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THE POTENTIAL EFFECTS OF ALTERNATIVE STRUCTURES AND PRICING POLICIES IN THE MARKETS FOR MAIZE IN TANZANIA

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The Potential Effects of Alternative Structures and Pricing Policies in the Markets for Maize in Tanzania

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Executive Summary

This report is a continuation of a policy research effort which has been undertaken by the staff of Sigma One Corporation under the auspices of the Marketing Development Bureau of the Ministry of Agriculture and with the financial support of the United States Agency for International Development. The present study processes and analyzes secondary data, selected farm management data, and a subsample of the 1976/77 Household Budget Survey collected during four man-months of field research as a means of providing policymakers and other concerned individuals with new information on the current state of Tanzania's markets for maize. This information allows an evaluation of the likely effects of a number of pricing, institutional, and technical innovations currently being considered by the Tanzanian government within the context of the Structural Adjustment Program.

During the past four years, between 17 and 25 percent of total national maize production has been marketed annually. The share of the marketed surpluses captured by the NMC has declined sharply during this time, while the amount sold in urban parallel markets has remained fairly steady. At the same time, an increasing percentage of marketable maize has apparently been lost to the country through spoilage and/or illegal international trade.

Average per capita consumption of maize and other preferred staples has grown significantly since 1969. An important reason

for this has been the increasing level of subsidization of these foods, especially ground maize (sembe). For urban areas well-served by the official market (principally Dar es Salaam and Tanga), the low price of NMC sembe has induced a certain amount of demand in excess of normative consumption requirements implied by 1976/77 consumption patterns. This overstatement of urban maize needs induced by the sembe subsidy has led to an overstatement of Tanzania's need to import maize.

In normal years national surpluses of drought staples have exceeded national deficits in maize and rice. This implies that Tanzania has the capability to be food self-sufficient if consumers are willing to substitute the less preferred for the more preferred grains. However, in all but the major sorghum producing regions, average per capita consumption of the drought staples has been declining. This is largely due to the fact that official consumer prices have been artificially set such that the relative prices of preferred and drought staples do not reflect the true value of these foods to consumers.

The present dual market structure combined with the subsidization of NMC sembe has driven parallel market prices and import requirements higher than would have been the case had a unified national market existed in which private trade was legal. The primary effect of official intervention into the marketplace has been to bias maize consumption in favor of that portion of the population with access to NMC maize and sembe at the expense of maize producers and urban consumers with limited access to the official market. In 1979/80 the existence of a dual market

structure led to a net welfare transfer of approximately Tsh. 87 million from producers and consumers dependent on the parallel market to NMC customers, as well as a national outlay of foreign exchange of about seven million U.S. dollars greater than would have been spent had an unsubsidized, unified market existed. At the same time, the existence of an unsubsidized unified market for maize in that year would have produced a real income decline of no more than 11 percent for the beneficiaries of the dual market structure, while average per capita consumption of maize would have been no less than 93 percent of estimated requirements.

Contemplation of policy measures which would reduce or eliminate consumer subsidies and/or remove restrictions on private trade in maize and other grains must consider the likely effects of such policy changes on low income urban dwellers who are fortunate enough to currently have access to NMC sales. Unless such policy changes are accompanied by specific measures to shelter these low income households, their nutritional status would undoubtedly fall below acceptable levels. Such protective measures could well be provided by the international donor community in the form of guaranteed concessionary food aid and technical assistance to Tanzania during the undeniably difficult transition toward a more efficient allocation of domestic resources within the agricultural sector. At the same time, the institution of a carefully considered distribution policy for imported grains could provide stability and security in Tanzanian

grain markets were restrictions on private grain trade eased.

National self-sufficiency in preferred staples could not be achieved within the present dual market structure, especially with subsidized consumer prices for sembe. Even with market unification and removal of the subsidies, self-sufficiency could only be achieved in the short-run through large reductions in per capita consumption and severe income redistribution. Over the long-run, however, self-sufficiency at adequate nutritional levels and without major redistribution of income could be achieved if efficient resource allocation and aggressive institutional actions could lead to a highly price responsive food production subsector.

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Section 1

Introduction

Tanzanians depend heavily on cereals--and especially maize--to meet their basic food needs. In the past several years, a large segment of the population has had increasing difficulty in meeting desired levels of maize consumption. A principal cause of this is that an increasing share of marketable surpluses of maize have entered parallel (unofficial) markets rather than official markets. While the volume of maize made available to the official market has fallen, demand for maize and sembe in the official market has increased. To bridge this widening gap between purchases and sales, the government has been forced to rely heavily on imported maize.

The expansion of parallel markets for maize in Tanzania has, to a large degree, developed as a consequence of the regulation by government institutions of price, transportation and entrepreneurship in the offical market. This intervention has resulted in large resource transfers from maize producers and urban consumers dependent on parallel markets to urban consumers with access to official supplies. In addition to these induced resource transfers, consumer subsidies and other aspects of official intervention have increased the effective demand for ground maize (sembe) so that total market requirements have been significantly overstated. These two effects of official intervention have interacted with weather variability to exacerbate the risks of inadequate food availability for a large

segment of the Tanzanian population.

This report presents new information on the volume of marketed surpluses of maize and the distribution of these surpluses between official and parallel markets. The report contains analyses of regional balances between production and consumption of maize, estimates of the distribution of marketed surpluses, analyses of potential supply responses to price and other incentives, and a simulation of the potential impact of alternative structures and pricing mechanisms in the markets for maize.

Specifically, the analyses develop estimates of quantities of maize marketed through official and unofficial channels in each region as well as quantities consumed by rural and urban households in each region of the country in three of the last four marketing years. These data are used as the basis for estimating production, marketing and consumption changes which might arise in response to a number of alternative policies. The alternative policies are evaluated through a simple simulation model of the relationship between the official and the unofficial markets. Alternative policies are analyzed with regard to:

- effects on producer prices in official and unofficial markets,
- consumption/nutritional levels and food security,
- selected aspects of national budgetary impacts, and
- selected aspects of foreign exchange use for import requirements and transport costs.

1.1 Background for the Study

This report is a continuation of a policy research effort which has been undertaken by the staff of Sigma One Corporation, in collaboration with other scholars of the economics of food and agriculture in Tanzania, under the auspices of the Marketing Development Bureau of the Ministry of Agriculture (Kilimo) and with the financial support of the United States Agency for International Development. The earlier report on "The Consumption Effects of Agricultural Policies in Tanzania" (CEAP) emphasized that the dominant influence on the consumption of food by different groups in the population has been the country's strategy towards industrialization which led to high explicit and implicit taxation of agriculture and artificially low food prices for certain urban consumers. As was presented in that report, Tanzanian policies on trade, money, and the importation, manufacture and distribution of capital goods to rural areas have all changed the structure of incentives faced by farmers. The major effect has been a decrease in incentives to produce either cash crops or food crops for the official market. This is due to a worsening of the offically-measured terms of trade between the agricultural and non-agricultural sectors, as well as to the extreme scarcity of consumer goods in rural areas through both official channels and high-priced unofficial ones.

Within this generally depressed environment for agricultural production, the nature of incentives faced by farmers has encouraged food production relative to the production of export crops. An increasing share of the value of export crops has been

taken by the government, either through taxes and increased parastatal costs or though the indirect tax caused by Tanzania's overvalued exchange rate. In addition, most farmers can more easily gain access to higher-priced parallel markets for food crops than for export crops. Further, cash crop producers have little access to officially marketed supplies of grain for their consumption needs, and thus have increased incentives to produce their own food. This return to subsistence production has not been the result of deliberate "food first" policies; incentives to farmers were most strongly affected by a capital-biased development strategy which emphasized basic manufacturing industries. A consequence of the return to subsistence food production by farmers who have traditionally produced export crops is that the domestic resource costs of producing food are high relative to the alternative use of those resources.

The regulation of price, transportation and entrepreneurship in agricultural markets has also had important effects. The majority of grain transactions are legally required to go through the National Milling Corporation (NMC). The parastatal has been limited by its inability to compete with parallel market prices, by the multitude of difficult and sometimes conflicting roles which it is required to perform, and by its own poor organization and shortage of trained manpower. The NMC's primary function has been to provide processed grain to Dar es Salaam and other important urban areas at a price below the parallel market price. Thus, residents of other towns and virtually all rural Tanzanians

must buy food on other markets at higher prices, or allocate a substantial portion of their time and resources to acquiring basic food needs.

The interaction of the NMC and unofficial markets increases the instability of supplies to urban consumers caused by output fluctuations due to variations in rainfall. When supplies are scarce, parallel market prices rise and illegal sales and exports receive a higher percentage of farmers' surpluses; the NMC price does not adjust, official purchases fall, and Tanzania becomes even more dependent on imports to feed the dependent urban population.

