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Analysis of Short Term Grain Policy Alternatives

(for the remainder of the 1974 rice year)

in the

Republic of Korea

by

Grains Policy Task Force

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Foreword

The following paper represents the first output of an ad hoc task force on grain policy composed of representatives from the National Agricultural Economics Research Institute, the Korean Development Institute, the Ministry of Agriculture and Fisheries, and the Economic Planning Board. Some of the Korean Agricultural Sector Study Team participated and a part of the KASS grain management program model was used for the analysis. Consultants from the Korean Agricultural Planning Project helped formulate the policy alternatives for analysis.

The task force plans to continue the analysis of grain policy alternatives during the next several months. While this paper deals with only short run issues the task force plans to consider grains policy alternatives both in a longer range and in a wider scope context.

Grains Policy Task Force

July 1974

Introduction

The purpose of this paper is to provide analysis of short-term grain policy alternatives for the period June thru September 1974. The major policy instrument analyzed is alternative grains pricing structures. In choosing the price structure alternatives consideration is given to objectives with respect to pricing and quantity of government procurement and release, level of grain imports, government buffer stock operation levels, methods of financing government grain operations, and administrative policy with respect to grain consumption. While this paper does not address the more fundamental long-term grains policy issues which must be faced begining with the next rice year, policy options in the short-term context of the next several months are considered consistent with likely direction of longer-term grains policies.

Situation as of 1 June, 1974

1. Stocks of rice are in relatively short supply between 1 Jun and rice harvest given the disappearance rate for the period. The disappearance rate during this period is approximately 350,000 tons per month while rice stocks as of 1 Jun in government inventory were about 500,000 tons and private rice stock inventory was estimated at 1,100,000 tons for a total supply of approximately 1,600,000 tons.

2. Rice price for government release rice-barley mix, which is a mixture of 30% IR-667, 45% native rice varieties, and 25% barley, was 7,920 ₩ per 80 kg bag at wholesale, while pure rice released by the government was priced at 10,500 ₩ per 80 kg bag. Non-government pure rice (mostly native varieties) was about 14,318 ₩/80 kg bag at wholesale. Approximately 80% of the retail rice sales in urban areas was from government stocks, up from a normal 30% in May during past years.

3. Last November the government had difficulty in building rice stocks at a producer price of 11,377 ₩ per 80 kg bag. Present cost of rice to the government is approximately 12,292 ₩/ 80 kg bag including handling and interest charges. Thus government rice sales from present stocks at present prices add to long term deficit in the Grain Management Special Account.

4. Much of the 1974 wheat import of about 1.7 million tons was contracted at or near peak world prices. In January the domestic price for wheat flour was increased 60% from 1,190 ₩/22 kg bag to 1,898 ₩/22 kg bag to prevent further drain on the already deficit GMSA. Until the price increase the wheat subsidy was costing the government about 11 billion won per month at a wheat disappearance rate of 150,000 MT per month. In addition administrative measures limiting the use of heat products in school lunches, and wheat flour in

brewing and makoli production were put into effect. The wheat consumption rate dropped from about 150,000 tons per month to about 70,000 tons per month immediately and then recovered by mid July to about 90,000 tons per month. This shifted consumption of grain to more rice and barley.

5. The allowable borrowing limit from BOK for the GMSA in 1974 is 170 billion won while the target is 119 billion won during the year. Between 1 Nov 73 and 1 Jun 74 borrowings accumulated to 85 billion won.

6. A reluctance persists on the part of the government to raise the rice price because rice is the most important single consumer commodity and accounts for 8.9% of the total weighting of the wholesale price index. Thus rice price increases have relatively heavy inflationary effects.

Problem

With low rice stocks, ample, but high cost wheat stocks, a rapidly mounting deficit in the grain management special account, and inflation progressing at a rapid rate, the major short run problem is how to cover the grain demand requirements between 1 Jun and rice harvest, maintain price stability in the consumer grain markets, and minimize the increase in the GMSA deficit. The major concerns in the short run period between 1 Jun and rice harvest are how to assure that present rice stocks can be stretched to last for the period and how to increase the rate of wheat disappearance. At the same time the government wants to avoid further deficit

in the GMSA and further contribution of the grain prices toward higher inflation. In order to decrease the rate of rice disappearance and increase the rate of wheat disappearance the price of rice should be increased and the price of wheat decreased. Table 1 indicates the expected consequences of this action on rice and wheat disappearance, direct inflation and the GMSA deficit[1/].

Table 1: Consequences of Price Policy Change in Rice and Wheat

Objective	Action	Consequences on	
		Inflation	GMSA Deficit
↓ Rice Cons.	↑ Rice Price	↑	↓
↑ Wheat Cons.	↓ Wheat Price	↓	↑

As can be seen, a rise in rice price will yield the desired effect of decreasing the quantity of rice demanded. It will also have the desirable effect of reducing the GMSA deficit as government rice release price becomes higher. It will however have an undesirable effect of contributing directly to inflation.

A decline in the wheat price will have the desired effect of increasing wheat demand and slowing the rate of direct inflation. An undesirable effect is to increase the deficit in the GMSA.

1/ This paper does not deal with the impact of the GMSA flow on inflation. If large deficits are occuring in the GMSA the situation is equivalent to government deficit financing and thus tend to be inflationary. Similarily GMSA surplus flows will tend to be deflationary. Quantification of these effects should be a high priority research topic.

If however the rice price is increased and the wheat price decreased simultaneously, the effects upon the rice and wheat demand will be as desired, and the effects on inflation and the GMSA will tend to be offsetting. While this does not address some of the broader or longer range issues, for the short run it has the potential of attaining the major direct objectives while not contributing substantially to worsening the inflation and GMSA situations. The problem is to choose alternative combinations of rice and wheat prices to achieve, as nearly as possible, the desired (and avoid the undesired) consequences. To begin the analysis of various policy solutions to this problem and to determine the extent of possible tradeoffs, a mechanism linking the prices and quantities demanded of the major grains - rice, barley and wheat - was necessary.

