Wheat Policy Options in Sub-Saharan Africa: The Case of Zimbabwe

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Abstract

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Like many countries in sub-Saharan Africa, Zimbabwe is experiencing rapid growth in wheat consumption and imports. Policy makers in Zimbabwe and elsewhere must decide whether increased domestic wheat production might reduce dependency on imports and at the same time contribute to economic efficiency and food security goals. The domestic resource cost framework was used to assess Zimbabwe's comparative advantage among six major irrigated crops and to measure the effects of current government policies on producer incentives. The results indicate that irrigated wheat production represents an efficient use of Zimbabwe's resources during times of abundant rainfall, but the nation enjoys a comparative advantage in tobacco, maize, and cotton production during times of water scarcity. Existing agricultural policies provide disincentives for commercial farmers, because private profitability is less than social profitability for the major irrigated crops. However, this tax occurs across all commodities with similar incidence, so that the private incentives among crops are not greatly distorted from their social pattern. Sensitivity analysis confirms the robustness of these findings under a range of possible future economic and political developments. The domestic resource cost approach used in this study provides an operational method for measuring comparative advantage and should be of interest to policy analysts throughout sub-Saharan Africa.

Introduction

Over the past 25 years, one of the most dramatic changes in dietary patterns in sub-Saharan Africa has been the increasing role of wheat as a staple food. Wheat consumption has risen rapidly, growing at an annual rate of 3.3% per capita from 1960 to 1985. Since very little wheat is produced in sub-Saharan Africa, most of the growth in consumption has been made possible by rising imports, which have increased more than 600% during the same period.

The rapid growth in wheat imports and consumption raises difficult ques-

tions for African policy makers. Will wheat over time become the main staple in sub-Saharan Africa, gradually substituting for coarse grains, roots, and tubers? What are the political and economic implications of such a change in dietary patterns? To what extent might domestic wheat production reduce dependency on wheat imports and at the same time contribute to economic efficiency and food security goals?

In addressing these questions, it is interesting to consider the case of Zimbabwe. Zimbabwe is unusual among the countries of sub-Saharan Africa in producing most of its own wheat. Between 1965 and 1975, rapid growth in wheat production transformed Zimbabwe from a net wheat importer to a net exporter. Although wheat consumption has since overtaken production and revived the need for imports, domestically produced wheat continues to make up the major part of supply (see Fig. 1).

Recent developments suggest that Zimbabwe's current high level of wheat self-sufficiency may be threatened. Demographic and economic factors have increased the demand for bread and other wheat-based products more rapidly than domestic wheat production has been able to expand, forcing the government to turn to imports to make up the shortfall. Imports averaged around 100 000 tons annually during 1983–85 and would have been even greater had import quotas not been imposed. Wheat is currently being rationed to millers, who claim that demand exceeds the available supply by at least 25–30%. While these figures are difficult to substantiate in the absence of reliable consumption data, the millers' claim is supported by the frequent appearance of bread lines in Harare, the capital city.
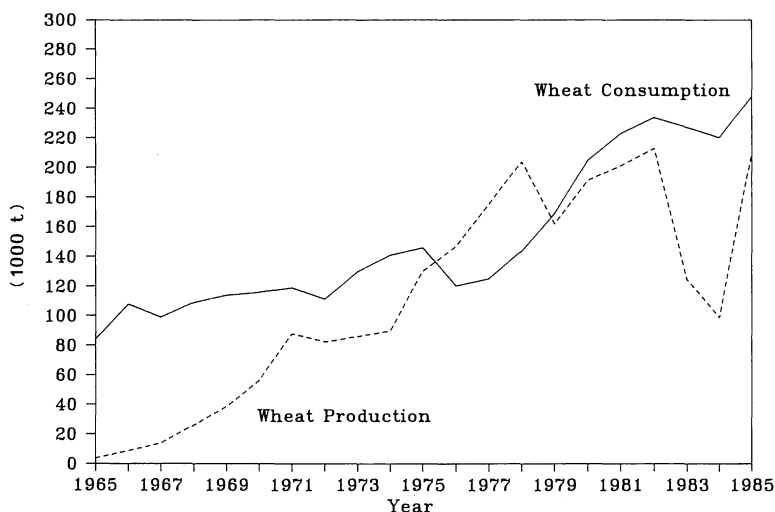

Fig. 1. Production and consumption of wheat in Zimbabwe (1965–1985).