One important aspect of recent official procurement policy in the markets for grains is pan-territorial pricing whereby all producers regardless of location would receive the same price for their crop. Pan-territorial pricing has been aimed at equalizing incomes for farmers and at encouraging production in remote areas through price incentives. The earlier CEAP report argued that the result of pan-territorial policy tended to be the opposite of the intended regarding income distribution, with some farmers implicitly subsidizing the costly production of others. That is, producers in remote regions, particularly Rukwa and Ruvuma, have benefitted from an explicit transport subsidy. These remote regions have expanded their production for official markets, but at high domestic resource costs due to transport costs. At the present time, a large proportion of official purchases of maize come from these two regions. There is concern, however, that removal of the distortions induced by pan-territorial pricing

could in the short-term exacerbate Tanzania's food security problem.

On the consumption side the real price of sembe sold through the NMC has declined by a third in the last decade as result of growing levels of subsidization. The transport subsidy and the sembe subsidy place a large burden on the nation's fiscal resources. The dependence of important segments of the population on subsidized, officially supplied sembe and the dependence of official procurement on the remote regions and on imports has created a policy dilemma. Attempts to reduce budgetary burdens and increase domestic supplies of maize through official channels would require significant changes to the structure of incentives facing maize farmers, primarily higher official prices. This would require higher levels of subsidy or higher consumer prices for sembe. Higher prices would, in turn, put upward pressure on urban wages.

The government of Tanzania has attempted to respond to this dilemma and other economic problems through the formulation of a "Structural Adjustment Programme". This effort to promote economic recovery in Tanzania must inevitably focus heavily on the agricultural sector. It is hoped that the analyses presented in this report will prove useful to Tanzanian policy makers and planners regarding the food security dilemma.

1.2 Current Policy Issues Regarding Maize

The widening gap between official procurement and official sales of maize, the need for imports of grains, the growing

fiscal burden and the resultant foreign exchange costs of transporting maize from remote regions have led to official consideration of alternative pricing and market structures for the markets for basic foods. As the official government agency responsible for developing agricultural price recommendations, the Marketing Development Bureau of the Ministry of Agriculture has prepared a set of proposals for staple food prices under the Structural Adjustment Programme. These proposals highlight the principal concerns of policy makers and analysts regarding the food security dilemma, particularly as it affects the markets for maize.

The consumer subsidy on sembe sold through NMC represents over 40 percent of the average full cost of that sembe to NMC and is projected at nearly Sh.500 million (more than $50 million U.S.) for the 1982/83 marketing year. In addition to being a substantial drain on fiscal resources, the subsidy may be contributing substantially to the overstatement of maize requirements and import needs through its income and price effects on the demand side. The Marketing Development Bureau has recommended in its proposals for the Structural Adjustment Programme that the subsidy on sembe be phased out. Their proposal adds the issue of equity as an important reason for eliminating the subsidy, since only urban dwellers with access to NMC supplies (primarily residents of Dar es Salaam) benefit from the subsidy. For this latter reason they further propose that cassava flour and maize grain be subsidized at the same rate as sembe during the period in which the sembe subsidy is phased out.

They further propose that during the period in which the subsidy is phased out, retail prices should be regionally differentiated to reflect transport costs; at the same fiscal cost, this proposal would raise the nominal price of sembe in Dar es Salaam by 44 percent.

Regional producer prices for maize and other staples were implemented for the 1981/82 and 1982/83 marketing years to pay a premium to those regions with "comparative advantage" in production. This premium amounted to 16 percent over the non-premium regions. The premium, however, further increased the implicit subsidy to remote regions such as Rukwa and Ruvuma. The proposals that MDB has made under the Structural Adjustment Programme would use a system of regionally differentiated producer prices that reflects the "economic" value of maize in each region. Under this system, the producer price of maize for Rukwa and Ruvuma would be 77 percent and 55 percent of the national average producer price. The proposed system is expected to reduce the average cost of official supplies of maize delivered to the consumer, and reduce the foreign exchange costs involved in transporting maize from surplus to deficit areas.

A key concern with regionally differentiated pricing centers on food security. If the producers in surplus regions in remote areas receive lower real prices and respond to lower prices by marketing less through official channels and the deficit (or at least the low transport cost) regions that would enjoy higher real prices fail to respond to the new price incentives, then

total marketed supplies entering official markets would fall below projections and the country woud need to import more maize to meet official (urban) demand. The food security concerns that evolve from regionally differentiated pricing and the income effects of higher sembe prices both lead to the question of what urban consumers that depend on NMC for maize would eat if maize becomes scarce and expensive.

These issues form the backdrop for this study. The analytical effort in this report has been specifically directed towards an assessment of the potential effects of these recommendations, specifically the elimination of consumer subsidies and regionally differentiated pricing. These are considered in the context of the present two market (official and parallel) structures and under a unified market structure where the NMC would act as a stabilizer but private trade in maize would be legalized and encouraged. For each of these options, the analysis addresses consumption, income and food security effects.

Section 2

The Structure of Maize Markets in Tanzania: Quantitative Information

Planning for food security in developing countries with dual market structures such as Tanzania's official and parallel markets for maize has been termed an exercise in "planning without facts" by Lele and Candler (1981). These scholars of the economics of agriculture in sub-Saharan Africa have cogently argued that to meaningfully address food policy and security issues in such countries requires "facts" on the various elements of the dual market structure. This section of this report contributes the first such "facts" to become available on the components of the market structure for maize in Tanzania.

This section presents regional estimates of the components of consumption of maize and other cereals--on-farm, urban official and urban unofficial; regional production estimates; and regional estimates of quantities being marketed unofficially in intra- and inter-regional trade. These estimates have been developed from a number of sources and depend crucially on the analysis of a sub-sample of the 1976/77 Household Budget Survey. The estimates are offered as "facts" regarding the structure of maize markets in Tanzania because great effort was spent during the field work to identify and process the most reliable or credible primary and secondary sources. The data have been treated systematically with modern data management techniques and analyzed with rigor founded in econometric practice and economic theory. The resulting estimates have been carefully

reviewed for internal consistency and consistency with other known information. It is recognized, however, that the various estimates presented below are dependent on the extent to which these best estimates reflect reality. Accordingly, the analyses should be considered more for the insight they offer rather than for any particular number that may result from even a very careful treatment of the data.

The foregoing notwithstanding, the authors are sensitive to the critical human and political issues that could hinge on the estimates that have been developed in this study were the analyses to be used as the basis for food policy changes in Tanzania. We are confident in offering the results in the hope that the estimates presented here provide a quantitative and analytical basis for furthering the food policy and economic policy analyses currently underway in Tanzania.

This section presents the consumption data first, then the estimates of production for three of the last four marketing years. These data are then used to estimate the marketed surplus entering official and unofficial markets in each region. The consumption data were developed from a sample of households selected from the 1976/77 Household Budget Survey (HBS). These included both rural and urban households in each region, as well as twenty-four households from four separate income strata in Dar es Salaam for each of seven reporting periods. The survey was used to obtain information concerning household expenditure patterns, consumption of staple grains and grain products, and

sources of income. These data were used to calculate quantities of the major staple foods consumed in rural and urban areas of each region and demand elasticities (both income and price) for maize, rice, wheat, sorghum, and millet and cassava for Dar es Salaam and the rest of Tanzania.

Regional population growth rates (both urban and rural) were applied to the 1976/77 consumption data to estimate demand for the various staples in 1979/80, 1981/82, and 1982/83--the years for which reliable production data were available. Combining these with the production data and information on NMC purchases and sales for each year allowed a break-down of food disappearance into its component parts: on-farm consumption and official and unofficial marketings.

2.1 Regional Consumption of Maize and Other Cereals

Data from the sub-sample of the 1976/77 HBS yielded estimates of the quantities of six staple foods consumed in each region in that year. Quantities of these staples consumed in each region in any subsequent year can be estimated by assuming that dietary patterns have on average remained constant. Under this assumption, consumption requirements for a particular crop in a particular region would have grown at a rate equivalent to the region's population growth rate.

Regional estimates of the consumption of maize, rice, and sorghum and millet for the years 1979/80, 1981/82 and 1982/83 are

presented in Tables 1, 2 and 3.* These estimates embody different intra-regional consumption patterns for urban and rural households. All are expressed in thousands of metric tons of grain equivalents. In Section 2.3, the regional consumption requirements are disaggregated into their urban and rural components.