Analytical Model

Such a mechanism (or model) is presently available as part of the yet incomplete Grain Management Program Component of the KASS model under development at NAERI. Many of the coefficients and the data necessary to use this part of the GMP for analysis of the present problem are available from work done at KDI.

The model is set up for only rice, barley, and wheat. It includes price, cross price, and income elasticities, which are estimated for 3 different periods during the year - October thru January, February thru May, and June thru September. These periods coincide with three distinctly different consumption behavior

patterns during the year. The portion of the model used to generate the results in this paper is for the June thru September period. The policy and solution variables which can be analyzed are the three grain prices and the three grain quantities demanded. The analyst can specify the level of any three of the variables and the model will solve for the other three. A fuller description of the model is found in appendix A.

Table 2 presents the price, cross price, and income elasticities used for this analysis for the June-September period. In looking at the first row of the urban portion of the table we find for example that for a 1% change in rice price, the quantity of rice demanded will change .340% in the opposite direction; for a 1% change in barley price the quantity of rice demanded will change .371% in the same direction; for a 1% change in wheat price the quantity of rice demanded will change .100% in the same direction; and for a 1% change in income the quantity of rice demanded will change .119% in the same direction. The rest of the table can be read in the same way. No income elasticities are indicated for the rural area; however the model is parameterized with the implicit assumption of a constant rural income for the 4 month period. The process used to estimate these elasticities is described in appendix B.

Population is assumed to remain constant at 33.6 million persons (55% urban, 45% rural) and income is assumed constant at 12,666 ¥ per capita per month during this 4 month period.

Levels chosen for population and income are those expected to prevail at the midpoint of the time period.

Table 2: Price, Cross Price, and Income Elasticities Used in the Model for the Jun-Sep Period

Urban

	Rice Price	Barley Price	Wheat Price	Income
Rice Quantity	-.340	.371	.100	.119
Barley Quantity	.549	-1.200	.344	-.110
Wheat Quantity	.400	.315	-.750	.035

Rural

	Rice Price	Barley Price	Wheat Price
Rice Quantity	-.311	.634	.100
Barley Quantity	.214	-1.000	.242
Wheat Quantity	.400	.315	-.750

The model will be used primarily to assess the consequences of different grain price sets. The guideline on whether one price set is more directly inflationary than another is a comparison of the total value of grain demanded per capita per year under the different price sets. That is $(PCC_r \times P_r) + (PCC_b \times P_b) + (PCC_w \times P_w)$ = value of grain consumed per capita per year; where PCC = per capita consumption per year, P = price and r,b,w = rice, barley, wheat. While this is not strictly a measure of inflation because quantities changes as well as prices, it is a reasonable approximation for our purposes.

The guideline on whether one price set contributes more or less to the GMSA deficit is to compare the value flows in or out of the GMSA over the 4 month period among the different price sets. For purposes of this set of model runs it is assumed for rice that at the begining of the period (1 Jun) government stocks were 500,000 MT, available on-farm stocks were 700,000 MT[2/] pipeline stocks in the marketing system were 50,000 MT and urban household stocks will be about 120,000 MT at the begining and near zero at the end of each month. Since household stocks must be replenished at the begining of October for consumption during the month, this flow level is not assumed available in the model.

Government stocks of barley on 1 Jun are assumed to be 190,000 MT and purchases during the period are 300,000 tons. The government market share in urban areas for barley sales is assumed at 65%.

Net changes in the GMSA for the period 1 June thru 30 September are calculated for each alternative grain price policy. Changes in the individual grain accounts and total GMSA change are indicated by the model. Since the government is not purchasing domestic rice during this period, changes in the GMSA rice

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2/ The model run is for the 4 month period Jun-Sep while rice stocks must last until harvest near the end of October. Thus while on farm stocks were estimated at 900,000 MT on 1 Jun only 700,000 MT are assumed available during the 1 Jun-30 Sep period, with 200,000 MT assumed held in farm stocks for consumption and sale in Oct.

account are calculated as government selling price multiplied by sales. Storage and handling costs, interest charges on rice inventory investments and import costs (should imports be necessary) also come into the calculations of GMSA rice account. The government barley purchasing program comes within the 1 June-30 September period, thus changes in the barley account reflect funds required for domestic barley purchases. Revenue from barley sales, handling and storage costs, and interest charges are handled similar to rice. Changes in the GMSA wheat account are calculated as subsidies on wheat flour sales receipts. A subsidy base of 2,790 won per 22 kg bag is assumed in the model.

Thus the GMSA flow referred to in later analysis is the activity in the account during the 4 month period and shows only net change during that period. Prior purchases or sales and value of stocks at the begining of the period are not accounted. Another measure of interest, although it is equally incomplete as a full measure of GMSA activity, is the cost to the government of the release activities in rice and barley and the subsidy on wheat during the period. This is calculated using the government cost or subsidy base and the government release price. These costs or subsidies are 12,292 ₩, 7,920 ₩ and 2,790 ₩ per bag of rice, barley, and wheat respectively. The calculation is government release, or in the case of wheat market, price minus government cost base multiplied by government release or in the case of wheat marketed quantity.

Initial conditions in the model are set as near as possible to the situation prevailing on 1 Jun. Table 3 presents these initial price and consumption rate conditions.