Some analysts have argued that wheat production in Zimbabwe could be increased if official producer prices were raised to provide adequate incentives for farmers. Others have countered that wheat production is inherently unprofitable in Zimbabwe and that the country would be better off concentrating on traditional export crops such as tobacco and cotton to generate the foreign exchange with which to purchase wheat in world markets. The issue is complicated by the fact that most wheat in Zimbabwe is grown by large-scale commercial farmers, so that policies affecting wheat are likely to have different impacts on large-scale and small-scale producers.

The wheat policy debate in Zimbabwe revolves around two basic economic questions. First, is it an efficient use of resources for Zimbabwe to produce wheat, today and in the foreseeable future? Second, are government policies creating producer incentives that are consistent with the national interest, in the sense of maximizing efficiency?

This article reports the results of a study undertaken to provide answers to these two questions. The domestic resource cost framework was used to determine Zimbabwe's comparative advantage among six major crops. In addition, social profitability analysis was used to quantify the effects of government policies on producer incentives. The findings reveal the conditions under which Zimbabwe enjoys a comparative advantage in wheat production and provide a basis for judging whether current policies are encouraging commercial farmers to behave in ways that are consistent with national efficiency goals. To the extent that other countries in sub-Saharan Africa face the same problem of rising wheat consumption and imports, the analysis is of wider interest.

A framework for measuring comparative advantage

Comparative advantage is an expression of the efficiency of using local resources to produce a particular product when measured against the possibilities of trade. Comparative advantage can be expressed quantitatively in several ways. One of the most useful is by means of the *resource cost ratio* (RCR), which is a measure of the domestic resource cost to a country of producing a particular commodity.[1] The resource cost ratio is calculated by dividing production inputs and outputs into 'tradables' (goods and services which are capable of being imported or exported) and 'primary factors' (goods and services which are not generally traded – chiefly land, labor, capital, and water) and expressing the economic value of primary factors used in production as a proportion of the value added to tradables:

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[1] Many excellent sources are available describing the justification for and use of domestic resource cost analysis, so no attempt is made here to describe the methodology in detail. For a general introduction, see Pearson and Monke (1987).

$$\text{RCR}_c = \frac{\sum\limits_{i=1}^{m} W_i F_i}{\sum\limits_{j=1}^{n} P_j T_j - \sum\limits_{k=1}^{s} P_k T_k}$$

where

RCR_c		resource cost ratio for crop c
W_i	$(i=1, ..., m)$	opportunity cost prices of primary factors
F_i	$(i=1, ..., m)$	primary factors of production
P_j	$(j=1, ..., n)$	world price equivalents of tradable outputs
T_j	$(j=1, ..., n)$	tradable production outputs
P_k	$(k=1, ..., s)$	world price equivalents of tradable inputs
T_k	$(k=1, ..., s)$	tradable production inputs

A RCR below 1 indicates that the value of the domestic resources used in production is less than the value of the foreign exchange earned or saved. Thus, a country has a comparative advantage in products associated with a RCR of less than 1, since the country earns or saves foreign exchange in their production. Conversely, a RCR above 1 indicates that the value of domestic resources used in production is greater than the value of the foreign exchange earned or saved, and the country does not have a comparative advantage in production.

Before RCR's are calculated, it may be necessary to adjust market prices to eliminate the effects of government policies and/or market failures. This adjustment is accomplished through the use of shadow prices, here referred to as 'social prices'. In the present study, social prices were determined differently for primary factors and tradables. Primary factors were valued at their opportunity cost, expressed in world price equivalents. Tradables were valued in one of two ways. For tradables with a recognized world reference price (e.g., Hard Red Winter Wheat, #2, FOB Gulf Ports), social prices were calculated by starting with the world reference price and adjusting for transportation, handling, and processing costs to arrive at import or export parity prices. For tradables without a recognized world reference price (e.g., Malathion pesticide), social prices were calculated by starting with the local market price and adjusting for sales taxes, import tariffs, or subsidies. The geographical reference point for production was the Mazowe valley, in the heart of Zimbabwe's wheat-producing region, while the reference point for consumption was Harare. For all currency conversions, an exchange rate adjustment factor of 1.3 was used to correct for the estimated 30% overvaluation of the Zimbabwe dollar in relation to the US dollar.[2]

