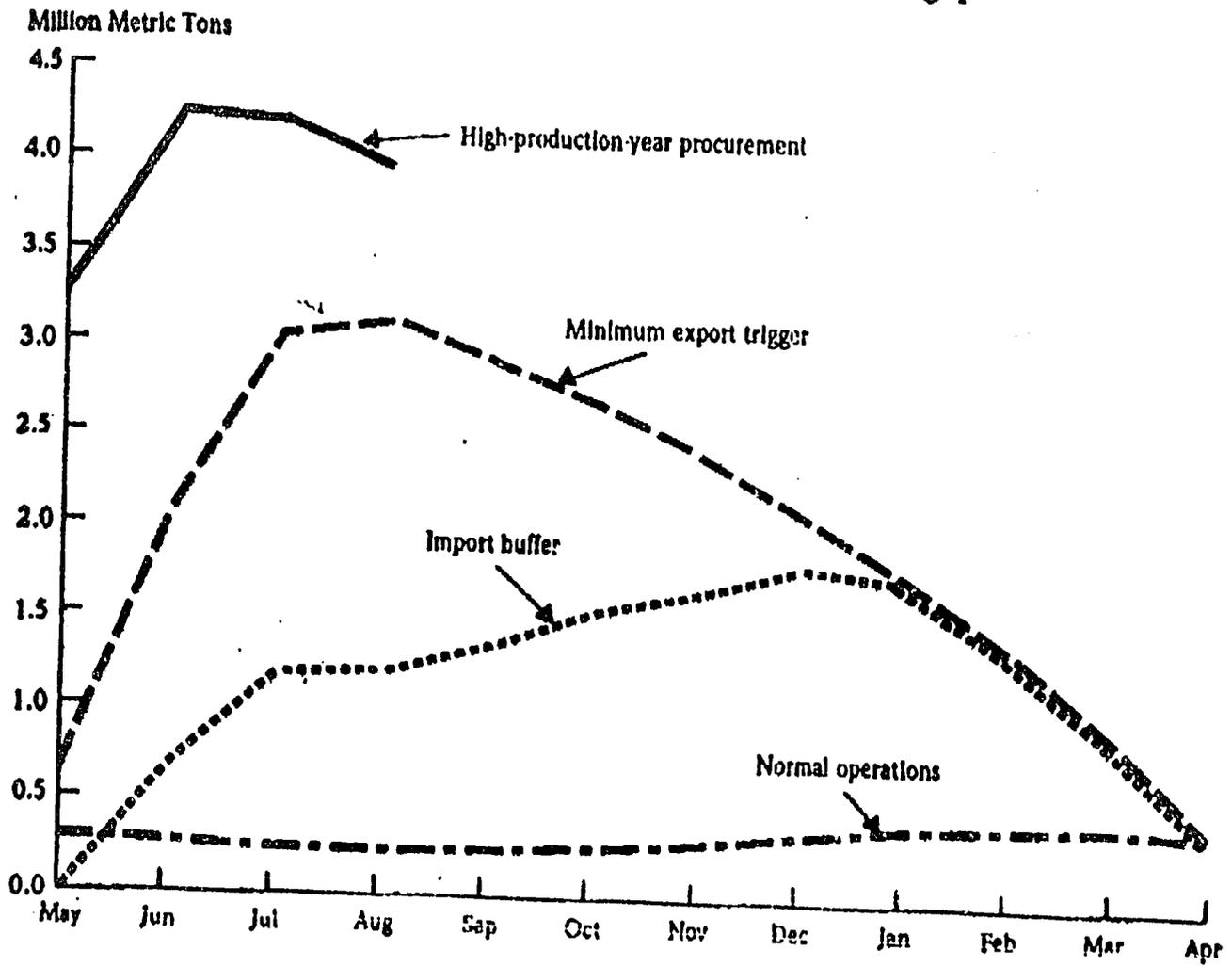
Policy recommendations for this part of the study are summarized in Figure 12 of the report, reproduced as Figure 1 in this document. In order to ensure that sufficient stocks are available to meet the January 1 import buffer requirements, the government must hold approximately 3 million tons (in 1988) on the first of August. This amount is consequently the minimum export trigger; to export when stocks on August 1 are below 3 million tons is to invite the fiscally disastrous possibility of both exporting and importing in the same market year.

### Conclusion

The total storage capacity of the government required to cater for all three types of stock is estimated in the report at about 3.5 million tons in 1988 with a 15% gap between the procurement and release price. Increasing population raises this figure to about 5.3 million tons in the year 2000.