Table 3: Initial Model Conditions (1 Jun 74)

		Urban	Rural
Price	Rice	10,500	13,600
(Won/bag)	Barley	4,800	5,760
	Wheat	1,898	2,088
Consumption Rate	Rice	115	96
(Jun-Sep Period	Barley	45	72
kg/capita/yr)	Wheat	36	36

The initial urban rice price is a weighted average wholesale price considering price and market share of government rice-barley mix, government pure rice, and free market rice. With a rice-barley mix price of 7,920₩/bag the rice portion of the mix is priced at 9,013 ₩ per bag. (This assumes a price of 4,437 ₩ per bag for the barley portion of the mix). Further, with a price of 10,500 ₩/bag for government release pure rice and assuming a government market share split of 60% for the rice-barley mix and 40% for the government pure rice, the weighted average government release price would be 9,608 ₩ per bag.

((9013 ₩).6 + (10,500 ₩).4 = 9608 ₩).

The average wholesale rice price in urban markets as of 1 Jun is assumed in the model to be 10,500 ₩/bag. This assumes a government average price of 9,608 ₩ per bag and a government market share of 80%. The free market price is assumed to be 14,318 ₩/bag and the free market share is assumed to be 20%.

((9608 ₩).8 + (14,318 ₩).2 = 10,550 ₩).

The rural rice price is assumed to be 13,600 ₩ per bag since farm sales of pure rice are flowing in the free market and are selling in urban markets at 14,318 ₩ per bag.

The barley price in urban areas is 4,800 ₩/bag and the consumer price in rural areas is assumed to be 20% above the urban price, or 5,760 ₩/bag. Even though the farm purchase price is 7,000 ₩ per bag, the negative marketing margin for barley requires the assumption of the lower consumer price in rural areas.

The wheat price is 1,898 ₩ per bag in urban areas and the rural price is assumed to be 10% higher at 2,088 ₩ per bag to account for transportation cost differentials.

On 15 Jun the government announced a new producer price for barley and new consumer prices for barley and for government release rice-barley mixed grain. The new barley consumer price is 6,000 ₩ per 76.5 kg bag and the new government release price at wholesale for the rice-barley mix is 9,920 ₩ per 80 kg bag. The government also stopped government release of pure rice and increased the allowable milling rate for all rice from 72% to 73%.

With no more pure rice being released by the government and the new government release price for the rice-barley mix of 9,920 ₩ per bag, the price of rice in the mix is 11,266 ₩ per 80 kg bag. (This implies a price of about 5,630 ₩ per bag for the barley in the mix). This action drastically reduced the amount of pure rice available in urban markets and drove the price of pure rice to an estimated 15,936 ₩ per bag. Thus assuming that the government market share is 80%, the weighted average price of rice in urban areas after 15 Jun is 12,200 ₩ per bag.

$$((11{,}266\ ₩).8 + (15{,}936\ ₩).2 = 12{,}200\ ₩)$$

The rural price is assumed to remain at 13,600 ₩ per bag with the upward pressure on price due to greater scarcity of pure rice canceled by the downward price pressure caused by increasing the number of rice-barley mix release points into urban areas.

The rural consumer barley price is again assumed to be 20% above the urban price and the rural wheat price 10% above the urban price. Table 4 summarizes the grains price situation after 15 Jun.

Table 4: Grain Prices after 15 Jun

		Urban	Rural
Price	Rice	12,200	13,600
(Won/bag)	Barley	6,000	7,200
	Wheat	1,898	2,088

Without further price adjustment this will tend to decrease barley, and rice-barley mix consumption in favor of wheat and pure rice. But with these consumption shifts the tendency will be for upward pressure on the price of both pure rice and wheat. With large wheat stocks now on hand the pressure on the wheat price is likely to be rather weak; but with short supplies of rice the pressure on the price of pure rice is likely to be rather strong.

Results

Table 5 displays the results of several runs of interest. Column 1 displays results of the base (1) run with prices as of 1 Jun 74. Column 2 shows results of the 15 Jun price increase in rice and barley, and differences in variable values from the base (1) run. This is also the base (2) run for further analysis below. Column 3 shows the wheat price necessary to keep the

net GMSA flow the same as in the base (1) run, the consequences on the other variables of concern, and the differences from the base (1) run. Column 4 shows the wheat price necessary, consequences on other variables, and differences from the base (1) run of keeping the inflation effect of the 15 Jun rice and barley price increases zero.

The situation prior to 15 Jun (Col. 1) shows urban prices of 10,550 ₩. 4,800 ₩, and 1,898 ₩ per bag of rice, barley, and wheat respectively. At these prices, urban consumption rates were 115, 45, and 36 kg per capita per year of rice, barley, and wheat respectively. With rural prices of 13,600 ₩ for rice, 5,760 ₩ for barley and 2,088 ₩ for wheat, rural per capita consumption rates were 96, 72, and 36 kg of rice, barley, and wheat respectively.

The total value of grain consumed per capita per year in urban areas was 21,095 won and the GMSA flow was positive for the 4 month period in the amount of 22,022 million won.

On 15 Jun the urban price of barley was increased to 6,000 ₩ per bag and rice to 12,200 ₩ per bag. The rural prices are 7,200 ₩ per bag for barley and 13,600 ₩ per bag for rice. The consequences projected by the model are as indicated in Col 2.

Relative to the base (1) condition shown in Col. 1, these price changes cause an increase in the value of grain consumed per capita of 3,494 ₩ per year for a total yearly per capita

grain expenditure of 24,589 ₩. These price changes are thus directly inflationary. But the inflow into the GMSA for the 4 month period is substantially increased from 22,022 million won to 36,835 million won. It should also be noted that the yearly per capita urban consumption rate of rice during the period increases from 115 kg to 119 kg while the barley consumption rate decreases from 45 kg to 37 kg and wheat increases from 36 kg to 41 kg. The rural consumption pattern change is in a similar direction with rice up 15 kg, barley down 14 kg, and wheat up 3 kg. Thus a major objective of decreasing rice consumption is not fulfilled and in fact total rice requirement for the 4 month period jumps from 1,192 thousand MT to 1,290 thousand MT. This is primarily because of the shift in consumption from barley to rice caused by the relatively large increase in barley price of 25% compared to only a 16% increase in urban rice price and no change in the rural rice price.