Social prices can differ substantially from market prices, for example when

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[2] For more information on pricing primary factors and tradables, see Gittinger (1982) and Pearson and Monke (1987). Complete details of the social pricing procedures used in this study appear in Morris (1988).

farmers pay less than the full import cost of fertilizer because of a government subsidy, or when they receive less than the full value of their output because the controlled producer price is set below the world price equivalent. When significant discrepancies exist between market and social prices, the interest of farmers and of the nation can diverge. A crop can be profitable to farmers even though its production does not represent an efficient use of national resources, and vice versa. Comparison of private profitability with social profitability thus provides important insights into the impacts of government policies and/or market failures on producer incentives.

The wheat industry in Zimbabwe

Wheat in Zimbabwe is grown under full irrigation during the cool, dry winter months (May to October). Most of the crop is produced by large-scale commercial farmers using high levels of inputs and modern production technologies (mechanized land preparation, sprinkler irrigation, combine harvesting). Yields are among the highest in the world, currently averaging around 6 t/ha.

Zimbabwe's impressive wheat industry owes much of its success to the other crops grown in rotation with wheat. Although wheat by itself is not profitable enough to justify investment in irrigation, the high-value summer crops (e.g., tobacco and cotton) pay for irrigation infrastructure which can then be used to irrigate wheat during the winter season when no other crops are grown.

Wheat producers in Zimbabwe face a complex set of cropping choices. Since wheat is the only crop grown during the winter, it does not compete directly with any other crop for land (although planting and/or harvesting dates of some summer crops must be altered to accommodate wheat in the rotation). However, wheat does compete directly with the summer crops for water. This competition is particularly acute during drought years, when farmers must choose between applying supplemental irrigation to summer crops or saving what little water is available to plant a wheat crop the following winter. Thus, even though wheat is not grown during the same season as other crops (and sometimes not even on the same land, since wheat is rarely planted on granite sands known as 'tobacco soils'), farmers often must choose between allocating water resources to wheat or allocating them to the summer crops. This tradeoff underlies the importance of determining Zimbabwe's pattern of comparative advantage and establishing appropriate agricultural policies that encourage efficient use of scarce water resources.

Enterprise budgets and calculation of RCR's

Enterprise budgets were constructed for six irrigated crops (wheat, maize, soybeans, groundnuts, cotton, tobacco) to permit estimation of private and

social profitability, and to make possible calculation of resource cost ratios.[3] The budgets are representative of commercial farms in the Highveld and Middleveld regions, where most of Zimbabwe's wheat is grown. Technical coefficients for the budgets were obtained from several sources. For all crops except tobacco, the primary sources of technical information were the budgets published each year by the government extension service (AGRITEX) and by the Commercial Farmers Union (CFU). These budgets are based on current farm survey data. Tobacco data were obtained from the production files published by the Zimbabwe Tobacco Association (ZTA). All data were verified through interviews with farmers, extension agents, and researchers.

Private vs. social profitability of irrigated crops

Private profitability per hectare of the six irrigated crops was calculated using 1986 market prices for inputs and outputs. Results of the private profitability analysis are shown in the first column of Table 1. Tobacco is by far the most profitable irrigated crop from the farmer's point of view, with estimated net returns to land, management, and farmer's labor of Z$2783/ha. Cotton is the next most profitable irrigated crop, with estimated net returns of Z$751/ha. Wheat (Z$178/ha), maize (Z$177/ha), and groundnuts (Z$170/ha) rank third in estimated private profitability, followed by soybeans (Z$144).

Next, the enterprise budgets were recalculated using social prices to assess the relative profitability of the six crops from the point of view of efficiency. Results of the social profitability analysis are shown in the second column of Table 1. In comparison with the results obtained using market prices, two features of the recalculated net returns are noteworthy. First, for all six irrigated crops the use of social prices drastically increases the returns to land, management, and farmer's labor. However, the relative profitabilities remain largely unchanged, with only groundnuts suffering a decline. Tobacco (Z$8703/ha) is still the most profitable crop, followed by cotton (Z$1550/ha), wheat (Z$682/ha) and maize (Z$679/ha), then groundnuts (Z$385/ha), and finally soybeans (Z$255/ha).