In addition to the analysis of storage capacity, the IFPRI research included a module that estimated the effect of a change in the procurement price on production and procurement using regression analysis. This research -- reported in Pinckney et al (1988) and Pinckney (1989a) -- concludes that the short run supply elasticity of Pakistan's wheat

**Figure 1A—Total storage requirements: 20 palsa seasonal gap**



production is about 0.4 and that, in any given year, an increase in production of one million tons increases procurement by about 840,000 tons.

This concludes the summary of past research results and assumptions. The next three sections of the report consider whether or not any modifications of the policy recommendations are necessary at this time given the data that have become available in recent years. Interannual, seasonal, and import buffer stocks are considered in turn.

### **III: INTERANNUAL STOCKS**

The policy recommendations for interannual storage were quite robust, and would not be expected to change unless there were major modifications of assumptions. During the 1990 trip to Pakistan, two questions were raised concerning these assumptions: first, whether or not Pakistan is still self-sufficient at a price between import and export parity; second, whether production variability has increased.

Pakistan has imported substantial amounts of grain in the last several years even though the crop harvested in 1989 was at least "normal." This may suggest that Pakistan is no longer self-sufficient in a normal year. There is strong evidence, however, that the government over-imported in the 1989/90 market year, possibly on the mistaken assumption that the exceptionally high offtakes experienced in 1987/88 and 1988/89 would continue in the future. This assumption will be discussed further below. If Pakistan is no longer self-sufficient, it is marginally less expensive than in the past to hold surplus production as stock since the expectation of using the stock the next market year has increased. But such changes are small at this point in time, and are not considered great enough to warrant a modification of the strong policy recommendation that no interannual stocks should be held.

Possible changes in the variability of production are easier to analyze. Table I extends Table 7 of the research report through the latest 10-year period, 1981 to 1990. The first three columns present mean production, area, and yield for successive 10-year periods;

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Table 1: Changes in the Variability of Pakistan Wheat Production

Years	Mean Production (Mill Mt)	Mean Area (Mill Ha)	Mean Yield (Mt/Ha)	c.v. Production	c.v. Area	c.v. Yield
68-77	7.43	6.05	1.23	4.7	4.5	3.4
69-78	7.62	6.09	1.25	5.5	4.2	4.2
70-79	7.96	6.14	1.29	5.5	3.5	4.2
71-80	8.28	6.21	1.33	5.3	2.8	4.0
72-81	8.78	6.31	1.38	6.3	3.0	4.1
73-82	9.23	6.46	1.42	5.9	3.3	3.9
74-83	9.72	6.60	1.46	6.4	3.8	4.0
75-84	10.05	6.72	1.49	6.8	3.8	5.3
76-85	10.45	6.87	1.52	6.5	2.8	5.4
77-86	10.98	7.00	1.56	6.8	2.3	6.0
78-87	11.26	7.13	1.58	7.7	2.2	7.1
79-88	11.69	7.22	1.62	7.6	2.3	6.7
80-89	12.14	7.33	1.65	7.3	2.2	6.5
81-90	12.58	7.41	1.70	6.9	2.2	6.5

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the last three columns present coefficients of variation for the same periods. These are coefficients of variation of the detrended series, and thus represent indexes of the variability of production. For example, the lower right-hand number "6.5" implies that the yield of wheat was within 6.5% of its trend about two out of every three years in the 1980's.<sup>3</sup>

Table 1 shows increasing variability of production through 1978-87, but a slight decrease in variability since that time as yields have become somewhat less variable and area variability has remained constant. Thus, there is no evidence that the variability of production has increased since the writing of the report.

In sum, given the evidence today there is still no rationale for Pakistan to hold interannual supply stabilization stocks. Should the world price of wheat fall to US\$90 per ton, and should evidence accumulate that Pakistan is indeed an importer in a normal production year, this result would need to be reexamined.

#### IV SEASONAL STOCKS

##### Impacts of Derationing on the Market

The seasonal analysis contained in the research report was confirmed to a large extent by the actual results of the 1987/88 scheme year. The model predicted that the change in policy would, ceteris paribus, result in an increase in procurement and offtake and a decrease in private storage. Given actual levels of production in the 1987 harvest and using the results from the procurement model (Pinckney 1989a), the model predicts that, had the ration system still been in effect, procurement and offtake would have been 2.9 and 4.1 million tons, respectively. With the existing procurement and release prices under the new system, the model predicts values for procurement and offtake of 3.7 and 4.9 million tons. Actual levels of procurement and offtake were 3.9 and 5.0 million tons, phenomenally close

<sup>3</sup> Coefficients of variation for earlier years differ slightly from those reported in the research report because trends for the entire time period 1968 to 1990 were reestimated.

to the predicted values. Furthermore, private storage at the end of July was predicted to be 4.6 million tons, and actually was 4.6 million tons, the lowest level for July since 1981.