One question we must now resolve is what happens to rice consumption, wheat consumption, direct inflation, and GMSA flows as the price of wheat is decreased. At a wheat price of about 1,354 ₩ per bag the flow in the GMSA for the period would be about the same as with the prices prevailing before 15 Jun (base (1) price set), but the per capita cost of grain would be higher by about 2,285 ₩ per year and thus inflationary, and the rice requirement would be higher by about 55 thousand MT (Col. 3). At a wheat price of about 667 ₩

bag the direct inflation effect would be zero, but the outflow in the GMSA would be a prohibitive 37,095 million won for the period, and the rice requirement would be lower by about 30 thousand MT (Col. 4).

Thus if the rice and barley prices are left at present levels and the wheat price dropped to somewhere between 1,354 and 667 ₩ per bag, wheat consumption can be increased but rice consumption can not be brought back down to levels existing before 15 Jun without prohibitive cost to the GMSA. This is largely due to the greater strength of the substitution effect between barley and rice than between wheat and rice. (See elasticities Table 2, pg. 7). At a wheat price of 1,354 ₩ the GMSA flow effect is zero and at a wheat price of 667 ₩ the direct inflation effect is zero. The trade off between a wheat price of 667 ₩ and 1,354 ₩ is between severely worsening deficit in the GMSA and direct inflation. Both zero effect conditions cannot be satisfied concurrently.

Column 5 and 6 show the effects of a further urban rice price increase to 13,600 ₩ with column 5 showing differences from the base (1) run and column 6 showing differences from the base (2) run.

This assumes that the government release rice price is 12,292 ₩ per bag - the price necessary for the government to just cover costs in the rice portion of the GMSA. With the government release price at 12,292 ₩ per bag, the average urban price at 13,600 ₩ per bag, and the government market share again assumed to be 80%, the price for pure rice in urban areas would be 18,830 ₩ per bag.

((12,292).8 + (18,830).2 = 13.600)

Rural rice price is assumed to increase by 10% due to the upward pressure on the pure rice price in urban markets. Column 7 shows the wheat price necessary to cause zero change in the GMSA from the base (2) run given an urban rice price increase to 13,600 ₩. Column 8 shows the wheat price necessary for a zero direct inflation effect compared to base (2) given the higher price for rice. Column 9 shows the price necessary for a zero GMSA effect from base (1).

A further urban rice price increase to 13,600 ₩ and a rural rice price increase to 14,960 ₩ per bag compared to the situation prior to 15 Jun (Col. 5 compared to Col. 1) shows rice consumption in urban areas remains unchanged and in rural areas is higher than in the earlier period, while the GMSA inflow increases and the direct inflation effect also increases. When this assumption is compared to the situation after 15 Jun, (Col. 6 compared to Col. 2) we find both urban and rural rice consumption a bit lower. Both GMSA inflow and direct inflation are higher.

A wheat price of 1,637 ₩ per bag would yield a zero change in the GMSA flow from the 15 Jun prices of base (2), (Col. 7 compared to Col. 2), but direct inflation is still present with the value of grain consumed per capita per year 1,110 ₩ above base (2). Rice consumption is somewhat lower and wheat consumption rises as expected.

A wheat price of 1,213 ₩ per bag is required for a zero direct inflation effect (Col. 8). With this price, urban rice consumption is below both base (1) and base (2) levels while rural rice consumption falls between base (1) and base (2) levels. Wheat consumption is up substantially in both rural and urban areas, but the inflow to the GMSA is less than both the situation prior to and after 15 Jun.

At a wheat price of 1,337 ₩ per bag (Col. 9) the situation is similar to that where the wheat price is 1,213 ₩ per bag. The 1,337 ₩ price however, causes a zero change in GMSA flows compared to the situation prior to 15 Jun, (Col. 1), but is somewhat inflationary compared to the 15 Jun situation (Col. 2).

Thus a feasible alternative grain price policy for the short run would be to increase rice price from the present 12,200 ₩ per bag to 13,600 ₩ per bag and at the same time to decrease the wheat price from the present 1,898 ₩ per bag to about 1,275 ₩ per bag. The effect of these price changes would be to (1) decrease rice disappearance to approximately the disappearance levels prior to 15 Jun (1,198 thousand MT vs. 1,192 thousand MT), (2) increase wheat consumption levels to approximately the consumption levels prior to the 60% wheat price increase in Jan 74, (627 thousand MT vs. 600 thousand MT), (3) maintain the value of grain consumption per capita at approximately the level with 15 Jun prices (24,767 ₩ vs. 24,589 ₩) thus creating no new direct inflationary influence, and (4) maintain the GMSA flow at approximately the level it was with prices prior to 15 Jun (18,394 Mil. ₩ vs. 22,022 Mil ₩), thus not contributing to greater GMSA deficits,[3/] and (5) maintain a government release cost to the GMSA at the approximate level they were before the 15 Jun price increases (36,510 Mil. ₩ vs. 35,910 Mil. ₩). See col. 10, Table 5.

3/ This will reduce the GMSA flow somewhat from levels with 15 Jun prices. Thus it should provide some indirect anti-inflationary effect.