2.1.1 Contributions of Different Cereals to Calorie Requirements

Evaluation of the effects of changes in the markets for food staples requires an assessment of the contribution of these staples to energy requirements. Regional consumption patterns for the basic grains and cassava were developed from the sub-sample of the 1976/77 HBS. Calculation of caloric contribution was made assuming an average calorie intake of 2320 calories per person per day, the FAO-WHO standard for Tanzania. The average percentage of total daily calories derived from each of the basic grains and cassava were developed into separate consumption patterns for urban and rural areas in each region.

The consumption patterns for Dar es Salaam, other urban areas and rural areas are presented in Table 4. In all areas, cereals contribute nearly one-half of the total daily calorie needs, with maize and sembe comprising the greater part of cereal consumption. The high level of cereal consumption in Dar es Salaam suggests that, on average, people in Dar es Salaam

*These correspond to the years and crops for which reliable production data exist (see Section 2.2).

Table 1: Estimated Quantities of Maize Consumed in 1979/80, 1981/82 and 1982/83 ('000 MT grain equivalents)

Region	1979/80	1981/82	1982/83
Dodoma	25.7	27.0	27.7
Arusha	86.5	92.7	96.0
Kilimanjaro	42.7	44.8	45.9
Tanga	129.7	135.8	139.0
Morogoro	134.2	141.4	145.2
Coast	28.5	29.5	30.0
Lindi	34.7	35.7	36.3
Mtwara	28.9	29.7	30.1
Ruvuma	77.5	82.5	85.1
Iringa	209.6	218.9	223.8
Mbeya	131.8	137.6	140.6
Singida	88.0	91.1	92.7
Tabora	130.4	138.3	142.5
Rukwa	105.6	115.9	121.6
Kigoma	49.2	53.5	55.8
Shinyanga	102.2	109.5	113.4
West Lake	35.1	37.7	39.0
Mwanza	97.2	104.7	108.9
Mara	9.6	10.7	11.2
Dar es Salaam	105.6	126.6	138.6
Tanzania	1652.7	1763.6	1823.4

Source: 1976/77 Household Budget Survey Subsample and Sigma One Corporation calculations

Table 2: Estimated Quantities of Rice Consumed in 1979/80, 1981/82 and 1982/83 ('000 MT grain equivalents)

Region	1979/80	1981/82	1982/83
Dodoma	0.8	0.8	0.8
Arusha	11.0	12.0	12.5
Kilimanjaro	13.4	14.3	14.8
Tanga	26.5	28.2	29.2
Morogoro	55.3	60.1	62.1
Coast	18.7	19.3	19.7
Lindi	10.3	11.0	11.4
Mtwara	14.9	15.9	16.4
Ruvuma	22.4	23.6	24.3
Iringa	4.6	4.8	5.0
Mbeya	23.2	26.0	27.6
Singida	11.9	12.3	12.5
Tabora	47.4	50.3	51.8
Rukwa	3.7	4.0	4.1
Kigoma	2.7	2.9	3.0
Shinyanga	10.1	11.4	12.1
West Lake	12.6	13.6	14.1
Mwanza	96.5	99.8	101.6
Mara	3.1	3.3	3.4
Dar es Salaam	103.9	124.5	136.4
Tanzania	493.0	538.1	562.8

Source: 1976/77 Household Budget Survey Subsample and Sigma One Corporation calculations

Table 3: Estimated Quantities of Sorghum/Millet Consumed in 1979/80, 1981/82 and 1982/83 ('000 MT grain equivalents)

Region	1979/80	1981/82	1982/83
Dodoma	77.7	81.8	84.0
Arusha	0.1	0.1	0.1
Kilimanjaro	0.8	0.8	0.9
Tanga	0.1	0.1	0.1
Morogoro	0.4	0.4	0.4
Coast	0.5	0.5	0.5
Lindi	3.7	4.0	4.1
Mtwara	10.0	10.7	11.2
Ruvuma	3.3	3.5	3.6
Iringa	0.3	0.3	0.4
Mbeya	5.6	5.8	5.9
Singida	65.4	69.6	71.9
Tabora	20.1	21.4	22.0
Rukwa	17.0	18.1	18.7
Kigoma	0.8	0.9	0.9
Shinyanga	74.7	79.3	81.8
West Lake	8.7	9.3	9.7
Mwanza	0.6	0.6	0.6
Mara	1.5	1.5	1.6
Dar es Salaam	0.3	0.4	0.4
Tanzania	291.6	309.1	318.8

Source: 1976/77 Household Budget Survey and Sigma One Corporation calculations

Table 4: Contribution of Cereals and Cassava to the Daily Calorie Requirements[1] of Tanzanians (%)
(1976/77 HBS Data)

	Dar es Salaam	Other Urban	Rural
Total (Cereals and Cassava)[2]	75.5	46.9	48.0
Maize/Sembe	36.7	29.3	33.3
Rice	28.3	9.3	5.8
Wheat	9.8	1.3	0.5
Sorghum/Millet	0.1	5.7	6.7
Cassava	0.6	1.3	1.7

[1]FAO average requirement for Tanzania is 2,320 calories per person per day.

[2]Includes cassava and excludes other cereals not listed in the table.

Source: Sigma One Corporation

consume at or above the average daily caloric requirement of 2320 calories, whereas the lower level of cereal consumption in rural areas suggests that in some rural areas, people consume less than the average daily calorie requirement. In order to satisfy calorie needs, people in rural areas would need to derive over one-half of their daily calories from other food sources.

Dar es Salaam and other urban consumers derive a much larger percentage of daily calories from the other preferred staples--rice and wheat--than do rural consumers. Rural consumers consume significantly greater amounts of the drought staples--sorghum, millet and cassava--than do Dar es Salaam consumers and most other urban consumers. Urban and rural consumption patterns within each region have been tabulated in Appendix B. Appendix B also includes a discussion of the methods used to derive the consumption patterns.

2.1.2 Comparison of Consumption Patterns in 1969 and 1976/77

Total expenditures on cereals, budget shares and year-mean retail prices for each of the major staples were included in the 1969 Household Budget Survey. From these data, consumption patterns have been developed for each of seven geographic zones into which the 1969 HBS data were grouped. Comparison of these consumption patterns with those indicated by the 1976/77 Household Budget Survey sub-sample provides information regarding changes in the dietary habits of different groups of Tanzanians which may have resulted from the many economic and

social changes occurring during the intervening years.*

The calorie shares for maize and sembe, rice and sorghum indicated by the two surveys are presented in Table 5. The calorie share of maize and sembe in the diet increased in all but two of the zones. For Tanzania as a whole, the average importance of maize and sembe in diets grew by over 25 percent; specifically, the average share of total per capita calorie intake increased from 26.8 percent to 33.6 percent. Nationwide the increased share of maize and sembe to the diets corresponds to an increase in consumption of maize and sembe of 17 kilograms per person per year. The largest increase was registered in the Southern Highlands zone (Mbeya and Iringa), while the largest decrease was registered in the zone comprising the regions surrounding Lake Victoria.

The calorie share of rice in the diet increased in all of the regional zones and more than doubled nationwide. That increase constitutes an increase in rice consumption of 10 kilograms per person per year. The share of sorghum in the diet decreased in all but two of the regional zones and decreased for Tanzania as a whole by 22 percent. The two regional zones showing an increase in the contribution of sorghum to the diet are sorghum-producing areas, implying that producers have had to consume increasing amounts of their own production in their attempts to satisfy their calorie needs.

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*To allow this comparison, the regional consumption patterns derived from the 1976/77 sub-sample were collapsed into the same geographical zones as were presented in the 1969 HBS.

Table 5: Comparison of the Contribution of Cereals and Cassava in the Diets of Tanzanians in 1969 and 1976/77

Zone	Maize, Sembe (%)			Rice (%)			Sorghum (%)		
	1969	1976/77	Diff.	1969	1976/77	Diff.	1969	1976/77	Diff
Arusha Kilimanjaro Tanga	34.5	31.3	-3.2	2.4	4.5	+2.1	1.5	0.0	-1.5
Coast Morogoro Dodoma	21.3	27.5	+6.2	6.0	8.4	+2.4	7.7	12.2	+4.5
Mara Mwanza Shinyanga West Lake	24.5	18.1	-6.4	2.9	7.2	+4.3	5.5	2.6	-2.9
Kigoma Singida Tabora Rukwa	28.8	50.5	+21.7	2.2	6.8	+4.6	7.7	9.2	+1.5
Iringa Mbeya	31.4	62.0	+30.6	2.6	3.5	+0.9	0.6	0.01	-0.5
Mtwara Ruvuma	20.2	26.1	+5.9	6.6	6.8	+0.2	6.7	0.4	-6.3
Dar es Salaam	26.6	36.7	+10.1	24.6	28.3	+3.7	0.06	0.05	-0.0
Weighted Average	26.8	33.6	+6.8	3.1	7.4	+4.3	4.9	3.8	-1.1

Source: 1969 Household Budget Survey and 1976/77 Household Budget Surve Subsample

2.1.3 Comparison with FAO Estimates

Analysis of consumption data for the National Food Strategy Project executed by FAO in collaboration with the Ministry of Agriculture (Kilimo) used a separate sample from the 1976/77 Household Budget Survey. The FAO sample included consumption data for all foods. A consumption pattern of calorie shares among cereals based on that data for Dar es Salaam, other urban areas and rural areas is presented in Table 6. These calorie shares are percentages of average daily calorie consumption as represented by the FAO's sample.