The differences between private profitability and social profitability for each crop are shown in the third column of Table 1. These differences represent the net effect per hectare of government policies during 1986 (assuming no price distortions due to market failures). A positive difference implies that government policies on the whole favored production of a particular crop (by making production more profitable to the farmer than it would have been in the absence of policy), whereas a negative difference implies that government policies on the whole discriminated against the production of a particular crop (by making production less profitable to the farmer than it would have been with-

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[3] The complete set of enterprise budgets appears in Morris (1988).

TABLE 1

Sources of differences between private and social profitability of six irrigated crops grown on commercial farms in Zimbabwe (1986)

Crop	Private profitability (Z$/ha)	Social profitability (Z$/ha)	Net policy effect (Z$/ha)	Difference due to					
				Producer price policy (Z$/ha)	Farm machinery prices (Z$/ha)	Purchased inputs prices (Z$/ha)	Labor policy (Z$/ha)	Credit policy (Z$/ha)	Other policies and market distortions[a] (Z$/ha)
Wheat	178.34	682.31	−503.97	−329.45	−41.79	−91.86	−39.19	24.48	−26.16
Maize	176.89	678.50	−501.61	−336.00	−22.14	−54.55	−89.16	20.10	−19.60
Soybeans	143.69	255.42	−111.73	0	−28.14	−52.55	−26.72	15.22	−19.54
Groundnuts	169.74	385.36	−215.62	0	−25.93	−55.96	−137.87	24.90	−20.76
Cotton	751.11	1549.94	−798.83	−485.88	−29.86	−67.01	−218.84	29.33	−26.57
Tobacco	2783.37	8702.70	−5919.33	−4928.19	−39.41	−76.94	−618.50	86.51	−342.80

[a]Includes effects of energy, transport, and insurance policies.
Z$1.00 = US$0.59 (1986).

out policy). The results appearing in Table 1 indicate that the net policy effect was negative for each of the six crops.

Table 1 also disaggregates the net policy effect for each crop to reveal the effects of specific government policies:

(1) Producer price policy generally reduced the profitability of commercial agriculture. Farmers received less than the world price equivalent for four out of the six crops (based on 1986 world prices, which were well below long-term trends). The only exceptions were groundnuts and soybeans, whose official producer prices (adjusted for transportation and handling charges) represented undistorted market-clearing prices.

(2) Import tariffs and sales taxes on farm machinery also generally reduced the profitability of agriculture, by making farmers pay more to purchase and maintain their machinery than they would have in the absence of these policies. However, the taxing effects of import tariffs and sales taxes on farm machinery were partially offset by the overvalued exchange rate, which reduced the prices of farm machinery in local currency.

(3) Policies affecting the prices of purchased inputs (seed, fertilizer, crop chemicals) also generally reduced the profitability of agriculture by raising market prices above world price equivalents. The greatest effect was on nitrogen fertilizer, since continued reliance on high-cost domestic manufacturing capacity resulted in significantly higher prices relative to world nitrogen prices.

(4) Labor policy, specifically minimum wage legislation, reduced the profitability of commercial agriculture by increasing the cost of farm labor above its opportunity cost. This effect was most pronounced for crops requiring high levels of labor inputs (e.g., tobacco, cotton, groundnuts).

(5) Agricultural credit policy, specifically, the provision of subsidized government credit at rates several points lower than the rates offered by commercial banks, increased the profitability of agricultural production by reducing the cost of short-term credit.

Resource cost ratios

To calculate resource cost ratios, the value of the primary factors used in production was divided by the net value added to tradables. Inputs and outputs were divided into primary factors and tradables. Primary factors (land, labor, capital, water) were assigned opportunity cost prices. Tradables (all other inputs and outputs) were assigned social prices.

Water was assigned several values, depending on whether or not it was assumed to be a limiting factor in wheat production. Under the normal rainfall scenario, water supply was assumed to exceed total summer and winter irrigation requirements, and the water cost used was the procurement cost (cost of irrigation equipment, pumping charges). Under the drought scenario, water supply was assumed to be less than total irrigation requirements, and water

was assigned a value consisting of the procurement cost plus an opportunity cost (i.e., the return to water in its best alternative use).