Table 5: Consequences of Alternative Grain Price Set Assumption

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Base (1) Price as of 1 Jun 74	Base (2) Price as of 15 Jun 74	15 Jun 74 Situation ₩/zero GMSA Change	15 Jun 74 Situation ₩/zero Inflation	Further Rice Price Increase to 13,600 ₩ from base (1)	Same as Column 5 from Base (2)	Rice Price at 13,600 ₩ zero GMSA, Change from Base (2)	Rice Price at 13,600 ₩ zero Inflation from Base (2)	Rice Price at 13,600 ₩ zero GMSA Change from Base (1)	A Feasible Alternative
Price Urban (₩/bag)										
Rice (80 kg)	10550	12200	12200	12200	13600	13600	13600	13600	13600	13600
Barley (76.5 kg)	4800	6000	6000	6000	6000	6000	6000	6000	6000	6000
Wheat (22 kg)	1898	1898	1354	667	1898	1898	1637	1213	1337	1275
Price Rural (₩/bag)										
Rice (80 kg)	13600	13600	13600	13600	14960	14960	14960	14960	14960	14960
Barley (76.5kg)	5760	7200	7200	7200	7200	7200	7200	7200	7200	7200
Wheat (22 kg)	2088	2088	1488	734	2088	2060	1801	1334	1471	1403
Consumption Urban (kg/capita/yr)										
Rice	115	119	115	107	115	115	113	110	111	110
Barley	45	37	33	26	40	40	38	34	35	35
Wheat	36	41	53	90	43	43	48	60	56	58
Total	196	197	201	223	197	197	198	203	201	202
Consumption Rural (kg/capita/yr)										
Rice	96	111	107	100	107	107	106	103	104	103
Barley	72	58	53	45	59	59	57	53	54	53
Wheat	36	39	50	85	40	40	45	56	52	54
Total	204	207	210	229	206	206	207	212	210	211
Total Requirement (1000 MT Jun-Sep)										
Rice	1192	1290	1247	1162	1247	1247	1229	1192	1204	1198
Barley	610	520	472	386	540	540	518	475	488	482
Wheat	403	447	576	979	466	466	520	651	605	627
Total	2236	2257	2295	2526	2253	2253	2266	2319	2298	2307
Government Share of Total Requirement (1000 MT Jun-Sep)										
Rice	442	540	497	412	497	497	479	442	454	448
Barley	180	149	133	104	158	158	151	136	140	138
Government Carry out Stocks* (1000 MT 30 Sep)										
Rice	58	- 40	3	88	3	3	21	58	46	52
Barley	310	341	357	386	332	332	339	354	350	352
GMSA Flow (Mil. Won Change in Account during Period)										
Rice	58271	74359	75786	62715	84483	84483	81354	75155	77147	76173
Barley	-23989	-23584	-24869	-27123	-22865	-22865	-23482	-24639	-24276	-24455
Wheat	-12260	-13940	-28910	-72698	-14559	-14559	-21027	-36009	-30842	-33324
Total	22022	36835	22007	-37095	47059	47059	36846	14507	22029	18394
Government Release Cost to GMSA ** **(Mil. Won)**										
Rice	14829	6413	6374	5284	0	0	0	0	0	0
Barley	8821	4460	3981	3113	4729	4729	4519	4071	4190	4130
Wheat	12260	13592	28195	70848	14169	14169	20438	34995	29965	32390
Total	35910	24465	38550	79245	18898	18898	24957	39066	34155	36519
Value of Grain Consumed, Urban (₩/capita/yr)	21095	24589	23380	21092	26273	26273	25699	24587	24941	24767
Selected Differences from Base (1) or Base (2) run		Base (1)	(1)	(1)	(1)	(2)	(2)	(2)	(1)	
Total Requirement (1000 MT Jun-Sep)										
Rice		98	55	- 30	55	- 43	- 61	- 98	12	
Barley		- 120	- 168	- 264	- 100	20	- 2	- 45	- 152	
Wheat		44	173	576	63	19	73	204	- 202	
Total		21	59	290	17	- 4	9	62	- 62	
GMSA Flow (Mil. Won)										
Total		14813	- 15	-59117	25037	10224	11	-22328	7	
Value of Grain Consumed, Urban (₩/capita/yr)		3494	2285	- 3	5178	1684	1110	- 2	3846	

* Negative number implies imports.

** Government cost base for calculation: Rice 12,292 ₩/bag, barley 7920 ₩/bag, wheat 2790 ₩/bag.

The government has also been thinking through the issue of increasing both the rice and wheat price just prior to rice harvest. In the past several years the rice purchase price and the wholesale rice price have been increased by the government just prior to rice harvest. In recent years these price increases have been on the order of 25-35%. Producers have come to anticipate such price increases and even consumers have come to expect them. At the same time pressure is felt by the government to also increase the price of wheat. The question we pose here is what would be the consequences of a 25% increase in both rice and wheat price on 1 Aug, mid-way through the 4 month period under analysis. A 25 percent increase in government rice price would raise the price from 11,266 ₩ per bag to 14,083. For wheat a 25% increase would be from 1,898 ₩ per bag to 2,373 ₩ per bag.

If the government price of rice were raised to 14,083 ₩ per bag the price of the rice-barley mix would be 12,131 ₩ per bag.

((14,083).75 + (6000) (80/76.5).25 = 12,131)

Further, based on past experience the price for pure rice will increase to approximately 45% higher than the rice-barley mix price. Thus the price for pure rice is estimated to be 20,420 ₩ and the weighted market price in urban areas, assuming a 80%-20% market split between the rice-barley mix and pure rice, would be 15,350 ₩ per bag.

((14,083).8 + (20,420).2 = 15,350)

The rice price in rural areas is assumed to be based on the pure rice price in urban areas minus transport and handling charges of 10%. Thus a rural rice price of 18,378 ₩ per bag is assumed between 1 August and rice harvest. The rural wheat price as before is 10% above the urban

price, or 2,610 ₩ per bag. Table 6 indicates the price assumptions for this alternative.