Unquestionably, the change in policy had the anticipated impact on incentives for private storage of wheat, and private agents responded.

Table 2 quantifies more of the impacts of the policy change. Private storage is presented in both absolute and per capita terms. The per capita calculations show that private storage decreased to a level far below even the 1981 outcome; if the series is continued back in time, the per capita level of private storage in 1987 is seen to be less than in any year since 1970. From July of 1986 to July of 1987, the decrease in private storage per capita was almost 20%.

The other major break with the past is in the percentage of national consumption provided by offtakes. Offtakes in 1981/82 provided just over 1/3 of national consumption, the highest percentage on record under the ration system. In 1987/88, this percentage increased dramatically to 43% and remained higher than in past years for the next two scheme years. The changing seasonal pattern of offtakes is discussed below under import buffer stocks.

The effect of the policy change on wholesale prices is shown on average in Table 2 and disaggregated by market in Table 3. The percentage difference between the procurement price and the total amount paid for a bag of wheat -- issue price plus charge for bags -- has risen from 4 percent to 18.3 percent in the four years since the policy change. Wholesale prices rose slightly more than this percentage difference in the first two years after the policy change, and actually less than the difference in 1989/90. Note that in 1986/87 the seasonal price rise was dampened by the announcement that de rationing would take place, and that the government would begin selling all that was demanded at a set price before the harvest. This held prices down in the months leading up to harvest.

The disaggregated data in Table 3 show that the average seasonal price rise has varied considerably from market to market. Four markets -- Hyderabad, Lahore, Multan,

Table 2: Indicators of the Impact of Government on the Wheat Market

Scheme Year	Private Storage in July (mil. tons)	Private Storage in July Per Capita (kg)	Per Capita Consumption (kg/year)	Percentage of Consumption from Offtake	Official Price Differential	Rise in Wholesale Price Six Markets
80/81	4.82	58.3	115	28.9		8.5%
81/82	4.31	50.7	111	33.6		23.3%
82/83	4.81	54.8	115	30.7		16.0%
83/84	4.95	54.7	116	30.7		17.8%
84/85	5.18	55.6	119	33.0		22.8%
85/86	5.74	59.7	118	30.3		14.6%
86/87	5.31	53.6	111	32.7		5.7%
87/88	4.55	44.5	117	43.2	4.0%	6.7%
88/89	5.29	50.2	128	42.0	7.6%	9.4%
89/90	5.93	54.5	126	35.9	17.6%	15.3%
90/91	6.08	54.3	NA	NA	18.3%	NA

Notes: (1) Scheme years are from May to April. The production from the previous harvest is consumed during this period.  
 (2) The official price differential is the percentage difference between the issue price plus bag charge and the procurement price.  
 (3) See notes for Table 3 concerning the wholesale price rise.

Table 3: Seasonal Price Rises in Selected Markets, 1978/79 to 1989/90

Year	Faisalabad	Hyderabad	Lahore	Multan	Okara	Sargodha	Weighted Average
	(percent)						
78/79	13.3	20.5	21.8	24.4	29.8	18.3	22.6
79/80	12.7	22.6	17.6	7.5	17.7	19.6	14.9
80/81	10.7	10.2	7.3	5.9	8.9	15.3	8.5
81/82	22.1	27.27	24.5	20.8	22.7	25.7	23.3
82/83	14.8	9.4	17.1	17.6	18.5	20.3	16.0
83/84	18.7	21.1	14.6	17.2	16.4	21.8	17.8
84/85	19.6	11.1	24.2	27.7	27.6	24.2	22.8
85/86	18.6	5.3	20.7	15.3	15.4	14.5	14.6
86/87	6.5	7.1	6.1	6.2	2.7	6.1	5.7
87/88	13.3	3.8	8.0	5.4	2.4	19.8	6.7
88/89	15.4	8.1	8.8	8.5	9.1	6.9	9.4
89/90	15.5	11.0	17.8	19.0	13.5	7.2	15.3

Note: Weights are proportional to the importance of the surrounding area in total procurement in the country.