Table 2 shows the resource cost ratios for the six irrigated crops under two rainfall regimes. Under the normal rainfall scenario, three irrigated crops (wheat, tobacco, cotton) have resource cost ratios below 1, indicating that Zimbabwe enjoys a comparative advantage in their production. The resource cost ratio of 0.28 associated with wheat signifies that Z$0.28 worth of domestic resources used in wheat production generates Z$1.00 of net foreign exchange earnings (or, alternatively, that Z$1.00 worth of domestic resources used in wheat production generates Z$3.75 worth of foreign exchange). The efficiency of wheat production in Zimbabwe is explained by the high wheat yields achieved by commercial farmers (6 t/ha), as well as by fact that land used for irrigated wheat production has no economically viable alternative use in winter and therefore carries an opportunity cost of zero. The extremely low absolute value of the resource cost ratio suggests that Zimbabwe's comparative advantage in wheat production would probably not be threatened even if land planted to wheat had some alternative use during the winter growing season.

During periods of drought, water becomes a limiting factor of production in the sense that insufficient water is available to irrigate both summer and winter crops. A decision must therefore be taken concerning which crop(s) should be irrigated when water is scarce. The extremely high private and social returns to tobacco production suggest that irrigating tobacco before the other crops will be profitable for the farmer and efficient from the point of view of the nation. But it is not clear what should be done with the water which remains after all available tobacco soils have been irrigated. Two questions arise: Assuming there is enough water available to irrigate the entire tobacco crop, what crop(s) should next be irrigated? In the event of a drought, is profit-maximizing behavior on the part of farmers consistent with efficient allocation of resources from a national viewpoint?

Table 2 also shows the resource cost ratios for the six irrigated crops during times of drought. Under the drought scenario, irrigating one crop means not being able to irrigate other crops, so an opportunity cost is assigned to water equal to the return in its best alternative use. Initially the most efficient course of action is to irrigate tobacco, which shows an extremely low resource cost ratio of 0.16. But since not all land is suitable for tobacco production, eventu-

TABLE 2

Resource cost ratios for six irrigated crops in Zimbabwe under two rainfall scenarios

	Wheat	Maize	Soybeans	Groundnuts	Cotton	Tobacco
Normal rainfall scenario	0.28	2.12	4.93	4.06	0.62	0.59
Drought scenario	1.56	0.72	1.51	2.42	0.76	0.16

ally land becomes a limiting factor as well. If water is left over after all available tobacco soils have been planted to tobacco, the opportunity cost of the remaining water is no longer its value in tobacco production, since the land constraint precludes planting more tobacco. Then the opportunity cost of water reverts to its value in the most profitable remaining possible use, maize production (except in the case of maize production itself, where the most profitable alternative use is cotton production).

As can be seen in Table 2, when these lower opportunity costs for water are used, the resource cost ratios associated with maize (0.72) and cotton (0.76) both drop below 1. These results indicate that in times of drought, once the tobacco crop has been irrigated, Zimbabwe has a comparative advantage in maize and cotton production. The resource cost ratio associated with wheat remains above one (1.56), indicating that wheat production does not represent an efficient use of domestic resources when water supplies are limited. One reason for this is that wheat, the only fully irrigated crop, uses relatively large amounts of irrigation water, whereas the summer crops receive only limited irrigation to supplement normal rainfall.

Effects of current agricultural policies

The budgets calculated for irrigated wheat, maize, soybeans, groundnuts, cotton, and tobacco confirm what many farmers already know: although all six crops generate positive net returns, given current market prices it is most profitable for farmers to concentrate first on tobacco and second on cotton. The resource cost ratios calculated using social prices reveal that what is good for farmers frequently is also good for the nation: Zimbabwe enjoys a comparative advantage in these two crops, as well as in wheat, at least during years when water is plentiful. However, the resource cost ratios indicate that if water availability is limited by drought, once tobacco irrigation needs have been satisfied the most efficient use of the remaining water is in irrigating maize and cotton.