Average daily calorie consumption is higher than the recommended allowance for Dar es Salaam and rural areas, but is lower for other urban areas. The FAO analysis indicates that average calories derived from cereals in rural areas and other urban areas is higher than the averages yielded by the sample used in this study. The relative importance of each cereal as an energy source within each area for the two samples is essentially the same except for higher wheat consumption in other urban areas in the FAO sample. The FAO sample also indicates that in rural areas, other foods with large calorie shares include bananas and other starches and pulses. Diets in urban areas other than Dar es Salaam are slightly more varied with pulses, starches and meat, fish and dairy products contributing the larger calorie shares among other foods. Dar es Salaam diets are even more diverse with sugar, pulses, nuts and seeds, and meat, fish and dairy products contributing significantly to the diet.

The FAO data are consistent with the data used in this study

Table 6: Contribution of Cereals and Cassava to Daily Calorie Intake[1] of Tanzanians (%)
(FAO Sample 1976/77 HBS)

	Dar es Salaam	Other Urban	Rural
Total[2]	64.2	66.7	63.7
Maize/Sembe	33.3	42.3	44.2
Rice	22.1	13.1	7.2
Wheat	8.1	8.2	1.0
Sorghum/Millet	0.0	2.3	9.6
Cassava	0.7	0.8	1.7

[1]Average daily calorie consumption is 2,586 for Dar es Salaam, 2,070 for other urban areas, and 2,521 for rural areas.

[2]Includes cassava, excludes other cereals.

Source: Tanzanian National Food Strategy, Ministry of Agriculture, National Food Strategy Project

regarding quantity estimates. The differences in calorie shares arise in that the FAO study estimated the calories derived from all foods and this study concentrated on the basic grains for cost and timing reasons. The basic data from both samples should be combined in any further research on food issues in Tanzania. Ultimately, it is imperative that the complete survey be analyzed and published.

2.1.4 Income and Price Elasticities

Data from the sub-sample of the 1976/77 HBS included information concerning household expenditures, consumption of major grains and sources of income. This information has been used to calculate income and own-price demand elasticities for the major grains consumed in Dar es Salaam and other urban areas of Tanzania. These elasticities, along with budget shares are presented in Table 7. The income elasticities were calculated using a semi-log function regressing quantities consumed on estimates of total household expenditures for other urban areas and on total household income for Dar es Salaam households. Budget shares were calculated using official retail prices. The own-price elasticities were calculated using the Frisch (Frisch, 1959) technique with a money flexibility parameter of -1.

The inelastic maize demand in Dar es Salaam is due in part to the existing high levels of maize consumption while lower incomes partially account for the more elastic demand for maize in other urban areas. Rice is the preferred staple in Dar es Salaam. Demand is rather elastic for all three commodities in other urban areas. The weighted average of the own-price

Table 7: Income and Own-Price Demand Elasticities for Basic Staples in Urban Areas (1976/77 HBS Data)

Commodity	Income Elasticity	Own Price Elasticity	Expenditure Share
Dar es Salaam			
Maize, Sembe	.090	-.100	.129
Rice	.486	-.536	.201
Wheat, Bread	.257	-.273	.084
Urban (Non-Dar es Salaam)			
Maize, Sembe	.478	-.530	.210
Rice	.275	-.290	.080
Wheat, Bread	.697	-.710	.060

Source: Sigma One Corporation

elasticity for maize for Tanzania is -0.36, which is used in the subsequent analyses.

2.2 The Balance Between Production and Consumption of Maize and Other Cereals

Fundamental to determining Tanzania's surplus/deficit status with respect to maize and other cereals are consistent and believable regional production data. While various time series of crop production statistics have been published by Kilimo and other sources, there is widespread skepticism as to the reliability of these data. Two sources of acceptable production estimates exist for maize, paddy and sorghum/millet for three of the last four growing seasons. The first is the National Food Strategy Report, recently published by the FAO. This document contains yield and areas estimates for 24 crops in the 1978/79 growing season. The second source of production data is the Early Warning System and Crop Monitoring Project (EWS). EWS has collected district estimates of maize, sorghum/millet and paddy production for the 1981/82 growing season. Other data furnished by the EWS allowed for the estimation of regional production of maize and sorghum/millet in the 1980/81 growing season.*

Tables 8, 9 and 10 present regional production estimates (net of seed, feed and losses) for three years. These demonstrate the variability of national production from year to year. For Tanzania as a whole, the 1980/81 growing season was a

*A complete description of the sources of production data is contained in Appendix A.

Table 8: Maize Production Estimates[1] ('000 MT)

Region	1978/79[2]	1980/81[3]	1981/82[3]
Dodoma	51.7	16.3	19.0
Arusha	135.9	139.4	123.9
Kilimanjaro	49.5	58.5	70.7
Tanga	112.2	108.5	151.5
Morogoro	177.3	99.7	91.4
Coast	15.4	24.6	34.6
Lindi	32.7	9.8	17.3
Mtwara	24.0	9.2	25.5
Ruvuma	92.2	89.1	113.9
Iringa	216.0	232.8	252.1
Mbeya	157.9	189.1	189.2
Singida	22.9	11.6	22.8
Tabora	102.4	48.3	57.5
Rukwa	101.2	202.1	207.9
Kigoma	44.9	40.5	38.2
Shinyanga	89.7	102.7	113.3
Kagera	38.1	46.5	38.7
Mwanza	83.5	27.1	27.6
Mara	55.8	39.6	58.5
Tanzania	1553.3	1495.4	1653.6

[1]Net of seed, feed and losses; assumed to be 90 percent of total production.

[2]Source: National Food Strategy.

[3]Source: Early Warning System.

Table 9: Sorghum and Millet Production Estimates[1]
('000 MT)

Region	1978/79[5]	1980/81[6]	1981/82[6]
Dodoma	127.8	40.4	56.3
Arusha	40.8	50.5	44.8
Kilimanjaro	0.4	3.3	3.7
Tanga	22.5	21.8	21.8
Morogoro	41.4	33.8[4]	31.5
Coast	7.0	14.9	15.9
Lindi	16.3	12.1	15.7
Mtwara	42.2	36.7	53.1
Ruvuma[3]	23.6	12.8	12.8
Iringa[2]	5.1	5.1	5.1
Mbeya	8.8	8.7	8.8
Singida	152.4	103.9	161.9
Tabora	52.5	55.0	57.8
Rukwa[3]	82.0	77.9	79.6
Kigoma[2]	2.4	2.4	2.4
Shinyanga	80.5	127.6	134.1
Kagera[3]	6.5	8.3	8.9
Mwanza[3]	31.8	18.1	16.8
Mara	57.9	77.3	69.6
Tanzania	801.9	710.6	800.6

[1]Net of seed, feed and losses; assumed to be 85 percent of total production.

[2]1980/81 and 1981/82 production assumed equal to 1978/79 production.

[3]For Biharamulo, Ngara, Ukerewe, Rombo, Ulanga, Mpanda, Tunduru, Songea, Muheza, Pangani and Handeni districts, 1980/81 production assumed equal to 1981/82 production.

[4]For Kilombero district, 1980/81 production assumed to be 90 percent of 1981/82 production.

[5]Source: National Food Strategy.

[6]Source: Early Warning System.

Table 10: Paddy Production Estimates[1] ('000 MT)

Region	1978/79[2]	1981/82[3]
Dodoma	0.3	-
Arusha	1.0	1.0[4]
Kilimanjaro	4.1	9.3
Tanga	15.3	13.8
Morogoro	34.3	25.4
Coast	25.2	37.6
Lindi	27.0	20.0
Mtwara	21.6	18.4
Ruvuma	17.1	18.5
Iringa	2.0	2.0[4]
Mbeya	43.6	59.4
Singida	1.2	-
Tabora	12.9	13.5
Rukwa	11.7	11.2
Kigoma	1.1	1.1[4]
Shinyanga	26.5	24.4
Kagera	1.3	1.3[4]
Mwanza	8.6	7.8
Mara	7.4	6.5
Tanzania	262.2	271.2

[1]Net of seed and losses; assumed to be 90 percent of total production.