and Okara -- exhibit price changes that approximately follow the average pattern. Sargodha, on the other hand, experienced a price rise of 20% in 1987/88 and only small rises in the two subsequent years, while Faisalabad had about the same price change each of the last three years. There are several possible explanations for these differences: poorly collected data, market collusion, and/or the government not actually selling all that is demanded at the issue price. Indeed, some of the data, particularly for Faisalabad, look rather suspicious; in addition, while in Pakistan I was presented with anecdotal evidence that millers could not get all that they desired at the issue price. Nevertheless, it is interesting to note that the weighted average of these price changes follows the pattern of official price differentials rather closely. The government must be selling close to total market demand at the issue price. Clearly, the gap between the procurement and release prices has had a profound effect on both the expected and the actual price rise in wholesale markets.

In addition to the expected changes in private storage, procurement, offtake, and seasonal price rises, Table 2 presents one surprising statistic: the per capita consumption of wheat rose dramatically in 1988/89 and remained high in 1989/90. Per capita consumption here is calculated using a modified food balance sheet approach: consumption equals production at harvest less ten percent (to adjust for seed, feed, and waste) plus offtake from government stocks less procurement. This is considered more accurate than using imports, exports, and the unreliable data on changes in stocks. It is hard to explain the 10% rise in per capita consumption between 1987/88 and 1988/89. There was no dramatic drop in the real price or dramatic rise in real incomes between these years. This apparent rise could be the result of an increase in private stocks at the end of the market year, since such an increase in stocks would appear as an increase in this estimate of per capita consumption. Indeed, an increase in private stocks at the end of April is predicted by the model. The support for this theory is weak, however, since the rise in per capita consumption does not take place until the second year of the policy change and continues high in the third year despite the dramatic increase in the difference between the procurement and release prices.

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Consequently, I am not at all sure that the apparent increase in per capita consumption has anything to do with the policy change.

### Implications for Future Government Policy

The evidence suggests that the government changed the market considerably by derationing, decreasing the role of the private sector substantially in the two years following the policy change. By July 1989, however, private stocks per capita had returned to their average level in the early 1980's, and the seasonal price rise in the major wholesale markets for 1989/90 was in the lower part of the range for years during rationing. Thus, the private sector seems to be returning to the market as the incentives for that return increase.

Despite the higher private storage and nearly-normal seasonal price rise, the percentage of consumption coming from offtakes remained abnormally high for 1989/90, although it declined substantially from 1988/89. Offtakes for the early months of 1990/91, however, are running substantially below those of 1989/90 even though in per capita terms the size of the harvest is approximately equal, suggesting that faith in the ability of private agents to supply the market may be increasing.

The present policy of gradually increasing the gap between the procurement and release prices should further enhance the ability of private agents to perform most of the required marketing functions. If this continues, both the percentage of the crop procured and the percentage of consumption that comes from offtakes should decline in future years.

There is a potential difficulty, however. As this process continues, government offtakes will be concentrated increasingly in farflung areas where private agents will not carry wheat because of the geographically-uniform issue price. If the gap becomes large enough and the uniform pricing policy continues, the reduction in procurement could leave the government with insufficient amounts of wheat to distribute to farflung, deficit areas. In such a case, if the private sector has demonstrated increased ability to manage the wheat trade, it could be in the government's interest to tender for private sector delivery of specified quantities of wheat in the farflung areas themselves, leaving the transportation

problem to the private contractor. Alternately, the government could tender for the wheat in surplus areas, using the existing method of transportation.

In no case should farmers be forced against their will to sell at the procurement price, nor should district borders be closed to trade at harvest time. If the government wants an efficient, private marketing system to develop, it must make clear policy statements and abide by them. The procurement price should provide a floor, and should not be used to penalize farmers who could fetch a higher price elsewhere. Similarly, limiting offtakes to specified amounts defeats the purpose of the stated policy and causes private agents to be suspicious of -- and hedge against changes in -- current government policy. This idea is developed further in the next section of the report.

In sum, the evidence to date supports the assumptions and conclusions of the seasonal storage analysis in the research report. Future increases in the gap between procurement and release prices will provide additional incentives for private agents to play a larger role in storing and marketing wheat.