The profitability analysis reveals that existing agricultural policies in Zimbabwe provide disincentives for commercial farmers, since private profitability is less than social profitability for all six crops. In other words, government policies are taxing away a large portion of the social profits (assuming no effects due to market failures). However, this tax occurs across all commodities with similar incidence, so that the relative private incentives among crops are not greatly distorted from their social pattern. Thus, although they reduce the overall private profitability of farming, current policies at least encourage commercial farmers to plant those crops in which Zimbabwe presently has a comparative advantage.

Effects of possible future developments

Technological change

Zimbabwe presently enjoys a comparative advantage in wheat production during periods when irrigation water is plentiful, but this comparative advantage is lost during times of drought. By implication, introduction of more water-efficient wheat production technologies might allow the comparative advantage in wheat production to be maintained even in periods of water scarcity. Break-even analysis suggests that Zimbabwe's comparative advantage in wheat production would be maintained even during periods of drought if the crop's (gross) irrigation requirement could be reduced from the present 720 mm to around 410 mm.

Zimbabwe's future self-sufficiency level in wheat thus could depend critically on near-term investments in research designed to increase the efficiency of water use. Efforts are currently underway in both the public and private research sectors to develop improved irrigation application methods allowing for substantial reductions in the crop's overall water requirements. Preliminary results indicate that yields of wheat can be maintained in spite of significant reductions in water application levels, suggesting that technological change has the potential to strengthen Zimbabwe's comparative advantage in wheat production in the short- or medium-run.

Changes in input and output prices

Comparative advantage is determined not only by technology, but also by the prices of inputs and outputs. One useful feature of the domestic resource cost framework is that it can be used to calculate how future price changes are likely to affect comparative advantage. Despite the difficulty of forecasting future developments in world commodity markets, recalculation of the enterprise budgets using 'best-guess' estimates of future input and output prices allows policy makers to determine whether the results of the comparative advantage analysis are sensitive to price changes.

The social profitability of the six irrigated crops was recalculated using projected future prices for outputs and fertilizers. Table 3 shows net returns to land and management at current (1986) prices compared to net returns at projected (2000) prices. The year 2000 prices were estimated by adjusting current prices upward or downward by the percentage changes forecast by World Bank commodity price analysts (these percentage changes vary by input category and by crop). When the projected year 2000 prices are substituted for current prices in the budgets, the estimated social profitability of the six crops shows little change. Tobacco (Z$9169/ha) remains the most profitable crop

TABLE 3

Profitability of six irrigated crops at 1986 prices compared to profitability at projected year 2000 prices

Irrigated crop	Social net returns to land and management at 1986 prices[a] (Z$/ha)	Social net returns to land and management at 2000 prices[a] (Z$/ha)
Wheat	682	1006
Maize	679	778
Soybeans	255	241
Groundnuts	385	373
Cotton	1550	4663
Tobacco	8703	9169

[a]Assumes water is not a limiting factor of production.
Z$1.00 = US$0.59 (1986).

by far, followed by cotton (Z$663/ha), wheat (Z$1006/ha), maize (Z$778/ha), groundnuts (Z$373/ha) and soybeans (Z$241/ha).

These figures suggest that future developments in global commodities markets probably will not eliminate Zimbabwe's curent comparative advantage in tobacco and cotton production. While this conclusion must be tempered by the knowledge that past forecasts of world commodity prices have often been inaccurate, the fact that tobacco is nearly ten times as profitable as the highest-ranking grain, and cotton nearly five times as profitable, suggests that relative prices would have to change a great deal in order for these two traditional export crops to be displaced. Sensitivity analysis confirms this conclusion; even if the projected year 2000 prices of wheat is increased 100%, tobacco and cotton continue to rank first and second in social profitability.

Restrictions on agricultural trade

Political developments in South Africa, to the extent that they have economic consequences, also could affect Zimbabwe's current structure of comparative advantage, with important implications for food policy. In particular, further restrictions on trade with and transit through South Africa would have considerable effects on the agricultural sector by affecting the availability and prices of production inputs, the prices received for agricultural exports, and the prices paid for food imports.