[2]Source: National Food Strategy.

[3]Source: Early Warning System.

[4]Production assumed to be equal to 1978/79 figure.

poor one, due to unfavorable growing conditions over large portions of the country, while the 1978/79 and 1981/82 seasons were normal. In addition to year to year variation in overall output, there is considerable variability in growing conditions in different regions within a particular year. For example, in Arusha--typically a major maize producing region--maize harvests were well below trend in the normal 1981/82 growing season, while in the poor 1980/81 growing season harvests were good. It may be added here that within a particular growing season conditions often vary from district to district within a given region.

As the predominant staple in the diets of Tanzanians, maize is by far the most important food crop cultivated in Tanzania (both in terms of area planted and labor use), and substantial quantities are harvested in all regions. By virtue of their natural endowments, certain regions have consistently been large maize producers; these include Arusha, Rukwa, Ruvuma, Mbeya and Iringa. Sorghum and millet rank second to maize in total production. These crops are much hardier than maize in that they are better able to withstand the effects of droughts. Thus, while they are cultivated in most parts of Tanzania, the bulk of national production takes place in the drier central part of the country. Paddy cultivation, on the other hand, is much more severely constrained by rainfall and soil requirements than are maize, soghum or millet. As a result, much smaller quantities of paddy are produced nationwide, with the bulk of production occurring in Mbeya, Shinyanga, Morogoro and the coastal regions.

A comparison of estimated regional consumption with regional production estimates for those years yields what may be termed regional production/consumption balances. These are indicative of a region's ability to produce enough of these foods to meet its specific consumption requirements. Regional production/consumption balances for the 1979/80, 1981/82 and 1982/83 marketing years* are presented in Table 11. Each value is simply net production less estimated consumption. A negative value indicates the amount by which regional production of a particular staple fell short of desired levels of consumption of that staple; a positive value indicates the amount of regional production of a particular staple in excess of the amount consumed by the inhabitants of the region.

It is important to note that a host of economic variables, including producer and consumer prices and the access of producers and consumers to official and parallel markets, underlie these production/consumption balances. To determine whether production/consumption deficits are filled or how regional production/consumption surpluses are disposed of requires analysis of the structure of the markets for these commodities. The subsequent sections of this report are devoted to such analysis. At this point, some preliminary observations may be made on Tanzania's ability to achieve self-sufficiency as

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*These correspond to the 1978/79, 1980/81 and 1981/82 growing seasons (i.e. food produced in the 1978/79 growing season was consumed in the 1979/80 marketing years).

Table 11: Regional Production/Consumption Balances[1] for the 1979/80, 1981/82 and 1982/83 Marketing Years

Region	1979/80			1981/82		1982/83		
	Maize	Sorghum Millet	Rice	Maize	Sorghum Millet	Maize	Sorghum Millet	Rice
Dodoma	+26.0	+50.1	-0.5	-10.7	-41.3	-8.7	-27.7	-0.8
Arusha	+49.4	+40.7	-10.0	+46.7	+50.4	+27.9	+44.7	-11.5
Kilimanjaro	+6.8	-0.4	-9.4	+13.7	+2.5	+24.7	+2.8	-5.5
Tanga	-17.5	+22.4	-11.2	-27.3	+21.7	+12.5	+21.7	-15.4
Morogoro	-7.0	+41.0	-21.0	-41.7	+33.4	-53.8	+31.1	-36.7
Coast	-13.1	+6.5	+6.5	-4.9	+14.4	+4.7	+15.4	+17.9
Lindi	-2.0	+12.6	+16.7	-25.9	+8.1	-19.0	+11.6	+8.6
Mtwara	-4.9	+32.2	+6.7	-20.5	+26.0	-4.6	+41.9	+2.1
Ruvuma	+14.6	+20.3	-5.3	+6.6	+9.3	+28.8	+9.2	-5.8
Iringa	+6.4	+4.8	-2.6	+13.9	+4.8	+28.3	+4.7	-3.0
Mbeya	+26.2	+3.2	+20.4	+51.5	+3.0	+48.6	+2.9	+31.8
Singida	-65.1	+87.0	-10.7	-79.5	+34.3	-69.9	+90.0	-12.5
Tabora	-28.0	+32.4	-34.5	-90.0	+33.6	-85.0	+35.8	-38.3
Rukwa	-4.4	+65.0	+8.0	+86.2	+59.8	+86.3	+60.9	+7.2
Kigoma	-4.3	+1.6	-1.6	-13.0	+1.5	-17.7	+1.4	-1.9
Shinyanga	-12.4	+5.8	+16.4	-6.8	+48.3	-0.1	+52.3	+12.3
Kagera	+2.9	-2.2	-11.3	+8.9	-1.0	-0.3	-0.8	-12.8
Mwanza	-13.6	+31.2	-87.9	-77.6	+17.5	-81.3	+16.2	-93.8
Mara	+46.2	+56.4	+4.3	+28.9	+75.7	+47.3	+68.0	+3.1
Dar es Sal.	-105.6	-0.3	-103.9	-126.6	-0.4	-138.6	-0.4	-136.4
Tanzania	-99.4	+510.3	-230.9	-267.7	+401.6	-170.0	+481.7	-291.4
Tanzania (excl. DSM)	+6.2	+510.6	-127.0	-141.1	+402.0	-31.4	+482.1	-155.0

[1]Net production minus estimated consumption, all in '000 metric tons of grain equivalents.

Source: Sigma One Corporation

indicated by the national aggregate production/consumption balances in Table 11.

In each of the three years considered here, Tanzania was in a net deficit position with respect to the preferred staples (maize and rice). In the normal years (1979/80 and 1982/83) most or all of the maize deficit was accounted for by the need to satisfy Dar es Salaam's consumption requirements. On the other hand, in 1981/82 Dar es Salaam's maize requirements accounted for less than half of the national deficit. To some extent, national deficits in production of preferred staples have been met through imports. However, as Table 12 indicates, imports have not been sufficient to satisfy consumption requirements unmet by domestic production. It would thus appear that in each of the past four years, a portion of the Tanzanian population has been unable to consume as much of the preferred staples as it would have liked to.

Whether the national shortages of supplies of preferred staples has led to decline in per capita calorie intake depends on the extent to which other less preferred foods were substituted for maize and rice. Table 11 indicates that in all years considered, large national surpluses of sorghum and millet existed. For 1979/80 and 1982/83, these surpluses were greater than the combined deficits in maize and rice. Two things account for this. First, since the time of the disastrous droughts of 1973/74 and 1974/75, the government has followed a policy of vigorously promoting the production of drought staples through increased producer prices and intense promotional efforts.

Table 12: Imports of Preferred Staples and National Production/Consumption Balances ('000 MT)

	Maize		Rice	
	Imports	Domestic Balance	Imports	Domestic Balance
1979/80	32.5[1]	-99.4	54.7[1]	-230.9
1981/82	231.6[1]	-267.7	66.5[1]	N/A
1982/83	120.0[2]	-170.0	64.0[2]	-291.4

[1]Source: MDB

[2]Projected

Second, consumer pricing policy has been such that the official consumer price of sembe has been much lower than that of sorghum flour. This latter phenomenon has interjected an important distortion into the official market in that it has stimulated the consumption of sembe by low income urban dwellers who--in the absence of the sembe subsidy--might have consumed sorghum flour.

To return to the question of whether national deficits in preferred staples have been compensated by increased consumption of less preferred foods, it is clear that the policy of subsidizing NMC sembe has provided a disincentive to the substitution of sorghum and millet for maize in the diets of those individuals with access to the official market. For those Tanzanians forced to rely on the parallel market for some or all of their consumption needs, however, there appears to have been great latitude for such substitution. In regions in which production/consumption surpluses of sorghum/millet exceed the combined production/consumption deficits for the preferred staples, it is very possible that calorie intake levels have remained adequate. The increased calorie share of sorghum in the diets of the inhabitants of sorghum-producing areas (as noted earlier) seems to confirm this. However, given that little unofficial inter-regional movement of drought staples has been observed in Tanzania, for regions in which maize and rice deficits are greater than drought staple surpluses, it is very likely that the nutritional status of a significant portion of those regions' inhabitants has suffered.

2.3 The Markets for Maize in Tanzania

This section presents estimates of the quantities of maize entering the parallel market, the level of urban parallel market maize* demand, and the volume of unofficial inter-regional trade in the 1979/80, 1981/82 and 1982/83 marketing years. This analysis is based upon the estimates of regional production and consumption developed in the two preceding sections, combined with certain assumptions as to the market behavior of producers, consumers and marketers of maize.