#### **v: IMPORT BUFFER STOCKS**

The import buffer analysis becomes increasingly important as the government plays a diminishing role in the market. This is the quantity that is necessary to "keep a lid on the price" in bad years. The worst-case scenario for the government under present policy could develop as follows: The harvest is poor, but apparently adequate to provide enough stocks to last until the next market year. The government is a bit nervous about the size of stocks, however, so instructs the food departments to limit offtakes to specified amounts each week. Millers and others quickly discover that they can't buy government wheat on Wednesdays and Thursdays, and immediately enter the wholesale market to build up stocks in case government supplies dry up and prices increase. They also try to buy even more on Sundays and Mondays when the food departments are selling. Government response to this increased

demand is to restrain sales even more, while the wholesale market reacts with an abrupt increase in price. As information about this spreads, all market participants, including consumers, begin to anticipate future price increases, thus increasing their present demand for stocks. The result is a food panic and the genuine possibility of a government stockout.

The way to avoid such behavior, as Indonesia has shown, is not to hold more stocks but always to sell whatever is demanded at the issue price. This may seem counterintuitive; how can the government avoid a stockout by selling more? The point is, if supplies are sufficient for the next 4 months of consumption -- and in Pakistan there is no reason why they should ever be insufficient for that length of time -- the only way that a stockout can occur is if the general public anticipates a major price increase and thus desires to hold more private stocks. By continually selling all that is demanded, the government keeps the lid on the present price and implicitly assures consumers and traders that the wholesale price will not rise significantly above the issue price. On the other hand, government constraints on quantities sold causes expectations of increasing prices, thereby increasing demand for wheat today.

In order to be able to sell all that is demanded, the government must have enough on hand even in a bad year to cover demand until imports arrive. The analysis contained in the research report was dependent on the two questionable assumptions mentioned above: that one-month's stock on May 1 is sufficient to keep the system functioning smoothly at monthly per capita demands. These will be considered in turn.

There is no additional evidence to speak of concerning the first assumption. In my discussion with the Joint Secretary/Food concerning this issue, however, he argued vigorously that this level of stock was too low. It may have been sufficient in the 1970's when amounts sold were closely tied to rationed amounts and thus known ahead of time, but under the present system demands can fluctuate. A decrease in the stock would cause some savings from storage costs but would also increase expenditures for last-minute cross-

haulage. The net savings, according to the JS, could be small or nonexistent. He would prefer a stock of at least 1 million tons at the end of April; my method would lead to a minimum stock of about 250,000 tons on that date.

Clearly, the JS does not personally bear the cost of carrying a higher stock, but would bear personally the penalty if individual depots ran out of wheat while he is in charge. We would thus expect his preference for stock levels to be on the high side. His point about an increase in cross-haulage is certainly valid, however. It would be interesting to study the issue to try to discover at what point the decreases in storage costs from holding a lower stock are equal to the increases in cross-haulage charges necessary to avoid stockouts. This issue clearly cannot be resolved here.

The second assumption -- that past monthly per capita offtakes would be reasonably good predictors of future per capita offtakes -- has proven to be far from correct. Consider Tables 4 and 5 together with Figure 2. From August through April the *average* per capita offtake in the post-rationing period is greater than the *maximum* per capita offtake in the rationing period. Furthermore, the post-rationing average for May and June is actually less than the ration-period average. Thus, both the size and the seasonality of offtakes has changed.

As noted above, both of these results were predicted by the seasonal storage model, but I did not have enough confidence in the exact seasonal pattern from the model to base the import buffer stocks analysis on them. Clearly, however, the import buffer stock calculations need to be modified on the basis of the latest evidence.

This is not straightforward, however. Recall that per capita offtakes for 1987/88 and 1988/89 were far above past levels and declined sharply in 1989/90. The high levels of per capita offtakes in those first two years were the result to a large extent of the small gap between the procurement and release prices in those years. If the government continues to have gaps of 18 percent or greater in the future, it is highly unlikely that offtake per capita