It is difficult to model the effects of such a scenario with any degree of quantitative precision, since it is impossible to predict what form trade restrictions might take. Nevertheless, the effects of a restricted-trade scenario can be an-

TABLE 4

Estimated social profitability of six irrigated crops under a 'restricted trade' scenario

Irrigated crop	Social net returns to land and management (free trade) (Z$/ha)	Social net returns to land and management (restricted trade)[a] (Z$/ha)
Wheat	682	1375
Maize	679	35
Soybeans	113	−260
Groundnuts	684	395
Cotton	1550	964
Tobacco	8703	8200

[a]Railage and handling charges to port increased threefold.
Z$1.00 = US$0.59 (1986).

ticipated in qualitative terms. In general, production costs for all crops would increase because imported inputs would become more expensive. At the same time, the social value of export commodities would decline due to the increased cost of getting them to market, while the social value of import-competing commodities would rise due to the increased cost of procuring supplies from outside the country.

These qualitative conclusions concerning the likely effects of trade restrictions are borne out by sensitivity analysis of the irrigated crop budgets. Table 4 shows the estimated social profitabilities of the six irrigated crops under a 'restricted trade' scenario. One likely impact of trade restrictions has been modelled by increasing port-to-border rail freight rates for all crops, as well as for imported fertilizers, by a factor of three. As expected, the social profitability of (import-competing) wheat increases relative to that of the export crops.

Under trade restrictions, the social value of wheat would rise as a function of rising import costs. Thus, it would probably make economic sense for Zimbabwe to strive for higher levels of self-sufficiency in wheat, presumably through some combination of production-enhancement and consumption-management policies. One obvious way to depress consumption would be to pass along to consumers the increase in the price of imported wheat caused by an increase in the transportation costs.

Summary

Agricultural policy makers throughout sub-Saharan Africa today face the difficult question of what to do about the widening gap between supply and

demand of wheat. Rapid growth in wheat consumption in many countries has led to an alarming increase in wheat imports, creating a drain on scarce foreign exchange and heightening concerns about national food security. The question of how best to meet the growing demand for wheat thus assumes critical importance in the food policy debate.

The case of Zimbabwe is particularly instructive. Even though Zimbabwe's wheat industry is well-developed by world standards, domestic production has not been able to keep pace with accelerating demand. In an attempt to evaluate the argument in favor of expanding domestic production, research was undertaken to establish whether or not Zimbabwe enjoys a comparative advantage in wheat production. Using 1986 data, comparative advantage was measured by calculating resource cost ratios for six major commercial crops under a normal rainfall scenario and under a drought scenario in order to determine which crops represent the most efficient use of domestic resources.

The results presented above suggest that wheat production represents an efficient use of Zimbabwe's resources in periods when water is plentiful. This implies that the government should be careful to set wheat producer prices at least high enough to encourage farmers to use their irrigation systems during the winter season. However, during drought years both farmers and the nation as a whole are better off if water is used to irrigate tobacco, cotton, and maize during summer. This implies that the government might consider modifying its current policy of encouraging commercial farmers to grow wheat during the winter months even in dry years, if this means they will not have enough water to irrigate tobacco the following season.

Sensitivity analysis was used to test the robustness of these results under several possible future scenarios. Use of projected year 2000 prices for outputs and major inputs did not significantly alter the comparative advantage rankings. However, use of high rail freight costs for imports and exports to simulate the likely effects of trade restrictions increased the profitability of wheat production relative to that of other crops. This suggests that a shift in cropping patterns would be appropriate if access to international markets via South Africa were to become restricted.

Care should be exercised in extending these findings from Zimbabwe to other countries in sub-Saharan Africa. The high social profitability of Zimbabwe's wheat industry is due in large part to the fact that wheat's unique position in the commercial cropping system enables it to be grown under full irrigation using high levels of machinery and purchased inputs. This is not the case in neighboring countries such as Tanzania, Zambia, and Kenya, where wheat is grown primarily under rainfed conditions using more modest levels of management and inputs.

But if the results described in this paper are relevant only for Zimbabwe, the framework of analysis should be of interest to analysts and policy makers in other countries throughout sub-Saharan Africa where difficult questions are

being raised about how best to meet the rising demand for wheat. The domestic resource cost approach provides an operational method for measuring comparative advantage across crops and makes possible quantification of the efficiency costs of producing wheat vs. importing. Although the comparative advantage framework does not address many important non-economic issues, it can nevertheless contribute valuable insights to the food policy debate.

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