The analysis hinges on the assumption that the consumption patterns indicated by the 1976/77 HBS data are "normal". In all cases, what is termed "demand" is in fact a normative measure of the quantities of maize which would have been consumed had the consumption patterns of 1976/77 remained constant. Obviously, this sort of static analysis does not account for changes in consumption levels brought about by changes in the relative prices of foods and other commodities or by changes in real income levels. Nevertheless, what follows amounts to the best information available to date on the disappearance of Tanzanian maize through various market channels, as well as the distribution of maize consumption among different segments of Tanzania's population.

2.3.1 Marketable Surplus

Tables 13, 14 and 15 present estimates of marketable surpluses of maize produced for the 1979/80, 1981/82 and 1982/83

*In this section, "maize" refers both to unground maize grain and sembe (converted to grain equivalents).

Table 13: Regional Estimates of Marketable Surpluses of Maize for the 1979/80 Marketing Year ('000 MT)

	Net Production	Rural Consumption	Marketable Surplus[1]	Rural Deficit[2]
Dodoma	51.7	24.2	27.5	0.0
Arusha	135.9	78.2	57.7	0.0
Kilimanjaro	49.5	41.7	7.8	0.0
Tanga	112.2	116.2	0.0	-4.0
Morogoro	127.3	114.8	12.5	0.0
Coast	15.4	28.5	0.0	-13.1
Lindi	32.7	33.9	0.0	-1.2
Mtwara	24.0	27.1	0.0	-3.1
Ruvuma	92.2	70.4	21.8	0.0
Iringa	216.0	198.7	17.3	0.0
Mbeya	157.9	126.8	31.1	0.0
Singida	22.9	86.9	0.0	-64.0
Tabora	102.4	109.5	0.0	-7.1
Rukwa	101.2	84.3	16.9	0.0
Kigoma	44.9	31.4	13.5	0.0
Shinyanga	89.7	93.4	0.0	-3.7
Kagera	38.1	34.8	3.3	0.0
Mwanza	83.5	73.0	10.5	0.0
Mara	55.8	3.6	52.2	0.0
Tanzania	1553.3	1377.4	272.1 (17.5%)[3]	-96.2

[1]Net production less rural consumption. If rural consumption exceeds net production, marketable surplus is taken to be zero.

[2]Net production less rural consumption for those regions in which the latter exceeds the former; zero in all other regions.

[3]Marketed surplus as percentage of net production.

Source: Sigma One Corporation

Table 14: Regional Estimates of Marketable Surpluses of Maize for the 1981/82 Marketing Year ('000 MT)

	Net Production	Rural Consumption	Marketable Surplus[1]	Rural Deficit[2]
Dodoma	16.3	25.4	0.0	-9.1
Arusha	139.4	82.6	56.8	0.0
Kilimanjaro	58.5	43.7	14.8	0.0
Tanga	108.5	120.9	0.0	-12.4
Morogoro	99.7	118.5	0.0	-18.8
Coast	24.6	29.5	0.0	-4.9
Lindi	9.8	34.9	0.0	-25.1
Mtwara	9.2	27.6	0.0	-18.4
Ruvuma	89.1	73.7	15.4	0.0
Iringa	232.8	205.9	26.9	0.0
Mbeya	189.1	131.4	57.7	0.0
Singida	11.6	89.7	0.0	-78.1
Tabora	48.3	116.2	0.0	-67.9
Rukwa	202.1	90.0	112.1	0.0
Kigoma	40.5	32.7	7.8	0.0
Shinyanga	102.7	98.9	3.8	0.0
Kagera	46.5	37.3	9.2	0.0
Mwanza	27.1	74.9	0.0	-47.8
Mara	39.6	3.8	35.8	0.0
Tanzania	1495.5	1437.6	340.3 (22.8%)[3]	-282.4

[1]Net production less rural consumption. If rural consumption exceeds net production, marketable surplus is taken to be zero.

[2]Net production less rural consumption for those regions in which the latter exceeds the former; zero in all other regions.

[3]Marketed surplus as percentage of net production.

Source: Sigma One Corporation

Table 15: Regional Estimates of Marketable Surpluses of Maize for the 1982/83 Marketing Year ('000 MT)

	Net Production	Rural Consumption	Marketable Surplus[1]	Rural Deficit[2]
Dodoma	19.0	26.0	0.0	-7.0
Arusha	123.9	84.9	39.0	0.0
Kilimanjaro	70.7	44.8	25.9	0.0
Tanga	151.5	123.3	28.2	0.0
Morogoro	91.4	120.4	0.0	-29.0
Coast	34.6	30.0	4.6	0.0
Lindi	17.3	35.4	0.0	-18.1
Mtwara	25.5	27.9	0.0	-2.4
Ruvuma	113.9	75.3	38.6	0.0
Iringa	252.1	209.7	42.4	0.0
Mbeya	189.2	133.7	55.5	0.0
Singida	22.8	91.1	0.0	-68.3
Tabora	57.5	119.7	0.0	-62.2
Rukwa	207.9	92.9	115.0	0.0
Kigoma	38.2	33.4	4.8	0.0
Shinyanga	113.3	101.8	11.5	0.0
Kagera	38.7	38.6	0.1	0.0
Mwanza	27.6	75.8	0.0	-48.2
Mara	58.5	3.8	54.7	0.0
Tanzania	1653.6	1468.5	420.3 (25.4%)[3]	-235.2

[1]Net production less rural consumption. If rural consumption exceeds net production, marketable surplus is taken to be zero.

[2]Net production less rural consumption for those regions in which the latter exceeds the former; zero in all other regions.

[3]Marketed surplus as percentage of net production.

Source: Sigma One Corporation

marketing years. Marketable surplus is taken to be the difference between net production and rural consumption. It is assumed that if rural demand exceeds production in a given region, then there is no marketable surplus.*

Nationally, surplus production ranged from 272,000 tons in 1979/80 to 420,000 tons in 1982/83--between 17 and 25 percent of total production. It is interesting that national production in 1981/82 was lower than that of 1979/80 by almost 58,000 tons, yet surplus production in 1981/82 was greater by about 68,000 tons. This is largely accounted for by the dramatic increases in production in Rukwa region during the period, and highlights the fact that most of the important maize producing regions benefit from relatively reliable weather.

Seven regions (Arusha, Kilimanjaro, Ruvuma, Iringa, Mbeya, Rukwa and Mara) consistently produced the great majority of the nation's surplus maize, accounting for 75.1 percent, 93.9 percent and 88.3 percent of the national total in 1979/80, 1981/82 and 1982/83, respectively. At the other extreme are four regions--Singida, Tabora, Lindi and Mtwara--in which rural demand exceeded production in each year, and five regions--Mwanza, Dodoma, Morogoro, Coast and Tanga--in which there were rural deficits in two of the three years.

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*Within each region there are likely to be pockets of surplus production in all but the most extreme drought years. By the same token, poor growing conditions in scattered locations often lead to localized rural deficits. The Masai districts of Arusha region are a good example of the latter phenomenon. With respect to this analysis, however, the two phenomena tend to cancel each other.

2.3.2 Allocation of Marketed Surpluses Between the Official and Unofficial Markets

Tables 16, 17 and 18 present regional estimates of the quantities of maize entering the official and unofficial markets in the 1979/80, 1981/82 and 1982/83 marketing years. The volume of maize sold on the parallel market by a region's producers is taken to be the difference between the marketable surplus available within the region and NMC purchases.

These tables clearly depict the sharp decline in the share of Tanzania's surplus maize sold through official channels. Whereas NMC captured 53.7 percent of the nation's marketed surplus in 1979/80, only 20.5 percent was marketed officially in 1981/82 and even less will enter the official market in 1982/83.* In absolute terms, the volume of maize which producers sold unofficially in 1981/82 was more than twice that of 1979/80; moreover, the amount of maize entering the parallel market in the current (1982/83) year will be at least 25 percent greater than last year.

The drop in official purchases of maize between 1979/80 and the two most recent years has been almost entirely acounted for by declining NMC procurement levels in Dodoma and Arusha regions. In the case of Dodoma, the low levels of purchases in 1981/82 and 1982/83 reflect the very poor weather experienced throughout the

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*1982/83 NMC procurement figures are projections published in a recent MDB document. It appears that these were overly optimistic; currently, NMC maize purchases for 1982/83 are expected to be somewhere between 70 and 75 thousand tons.