Table 4: Offtake Per Capita by Month, May 1976 to August 1990

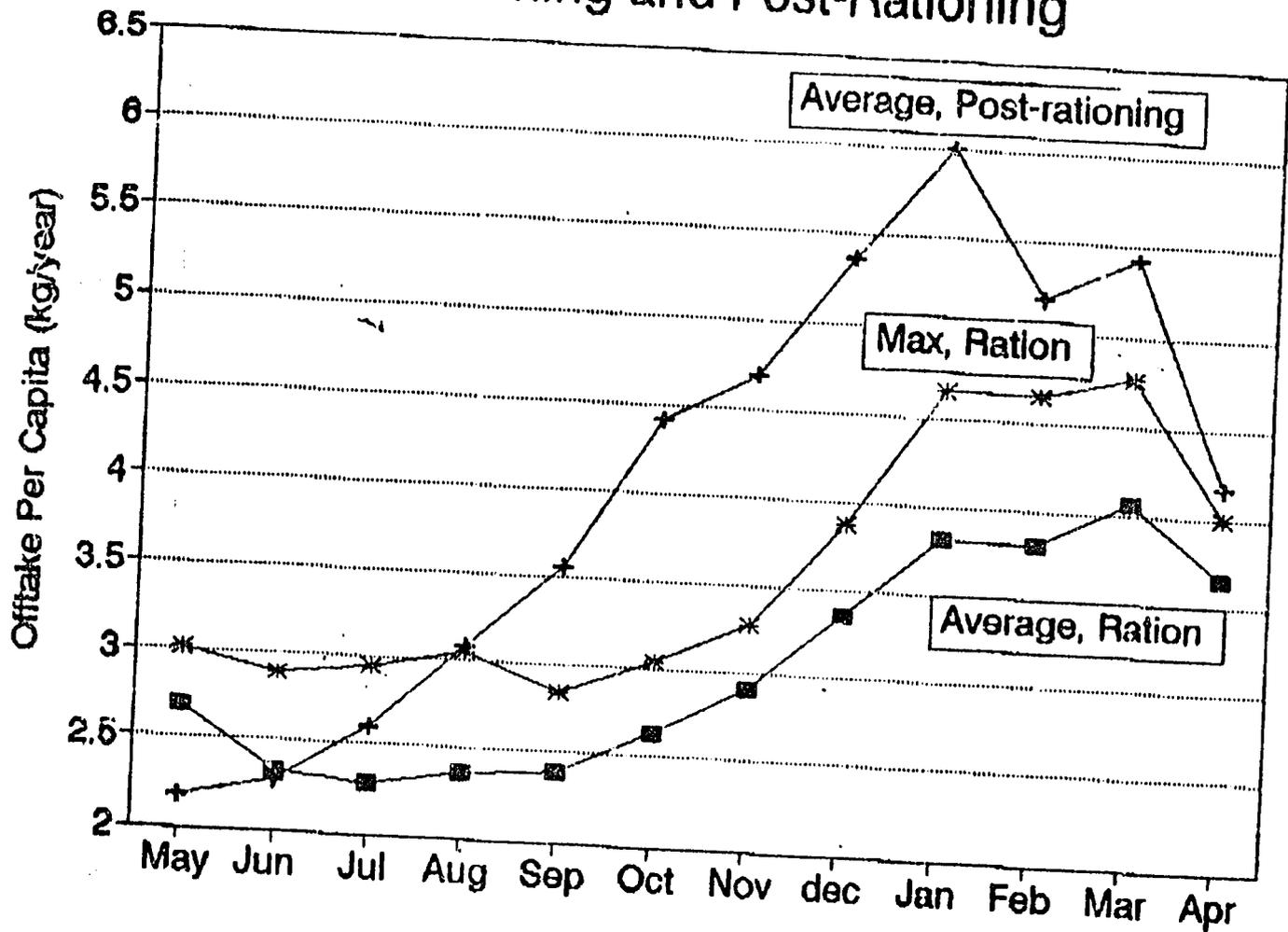
	May	Jun	Jul	Aug	Sep	Oct	Nov	dec	Jan	Feb	Mar	Apr	Annual Total
	(kilograms per capita)												
1976/77	2.53	2.48	2.25	2.60	2.14	2.27	2.04	3.14	3.87	4.65	4.72	4.00	37.3
1977/78	2.09	2.88	2.63	2.55	2.49	2.80	3.10	3.58	4.01	3.83	3.87	3.51	37.6
1978/79	2.83	2.89	2.94	3.05	2.71	3.03	2.87	3.40	3.56	3.51	3.80	3.33	37.9
1979/80	2.78	2.51	2.59	2.38	2.61	2.65	2.44	2.68	3.11	3.34	3.54	2.27	33.8
1980/81	2.70	2.55	2.47	2.23	2.37	2.34	2.71	2.85	3.26	3.16	3.24	3.14	33.2
1981/82	2.83	2.48	1.87	1.71	1.80	2.40	3.28	3.85	4.29	4.21	4.78	3.98	37.3
1982/83	2.84	1.83	1.83	2.85	2.83	2.73	3.88	3.82	3.81	3.74	3.88	3.83	33.1
1983/84	2.61	1.83	1.81	1.87	1.89	2.38	2.88	3.45	4.19	4.33	4.55	3.82	33.3
1984/85	2.01	1.85	3.44	3.80	2.84	3.83	3.23	3.88	4.88	4.18	4.53	3.88	33.2
1985/86	2.85	2.28	2.42	2.37	2.48	2.67	2.83	3.25	3.60	3.69	3.85	3.51	35.7
1986/87	3.01	2.34	2.49	2.46	2.58	2.85	2.78	3.10	3.49	3.44	4.27	3.84	36.4
1987/88	2.57	3.02	2.89	2.71	3.18	3.72	4.38	5.58	6.42	5.43	6.13	4.30	50.3
1988/89	2.18	3.02	3.11	4.01	4.13	5.13	5.27	5.70	6.21	5.49	5.43	4.07	53.8
1989/90	1.83	1.35	2.38	3.32	3.38	4.40	4.43	4.61	5.40	4.84	4.70	4.14	43.0
1990/91	2.11	1.35	2.01	2.28									
Average, Ration	2.89	2.33	2.28	2.38	2.39	2.83	2.81	3.38	3.82	3.81	4.07	3.83	38.3
Minimum, Ration	2.01	1.83	1.81	1.71	1.80	2.27	2.44	2.68	3.11	3.18	3.24	3.14	33.2
Maximum, Ration	3.01	2.89	2.94	3.05	2.84	3.03	3.28	3.68	4.60	4.65	4.76	4.00	39.2
Average, Post-Ration	2.17	2.28	2.80	3.07	3.58	4.42	4.69	5.28	6.01	5.18	5.42	4.17	48.7