Table 6: Urban and Rural Price Assumptions for the Model with a 25% increase in Rice and Wheat Prices

		Urban	Rural
Price	Rice	15,350	18,378
₩/bag	Barley	6,000	7,200
	Wheat	2,373	2,610

Since this alternative assumption will only hold for 2 of the 4 months for which the model runs, an adjustment in the results must be made and care must be taken in analyzing the outcome. The model is not well suited to assessing intraperiod policy changes, however an approximate analysis can be done by running the model before and after the intraperiod adjustment and weighting the two results on the basis of the proportion of time during the period when the alternative assumptions hold. Table 7 reproduces the results of the base (2) run in column 1 as the condition assumed to hold during the first half of the period. Column 2 shows the results of the prices assumed in Table 6 for the last half of the period. Column 3 presents the weighted average (50%-50%) results of columns 1 and 2.

The results of higher rice and wheat prices include a shift in consumption away from rice and wheat toward barley, and large jumps in both the GMSA inflow and value of grain consumed per capita. The government release cost to the GMSA is drastically reduced due to a rice release price above the government cost base for rice.

Table 7: Result of Price Changes within the Period

	Base (2) Price as of 15 Jun 74	Price Change Alternative for 1 Aug.	Weighted Result for 4 Month Period
Price Urban (₩/bag)			
Rice (80 kg)	12200	15350	13775
Barley (76.5 kg)	6000	6000	6000
Wheat (22 kg)	1898	2373	2136
Price Rural (₩/bag)			
Rice (80 kg)	13600	18378	15989
Barley (76.5 kg)	7200	7200	7200
Wheat (22 kg)	2088	2610	2350
Consumption Urban (kg/capita/yr)			
Rice	119	112	115
Barley	37	46	42
Wheat	41	38	40
Total	197	196	197
Consumption Rural (kg/capita/yr)			
Rice	111	103	106
Barley	58	65	62
Wheat	39	37	38
Total	207	205	206
Total Requirement (1000 MT Jun-Sep)			
Rice	1290	1212	1251
Barley	520	608	564
Wheat	447	419	433
Total	2257	2239	2248
Government Share of Total Requirement (1000 MT Jun-Sep)			
Rice	540	462	501
Barley	149	183	166
Government Carry out Stocks (1000 MT 30 Sep)			
Rice	- 40	38	- 1
Barley	341	307	324
GMSA Flow (Million Won change during period)			
Rice	74359	88562	81461
Barley	23584	-20950	-22267
Wheat	-13940	- 6042	- 9991
Total	36835	61571	49203
Government Release Cost to GMSA (Mil. Won)			
Rice	6413	-10343	- 1965
Barley	4460	5477	4969
Wheat	13592	5956	9774
Total	24465	1090	12778
Value of Grain Consumed, Urban (₩/capita/yr)	24589	29253	26921

It must be recognized that while column 3 approximates the conditions during the period under analysis, column 2 depicts the situation as this period ends and the next begins.

Limitations and Further Analysis Required

Four major points need to be made in this section. First, the results presented above and the alternatives analyzed do not include changes in the barley price from the 15 Jun level. If a decrease in barley price were a feasible alternative it would be well worth exploring with the model, since this would be the most direct way to decrease the rate of rice consumption and could likely provide more acceptable ranges of trade-off between GMSA flows and direct inflation. This alternative was not analyzed by the task force since it was considered to be a non-feasible alternative. A major factor in increasing barley price on 15 Jun was to discourage the use of barley as an animal feed. Unfortunately this action also discourages the use of barley as a human food. But it appears that the objective of decreasing the use of barley for feed outweighs the conflicting objective of maintaining or increasing barley use for food, at least in the short run. If both of these presently conflicting objectives are important, further work should be done in developing price and administrative policies and policy instrumentation which would achieve both objectives without conflict.

Second, another difficult problem involves the rice-barley mix. When rice and barley are mixed together before sale, the mixture becomes a separate and distinct grain product with its own market and demand

function. It appears to be favored by consumers over straight barley but not liked as well as pure rice. In our analysis, we have treated the rice-barley mixture and pure rice together as a single product for pricing purposes and yet have separated the rice and barley quantities for consumer demand estimation in the model. We are certain if the rice-barley mix were included in the model as a separate commodity with its own demand functions, own demand elasticity, and set of cross price elasticities with the other grains, the results would be different from those we have reported. But we have no empirical basis at present to even predict how or in what magnitude they would be different.

An immediate reaction is to argue for additional research to determine consumer behavior with respect to the rice-barley mix and to empirically estimate the required elasticities necessary to include this "new commodity" separately in the model and in the analysis. The problem is that since it is a new commodity, no time series data are available for making the required analysis and estimating the needed coefficients. If the rice-barley mix is to remain on the market in the future, a plan should be developed for collecting the necessary cross-sectional data for preliminary analysis and this data should be collected through time in order that historical time series can be developed for more definitive analysis in the future. In the meantime a mathematically derived set of elasticities will be derived in order to include the rice-barley mix in the model as a separate commodity. If successful, this procedure will provide a stop-gap method of handling the problem until the empirical work can be accomplished.

Third, as indicated in an earlier footnote, research should begin immediately on the effect of government deficit financing on inflation although results cannot be expected in time to be helpful in the policy decisions necessary in the remainder of this rice year. A small amount of evidence is available to give some indication of the potential impact of increased deficit in the GMSA.

According to a study made by Kwang Suk Kim, the inflation rate is positively related to increases in money supply4/ The relationship is expressed as follows:

$$P' = \underset{}{51.22} + \underset{(4.96)}{0.651\,\bar{M}'} - \underset{(-2.81)}{1.127\,TAR'} + \underset{(5.49)}{0.681\,T'}$$
$$\qquad\quad (1.26)$$

$$R^2 = 0.815$$

where P' = annual inflation rate in terms of GNP deflater

$\bar{M}' = 0.6\,M'_t + 0.4\,M'_{t-1}$

M' = annual percentage change in nominal currency supply

TAR' = annual growth rate of total available resources

T' = annual percentage change in circulation rate of demand deposit

( ) = t - ratio

If the currency supply increases by 10% this year due to deficit financing GMSA, this is expected to generate 3.9 percent inflation this year and a further 2.6 percent inflation next year.