Table 16: Quantities of Maize Entering the Official and Unofficial Markets in the 1979/80 Marketing Year ('000 MT)

	Marketable Surplus	NMC Purchases[1]	Unofficial Marketings[2]
Dodoma	27.5	27.1	0.4
Arusha	57.7	47.4	10.3
Kilimanjaro	7.8	5.9	1.9
Tanga	0.0	0.4	0.0
Morogoro	12.5	1.1	11.4
Coast	0.0	0.0	0.0
Lindi	0.0	0.0	0.0
Mtwara	0.0	0.0	0.0
Ruvuma	21.8	17.8	4.0
Iringa	17.3	26.3	0.0
Mbeya	31.1	6.4	24.7
Singida	0.0	0.7	0.0
Tabora	0.0	4.9	0.0
Rukwa	16.9	15.9	1.0
Kigoma	13.5	0.4	13.1
Shinyanga	0.0	1.1	0.0
Kagera	3.3	0.7	2.6
Mwanza	10.5	2.0	8.5
Mara	52.2	3.0	49.2
Tanzania	272.1	161.1	127.1

[1]Source: Marketing Development Bureau.

[2]Marketable surplus less NMC purchases. Unofficial marketings taken to be zero if NMC purchases exceed marketable surplus. National totals do not balance because in some regions NMC purchases exceeded marketable surplus (see text).

Table 17: Quantities of Maize Entering the Official and Unofficial Market in the 1981/82 Marketing Year ('000 MT)

	Marketable Surplus	NMC Purchases[1]	Unofficial Marketings[2]
Dodoma	0.0	4.4	0.0
Arusha	56.8	3.2	53.6
Kilimanjaro	14.8	0.0	14.8
Tanga	0.0	1.3	0.0
Morogoro	0.0	0.4	0.0
Coast	0.0	0.0	0.0
Lindi	0.0	0.4	0.0
Mtwara	0.0	0.0	0.0
Ruvuma	15.4	21.1	0.0
Iringa	26.9	33.1	0.0
Mbeya	57.7	7.2	50.5
Singida	0.0	0.2	0.0
Tabora	0.0	1.2	0.0
Rukwa	112.1	16.0	96.1
Kigoma	7.8	0.4	7.4
Shinyanga	3.8	0.2	3.6
Kagera	9.2	0.0	9.2
Mwanza	0.0	0.0	0.0
Mara	35.8	0.3	35.5
Tanzania	340.3	89.4	270.7

[1]Source: Marketing Development Bureau.

[2]Marketable surplus less NMC purchases. Unofficial marketings taken to be zero if NMC purchases exceed marketable surplus. National totals do not balance because in some regions NMC purchases exceeded marketable surplus (see text).

Table 18: Quantities of Maize Entering the Official and Unofficial Markets in the 1982/83 Marketing Year ('000 MT)

	Marketable Surplus	NMC Purchases[1]	Unofficial Marketings[2]
Dodoma	0.0	4.0	0.0
Arusha	39.0	2.0	37.0
Kilimanjaro	25.9	0.0	25.9
Tanga	28.2	1.0	27.2
Morogoro	0.0	1.0	0.0
Coast	4.6	0.0	4.6
Lindi	0.0	0.0	0.0
Mtwara	0.0	0.0	0.0
Ruvuma	38.6	20.0	18.6
Iringa	42.4	30.0	12.4
Mbeya	55.5	7.0	48.5
Singida	0.0	0.0	0.0
Tabora	0.0	2.0	0.0
Rukwa	115.0	18.0	97.0
Kigoma	4.8	0.0	4.8
Shinyanga	11.5	0.0	11.5
Kagera	0.1	0.0	0.1
Mwanza	0.0	0.0	0.0
Mara	54.7	0.0	54.7
Tanzania	420.3	85.0	342.3

[1]Source: Stainburn, Production Costs of Major Agricultural Commodities in Tanzania, MDB, 1982. These figures are projections and are probably over-estimates. It is currently believed that total NMC purchases for 1982/83 will not exceed 70,000 tons.

[2]Marketable surplus less NMC purchases. Unofficial marketings taken to be zero if NMC purchases exceed marketable surplus. National totals do not balance because in some regions NMC purchases exceeded marketable surplus (see text).

region in the 1980/81 and 1981/82 growing seasons. In Arusha, however, there have been sizeable marketable surpluses produced in each of the past two years. Whereas over 80 percent of Arusha's maize surpluses were procured by the NMC in 1979/80, NMC has been able to procure only about 5 percent of the region's surplus maize in the past two years.

It is noteworthy that in certain years NMC purchases were made in regions for which there was a net rural deficit. Of additional note is the fact that in 1981/82, NMC purchases in Ruvuma and Iringa exceed the estimated quantities of marketable surpluses in those two regions. These points highlight a phenomenon which was noted in the previous section; that is, the regional estimates of marketable surplus used in this analysis mask a certain amount of production variability within regions. That the NMC is able to procure maize in regions which are, on aggregate, in a deficit position indicates that in these regions pockets of surplus production did in fact exist, and some of this surplus was sold officially. Furthermore, in many regions law enforcement and political pressures insure that in any year a certain amount of maize will be marketed officially. Examples of this "command" production include the output of village communal plots and block farms, as well as the output of NAFCO farms.

2.3.3 Parallel Market Sales in Urban Areas

Urban parallel market demand for maize exists because of the

NMC's inability to supply enough maize* to meet total urban maize demand. In any town the level of parallel market demand is determined by the difference between total demand and available official supplies. Given this identity, Tables 19, 20 and 21 present regional estimates of unofficial urban maize demand in the 1979/80, 1981/82 and 1982/83 marketing years. These estimates are based on the assumption that 100 percent of NMC sales take place in urban areas (i.e. regional and district headqarters) and that NMC maize is consumed exclusively by urban dwellers.

For individual regions, there are great differences in the importance of the parallel market in satisfying urban maize demand. In Mwanza, Morogoro, Kigoma, Tabora, Ruvuma, Iringa, Mbeya and Rukwa, parallel markets are needed to supply over half of urban maize demand. At the other extreme are several regions in which NMC has apparently oversupplied urban areas relative to urban demand. These regions include Dar es Salaam, Tanga, Kagera, Arusha and Kilimanjaro.

The analysis in Section 2.3.1 indicated that in certain regions net rural production/consumption deficits have existed in some years. In many of these regions--including Dodoma, Mwanza, Shinyanga, Singida, Mtwara and Lindi--NMC has sold substanital quantities of grain in drought stricken rural areas to avert

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*In this section, "maize" refers to both unground maize grain and sembe. In the analysis, quantities of sembe sold by NMC are converted to maize grain equivalents using a conversion factor of 0.85.

famine*. To the extent that NMC maize was sold in rural areas, the estimates of NMC "oversupply" in Tables 19, 20 and 21 are overstated. Moreover, such official sales have partially decreased the level of rural production/consumption deficits. However, it is highly unlikely that NMC sales have ever entirely mitigated these rural deficits.

On aggregate, NMC has been much more successful in supplying maize to urban areas than it has been in procuring marketable surpluses. The percentage of urban maize demand met by NMC sales (net of oversupply) has risen from 60 percent in 1979/80 to about 70 percent in each of the two most recent marketing years. Obviously, this has been enabled by the official policy of using imported maize to partially fill the widening gap between declining NMC procurement and growing urban demand.

For the years considered here, the level of urban parallel market demand in Tanzania has remained fairly stable, ranging from 100 to 110 thousand metric tons per year. As was just noted, the assumption that 100 percent of NMC sales takes place in urban areas has probably understated these estimates. On the other hand, urban dwellers have responded to the combined effects of unavailability of NMC maize and high parallel market prices by growing maize to satisfy their consumption requirements. This phenomenon implies that the estimates of total urban market demand for maize (and, correspondingly, parallel market

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*Regrettably, no figures on the amount of NMC maize sold in rural areas is available. It should be noted, however, that such sales amount to a small percentage of total NMC sales.

Table 19: Parallel Market Demand for Maize in Urban Areas: 1979/80 Marketing Year ('000 MT grain equivalents)

	Urban Demand	NMC Sales[1]	Parallel Market Demand[2]	NMC "Over-Supply"[3]
Dodoma*	1.5	15.0	0.0	13.5
Arusha*	8.3	16.0	0.0	7.7
Kilimanjaro	0.9	8.0	0.0	7.1
Tanga	13.6	26.0	0.0	12.4
Morogoro	19.4	8.0	11.4	0.0
Dar es Salaam	105.6	107.0	0.0	1.4
Lindi*	0.8	5.0	0.0	4.2
Mtwara*	1.7	4.0	0.0	2.3
Ruvuma	7.2	1.0	6.2	0.0
Iringa	10.9	7.0	3.9	0.0
Mbeya	5.0	2.0	3.0	0.0
Singida*	1.1	7.0	0.0	5.9
Tabora	20.9	2.0	18.9	0.0
Rukwa	21.3	2.0	19.3	0.0
Kigoma	17.8	1.0	16.8	0.0
Shinyanga*	8.8	2.0	6.8	0.0
Kagera	0.3	2.0	0.0	1.7
Mwanza*	24.2	5.0	19.2	0.0
Mara*	6.0	3.0	3.0	0.0
Tanzania	275.3	223.0	108.5	56.2

*Indicates regions in which substantial quantities have in some years been sold in rural areas as famine relief.