Table 5: Offtake less Procurement Per Capita, 4-month periods (beginning in the indicated month)

1976/77	-19.41	-11.32	1.36	7.42	9.02	11.29	14.04	18.35	18.85	8.08	-4.72	-10.51
1977/78	-12.70	-5.88	4.95	9.12	11.37	13.44	14.42	13.19	14.55	5.81	-0.20	-1.58
1978/79	-1.68	5.83	11.11	11.59	12.06	12.83	13.46	14.08	13.46	0.16	-12.89	-17.13
1979/80	-18.20	-8.33	3.41	8.88	9.87	10.83	11.57	12.67	12.40	-6.38	-21.01	-24.18
1980/81	-24.80	-7.00	6.59	8.81	10.13	11.28	12.14	12.67	10.84	-13.30	-31.50	-33.83
1981/82	-36.18	-13.57	3.84	8.30	11.14	13.78	15.80	17.09	18.12	4.29	-16.84	-24.87
1982/83	-26.31	-18.63	2.81	9.34	11.44	13.20	14.22	15.04	14.22	-4.31	-25.77	-31.85
1983/84	-33.15	-18.81	3.28	8.18	10.43	12.69	14.85	16.52	15.88	-3.13	-11.71	-14.18
1984/85	-13.21	8.40	8.34	10.42	11.35	12.48	13.48	14.32	11.71	-18.80	-34.26	-39.01
1985/86	-37.71	-8.28	8.13	9.88	11.04	12.00	12.78	14.26	11.81	-10.00	-23.33	-28.68
1986/87	-24.57	-3.22	10.48	13.63	16.84	20.10	21.81	23.55	19.45	-9.37	-17.42	-20.88
1987/88	-18.13	8.38	18.18	18.53	20.28	22.33	22.88	22.84	19.23	-11.34	-24.72	-28.33
1988/89	-27.17	0.57	12.88	15.47	17.00	19.04	19.28	18.48	16.29	-13.28	-26.51	-28.59
1990/91	-28.04											
Average, Ration	-21.82	-6.23	5.94	9.40	10.97	12.83	13.87	15.04	13.79	-4.35	-17.88	-21.89
Minimum, Ration	-37.71	-18.81	1.36	7.42	9.02	10.83	11.37	12.67	10.84	-18.80	-34.26	-39.01
Maximum, Ration	-1.68	8.40	11.11	11.83	13.00	14.82	15.87	17.19	16.85	8.08	-0.20	-1.58
Average, Post-ration	-24.73	1.81	13.17	13.88	18.04	20.49	21.26	21.35	18.33	-11.33	-22.88	-28.20

Figure 2

# Offtake Per Capita of Wheat in Pakistan Under Rationing and Post-Rationing



would ever reach such extremely high levels again. But if we exclude those two years from the calculations, we are left with only one year of data.