4/ K.S. Kim. The Causes and Effects of Inflation in Korea, KDI Research Report No. 1, 1973, p. 31-43.

In order for government deficit financing of the GMSA to have the impact on inflation indicated by the Kim equation, two conditions must hold. First the deficit in the GMSA must be financed in such a way as to increase the money supply to the full extent of the deficit. Second the economy must be in the same structural state as it was as the time that the study was done so that the impact of the increased money supply on the price level is the same as estimated in the Kim equation.

If these rather strict conditions hold we can estimate the upper bound on the inflation effect of deficit or surplus government financing through the GMSA. Thus with a money supply level of 710 billion won (May 74 BOK figure) and an <u>increase</u> in the GMSA inflow between the base (1) and base (2) runs of 15 billion won, the percentage <u>decrease</u> in the money supply would be 15/710 or 2.11%. Applying the K.S. Kim coefficient's (.651(2.11%).6 = .82%) we find the decrease in the inflation rate in terms of the GNP deflator to be .82% in the current period and 1.37% in the next period, (.651(2.11%).4) + .82% = 1.37%.

The direct inflation impact is measured in terms of the current weighted change in value of grain consumed per capita per year. The difference between the base (1) and base (2) value of grain consumed per capita is 3,494 won. Assumed annual per capita income is 151,992. Thus the direct inflation effect is 3,494/151,992 or 2.30% increase. The net effect on inflation of the shift from the base (1) to the base (2) alternative is roughly estimated to be a 1.48% increase in the inflation rate in the current time period and .93% in the following time period. To the extent that GMSA operations do <u>not</u> decrease money supply the net inflation effect will be greater.

A good deal more conceptual thought and empirical work needs to be done before definitive assessment of these impacts and tradeoffs can be done. However, the above preliminary logic and example indicates that further work is well worth doing. In the meantime, researchers and decision makers should be aware that this limitation exists in the ability to fully analyze this type of problem.

Finally, for the longer term grain policy issues, analysis of effects and tradeoffs between price, market, credit, trade, and institutional policies should be done. This work should receive immediate priority in order that decision makers have the benefit of this analysis for policy decision necessary for the 1975 rice year and beyond.

Appendix A

Generalized Front End Model for GMP Component

Suppose we have a model for foodgrain demand in the following form,

$$Q = A + BP + CY \tag{1}$$

where Q = a 3x1 vector of rice, barley and wheat flour consumption.

A = a 3x1 vector of constant (intercept terms)

B = a 3x3 matrix of price and cross price coefficients

P = a 3x1 vector of prices for rice barley and wheat flour

C = a 3x1 vector of income coefficient

Y = a scalar representing income or GN

For clarity (1) can be written out as

$$\begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix} + \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} Y$$

where subscript 1 = rice

subscript 2 = barley

subscript 3 = wheat flour

(1) can also we rearranged

$$Q - BP = A + CY \tag{3}$$

or

$$\begin{bmatrix} U, & -B \end{bmatrix} \begin{bmatrix} Q \\ P \end{bmatrix} = A + CY \tag{4}$$

written out (4) becomes

$$\begin{bmatrix} 1 & 0 & 0 & -b_{11} & -b_{12} & -b_{13} \\ 0 & 1 & 0 & -b_{21} & -b_{22} & -b_{23} \\ 0 & 0 & 1 & -b_{31} & -b_{32} & -b_{33} \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ p_1 \\ p_2 \\ p_3 \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} \qquad (5)$$

where

$$\begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} Y$$

(5) is a system of 3 equations and 6 unknowns (q_1, q_2, q_3, p_1, p_2, p_3). imple linear algebra theory states that an infinite number of solutions o this set of equations exists. However, if any 3 of the 6 unknowns are pecified (eq. q_1, q_3, p_1) the system will have a unique solution; roviding the matrix of coefficients to the unspecified variables is onsingular.

--- Example ----

Let q_1, q_3 and p_1 be specified i.e.

quantity of rice

quantity of wheat

price of rice

Equation (5) can be written in the form

$$\left[A_1 \vdots A_2\right] \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = D \qquad (6)$$

where

A_1 = a 3x3 matrix of coefficents of the unspecified variables (q_2, p_2, p_3)

A_2 = a 3x3 matrix of coefficients of the specified variables (q_1, q_3, p_1)

X_1 = a 3x1 vector of unspecified variables (q_2, p_2, p_3)

X_2 = a 3x1 vector of specified variables (q_1, q_2, p_1)

for clarity equation (6) can be written out as

$$\left[\begin{array}{ccc|ccc} 0 & -b_{12} & -b_{13} & 1 & 0 & -b_{11} \\ 1 & -b_{22} & -b_{23} & 0 & 0 & -b_{21} \\ 0 & -b_{32} & -b_{33} & 0 & 1 & -b_{31} \end{array}\right] \left[\begin{array}{c} q_2 \\ p_2 \\ p_3 \\ \hline q_1 \\ q_3 \\ p_1 \end{array}\right] = \left[\begin{array}{c} d_1 \\ d_2 \\ d_3 \end{array}\right] \qquad (7)$$

Equation (6) can also be written

$$A_1X_1 + A_2X_2 = D \qquad (8)$$

with a solution

$$X_1 = A_1^{-1} \left[D - A_2 X_2 \right] \qquad (9)$$

where the only necessary condition is that the inverse A_1^{-1} exists.