An exceptionally prudent calculation of import buffer stock would use the offtake data from 1987/88 and 1988/89. In this case, about 19.5 kilograms per capita are required on January 1 to ensure that stocks do not go to zero by April 30. An additional 2.0 kilograms per capita are required if one-month's offtake is to be available on April 30. Assuming that net offtakes for August through December are at their average level for the post-rationing period yields a minimum export trigger of 39.5 kilograms per capita on August 1, or about 4.5 million tons with present population; that is, no wheat should be exported if stocks are below this level on August 1, even though expected net offtake for the rest of the year is less than this amount, to provide for possible increases in demand at year's end.

This is certainly higher than what would be required under a system with an 18 percent price differential. Calculations in the research report suggest that the minimum export trigger on August 1 in 1991 should be about 3.4 million tons. This is almost certainly too low given the marked change in the seasonal pattern of offtakes under the new system. The actual minimum export trigger for August 1, 1991 should be between 3.4 and 4.5 million tons, but only several years of additional data will be sufficient to approximate it more precisely.

## VI CONCLUSIONS

The total impact of these changes on government required storage capacity is to raise the lower limit of the range. The amounts presented in the research report updated to 1991 are for required capacity ranging from 3.8 to 5.9 million tons, with the lower and upper limits corresponding to a seasonal price gap of 15 and 4 percent, respectively. Assuming that the government will not decrease the seasonal price gap back below 15 percent, the

maximum capacity required for procurement in a high-production year is now only about 3.8 million tons. Since the minimum export trigger could be as high as 4.5 million tons, this trigger rather than the high procurement year becomes the necessary storage capacity for wheat.

The difference of opinion between myself and the Joint Secretary/Food regarding the necessary levels of stocks on May 1 in the end has surprisingly little impact on total storage requirements. If the country was holding about 1 million rather than 300,000 tons on May 1, the required capacity in a high-production year would be about 700,000 tons higher than 3.8 million tons, or about 4.5 million tons. Since this just equals the minimum export trigger, there is no change in the required storage capacity.

The highest estimate of future storage requirements comes from increasing the 4.5 million tons minimum export trigger at the rate of population growth (assuming that the gap between procurement and release prices remains at 15% or greater). In this case, by the year 2000 the required capacity is 5.9 million tons. My suspicion is that the minimum export trigger will decrease in the future, and that Pakistan will never again see the exceptionally high levels of offtake per capita that occurred in 1987/88 and 1988/89. If this is the case, the minimum export trigger could fall below 5.0 million tons, particularly if the government continues to increase the gap between the procurement and release prices. Nevertheless, it is prudent in the short run to act as if releases of this magnitude are possible in an extreme year, and to plan accordingly.

Storage capacity at present is about 4 million tons under cover and 900,000 tons on raised platforms. This is adequate for 1991 under present policy, although the large amount on raised platforms may be problematical. With the monsoon beginning in July, it may be necessary to rent private capacity during July and August to ensure that all wheat can be moved indoors during those months. I do not have the expertise to judge whether or not such an arrangement is necessary to maintain the quality of the wheat.

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The proposed Asian Development Bank project to expand enclosed storage capacity by 400,000 tons by 1995 would raise total enclosed capacity to 4.4 million tons. This may be an economical investment for the government even if the gap between procurement and release prices continues to expand. Clearly this analysis shows that government should expect to continue storing more than 4 million tons a few months of each market year frequently for the rest of this century. Calculating whether it is best for the government to build and operate its own stores or to rent private capacity when necessary is beyond the scope of this study. The viability of a rental arrangement would depend on cost, availability, and quality of the private capacity.

Note that this report agrees with the conclusion of the research report that no additional capacity should be built to hold *interannual supply stabilization stocks*. Optimal levels of such stocks are considered to be zero here as in the earlier report. But seasonal and import buffer stocks will be larger than 4 million tons many times in the 1990's, and will have to be stored in government-owned or rented facilities.

In sum, the data that have become available since the writing of IFPRI Research Report 77 do not change the conclusions of the interannual or seasonal storage chapters. Indeed, the seasonal analysis has been confirmed strongly by price, procurement, and offtake data from 1987 to 1990. The calculation of import buffer stocks and minimum export triggers, on the other hand, must be adjusted because of the marked change in the seasonal pattern and overall level of offtakes during 1987/88 and 1988/89. Although the high level of offtakes in those years is unlikely to occur in the future if the government maintains or enlarges the present differential between procurement and release prices, it is prudent to keep the minimum export trigger at 4.5 million tons on August 1. This could rise as high as 5.9 million tons by the year 2000, but I expect that future offtakes will show that 5.0 million tons or less will be sufficient once the market adjusts to the larger seasonal price gap.

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