tten out for clarity equation (9) is equivalant to

$$\left[\begin{array}{c} q_2 \\ \hline p_2 \\ p_3 \end{array}\right] = \left[\begin{array}{ccc} 0 & -b_{12} & -b_{13} \\ 1 & -b_{22} & -b_{23} \\ 0 & -b_{32} & -b_{33} \end{array}\right]^{-1} \left\{ \left[\begin{array}{c} d_1 \\ d_2 \\ d_3 \end{array}\right] + \left[\begin{array}{ccc} 1 & 0 & -b_{11} \\ 0 & 0 & -b_{21} \\ 0 & 1 & -b_{31} \end{array}\right] \left[\begin{array}{c} q_1 \\ q_3 \\ R_1 \end{array}\right] \right\} \qquad (10)$$

---- End of Example ----

If the foodgrain demand model represented in (1) is in log-log form, i.e.

$$\ln Q = \ln A + B\ln P + C\ln Y, \tag{11}$$

where the B and C represent elasticity matrices directly, the same generalization for the linear form above can be used, the solution in (10) is then given by the transformation.

$$x = e^{\ln x}$$

APPENDIX B

Adjusting Demand Elasticities to Reflect Stable Total Per-Capita Grain Consumption

Although consumption levels of major foodgrains vary markedly with prices, historical data indicates that total per-capita consumption of rice, barley and wheat combined remains fairly stable. Original estimates of price elasticities of demand can be adjusted to reflect this assumption.

By definition the price elasticity of demand is given by the following relationship:

$$\epsilon_{ij} = \frac{\partial Q_i}{\partial P_j} \frac{P_j}{Q_i} \qquad (1)$$

or

$$\frac{\partial Q_i}{\partial P_j} = \epsilon_{ij} \frac{Q_i}{P_j} \qquad (2)$$

Equation (2) states that the change in demand for commodity i due to a change in price of commodity j is equal to the elasticity ϵ_{ij} times the ratio of the expected value of Q_i over the expected value of P_j.

Consider the case of rice, barley, and wheat flour demands. The change in combined demand for these commodities due to changes in each price are given by the following three equations:

$$\frac{\partial Q_T}{\partial P_R} = \epsilon_{RR} \frac{Q_R}{P_R} + \epsilon_{BR} \frac{Q_B}{P_R} + \epsilon_{WR} \frac{Q_W}{P_R} \quad (3)$$

$$\frac{\partial Q_T}{\partial P_B} = \epsilon_{RB} \frac{Q_R}{P_B} + \epsilon_{BB} \frac{Q_B}{P_B} + \epsilon_{WB} \frac{Q_W}{P_B} \quad (4)$$

$$\frac{\partial Q_T}{\partial P_W} = \epsilon_{RW} \frac{Q_R}{P_W} + \epsilon_{BW} \frac{Q_B}{P_W} + \epsilon_{WW} \frac{Q_W}{P_W} \quad (5)$$

If it is assumed that total combined demand remains constant, then each of the three equations above is equal to zero. Furthermore, each equation can be multiplied by its common denominator to yield

$$\bar{Q}_R \epsilon_{RR} + \bar{Q}_B \epsilon_{BR} + \bar{Q}_W \epsilon_{WR} = 0 \quad (6)$$

$$\bar{Q}_R \epsilon_{RB} + \bar{Q}_B \epsilon_{BB} + \bar{Q}_W \epsilon_{WB} = 0 \quad (7)$$

$$\bar{Q}_R \epsilon_{RW} + \bar{Q}_B \epsilon_{BW} + \bar{Q}_W \epsilon_{WW} = 0 \quad (8)$$

Equation (6) thru (8) given the linear relationships which must hold among the elements in each column of the elasticity matrix for the constant consumption assumption to hold for changes in each price. It is also possible to apply these conditions to only certain columns of the elasticity matrix, forcing the condition to hold with respect to only certain prices. For clarity the demand model structure with elasticity matrix is given below.

$$\ln \begin{bmatrix} Q_R \\ Q_B \\ Q_W \end{bmatrix} = \ln \begin{bmatrix} C_R \\ C_B \\ C_W \end{bmatrix} + \begin{bmatrix} \epsilon_{RR} & \epsilon_{RB} & \epsilon_{RW} \\ \epsilon_{BR} & \epsilon_{BB} & \epsilon_{BW} \\ \epsilon_{WR} & \epsilon_{WB} & \epsilon_{WW} \end{bmatrix} \ln \begin{bmatrix} P_R \\ P_B \\ P_W \end{bmatrix} + \begin{bmatrix} \epsilon_{RI} \\ \epsilon_{BI} \\ \epsilon_{WI} \end{bmatrix} \ln Y \quad (9)$$

When attempting to estimate the seasonal elasticities in (9), researchers are consistantly plagued with unrealistic estimates (wrong signs) of certain cross elasticities. Specifically, the elasticity estimates which seem to give the most problems are ϵ_{RW} and ϵ_{WB} in (9). Furthermore, the statistical significance of these estimates is oftentimes greater than that of the own elasticity. When these models are subjected to rigorous validity checks they invarably fail to be good predictors at one stage or another. To get around this problem in the very restrictive time frame available to the task force, the conditions in equations (6) thru (8) were applied to original estimates of (9). Well over one hundred regressions were run using monthly time series data on prices, consumption and income from 1966 to 1973 for farm, urban and total populations. Although wrong signs seemed to persist on ϵ_{RW} and ϵ_{WB}, researchers were able to build confidence in the own seasonal price elasticities (diagonal elements) in (9) as well as in some of the 'well behaved' cross elasticity estimates. Final estimates of (9) were then made by choosing two elements from each column of the elasticity matrix where credability was highest and then solving the conditions (6) through (7) for the third element in each column. Several elasticity estimates were made in this fashion. The generalized front end model described in Appendix A was then used to test the validity of these estimates. The elasticity matrix finally agreed on by the task force gave the best results of any tested to date.