[1]Source: Marketing Development Bureau.

[2]Urban demand less NMC sales. In regions in which NMC sales exceed urban demand, parallel market demand is taken to be zero.

[3]NMC sales less urban demand, for those regions in which NMC sales exceed urban demand. Based on the assumption that 100 percent of NMC sales take place in urban areas.

Table 20: Parallel Market Demand for Maize in Urban Areas: 1981/82 Marketing Year ('000 MT grain equivalents)

	Urban Demand	NMC Sales[1]	Parallel Market Demand[2]	NMC "Over-Supply"[3]
Dodoma*	1.7	30.0	0.0	28.3
Arusha*	10.1	10.0	0.1	0.0
Kilimanjaro	1.1	6.0	0.0	4.9
Tanga	15.0	13.0	2.0	0.0
Morogoro	22.8	9.0	13.8	0.0
Dar es Salaam	126.6	137.0	0.0	10.4
Lindi*	0.9	3.0	0.0	2.1
Mtwara*	2.0	6.0	0.0	4.0
Ruvuma	8.8	1.0	7.8	0.0
Iringa	13.0	6.0	7.0	0.0
Mbeya	6.2	1.0	5.2	0.0
Singida*	1.4	2.0	0.0	0.6
Tabora	22.1	9.0	13.1	0.0
Rukwa	26.0	5.0	21.0	0.0
Kigoma	20.8	2.0	18.8	0.0
Shinyanga*	10.6	14.0	0.0	3.4
Kagera	0.3	4.0	0.0	3.7
Mwanza*	29.8	19.0	10.8	0.0
Mara*	6.9	11.0	0.0	4.1
Tanzania	326.1	288.0	99.6	61.5

*Indicates regions in which substantial quantities have in some years been sold in rural areas as famine relief.

[1]Source: Marketing Development Bureau.

[2]Urban demand less NMC sales. In regions in which NMC sales exceed urban demand, parallel market demand is taken to be zero.

[3]NMC sales less urban demand, for those regions in which NMC sales exceed urban demand. Based on the assumption that 100 percent of NMC sales take place in urban areas.

Table 21: Parallel Market Demand for Maize in Urban Areas: 1982/83 Marketing Year ('000 MT grain equivalents)

	Urban Demand	Projected NMC Sales[1]	Parallel Market Demand[2]	NMC "Over-Supply"[3]
Dodoma*	1.8	25.0	0.0	23.2
Arusha*	11.1	20.0	0.0	8.9
Kilimanjaro	1.1	5.0	0.0	3.9
Tanga	15.7	30.0	0.0	14.3
Morogoro	24.8	10.0	14.8	0.0
Dar es Salaam	138.6	144.0	0.0	5.4
Lindi*	0.9	3.0	0.0	2.1
Mtwara*	2.2	6.0	0.0	3.8
Ruvuma	9.8	1.0	8.8	0.0
Iringa	14.2	7.0	7.2	0.0
Mbeya	6.9	3.0	3.9	0.0
Singida*	1.5	2.0	0.0	0.5
Tabora	22.8	10.0	12.8	0.0
Rukwa	28.7	4.0	24.7	0.0
Kigoma	22.4	2.0	20.4	0.0
Shinyanga*	11.7	11.0	0.7	0.0
Kagera	0.4	5.0	0.0	4.6
Mwanza*	33.1	21.0	12.1	0.0
Mara*	7.4	13.0	0.0	5.6
Tanzania	355.1	322.0	105.4	72.3

*Indicates regions in which substantial quantities of grain have in some years been sold in rural areas as famine relief.

[1]Source: Stainburn, Production Costs of Major Agricultural Commodities in Tanzania, MDB, 1982.

[2]Urban demand less NMC sales. In regions in which NMC sales exceed urban demand, parallel market demand is taken to be zero.

[3]NMC sales less urban demand for those regions in which NMC sales exceed urban demand. Based on the assumption that 100 percent of NMC sales take place in urban areas.

demand) are overstated. The effects of these two phenomena have, to some extent, canceled each other.

2.3.4 Parallel Market Trade Flows

Drawing from the estimates of urban parallel market demand presented in Section 2.3.3 and the estimates of unofficial supplies of maize presented in Section 2.3.2, Tables 22, 23 and 24 present estimates of the quantities of maize traded in intra- and inter-regional parallel markets during the 1980/81, 1981/82 and 1982/83 marketing years. The analysis is based on the following assumptions:

- To the extent possible, urban parallel market demand is met by surplus maize produced within the region (net of rural consumption and NMC purchases).
- If a region's urban parallel market demand exceeds the unofficial supply of maize available within the region, this excess demand is met by unofficial imports from other regions. Likewise, if the unofficial supply of maize within the region exceeds unofficial urban demand, the excess supply is exported from the region.
- Urban parallel market demand is fully met.
- There are no parallel market flows into rural areas.

Of the major surplus-producing regions, Mara, Mbeya, Arusha, Rukwa and Kilimanjaro have all been unofficial exporters* of

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In this section, "imports" and "exports" refer to unofficial trade which crosses regional boundaries, without regard to source or destination of such trade. The issue of unofficial international trade is discussed in Section 2.3.5.

Table 22: Unofficial Flows of Maize into Urban Areas
1979/80 Marketing Year ('000 MT grain equivalents)

	Urban Parallel Market Demand[1]	Parallel Market Supply[2]	Unofficial Intra-Regional Trade	Unofficial Inter-Regional Flows	
				Exports	Imports
Dodoma	0.0	0.4	0.0	0.4	0.0
Arusha	0.0	10.3	0.0	10.3	0.0
Kilimanjaro	0.0	1.9	0.0	1.9	0.0
Tanga	0.0	0.0	0.0	0.0	0.0
Morogoro	11.4	11.4	11.4	0.0	0.0
Coast/DSM	0.0	0.0	0.0	0.0	0.0
Lindi	0.0	0.0	0.0	0.0	0.0
Mtwara	0.0	0.0	0.0	0.0	0.0
Ruvuma	6.2	4.0	4.0	0.0	2.2
Iringa	3.9	0.0	0.0	0.0	3.9
Mbeya	3.0	24.7	3.0	21.7	0.0
Singida	0.0	0.0	0.0	0.0	0.0
Tabora	18.9	0.0	0.0	0.0	18.9
Rukwa	19.3	1.0	1.0	0.0	18.3
Kigoma	16.8	13.1	13.1	0.0	3.7
Shinyanga	6.8	0.0	0.0	0.0	6.8
Kagera	0.0	2.6	0.0	2.6	0.0
Mwanza	19.2	8.5	8.5	0.0	10.7
Mara	3.0	49.2	3.0	46.2	0.0
Tanzania[3]	108.5	127.1	44.0	83.1	64.5

[1]Total urban demand less NMC sales.

[2]Marketable surplus less NMC purchases.

[3]The difference between the national parallel market supply and national urban parallel market demand is identical to the sum of unofficial exports less the sum of unofficial imports.

Source: Sigma One Corporation

Table 23: Unofficial Flows of Maize into Urban Areas: 1981/82 Marketing Year ('000 MT grain equivalents)

	Urban Parallel Market Demand[1]	Parallel Market Supply[2]	Unofficial Intra-Regional Sales	Unofficial Inter-Regional Trade	
				Exports	Imports
Dodoma	0.0	0.0	0.0	0.0	0.0
Arusha	0.1	53.6	0.1	53.5	0.0
Kilimanjaro	0.0	14.8	0.0	14.8	0.0
Tanga	2.0	0.0	0.0	0.0	2.0
Morogoro	13.8	0.0	0.0	0.0	13.8
Coast/DSM	0.0	0.0	0.0	0.0	0.0
Lindi	0.0	0.0	0.0	0.0	0.0
Mtwara	0.0	0.0	0.0	0.0	0.0
Ruvuma	7.8	0.0	0.0	0.0	7.8
Iringa	7.0	0.0	0.0	0.0	7.0
Mbeya	5.2	50.5	5.2	45.3	0.0
Singida	0.0	0.0	0.0	0.0	0.0
Tabora	13.1	0.0	0.0	0.0	13.1
Rukwa	21.0	96.1	21.0	75.1	0.0
Kigoma	18.8	7.4	7.4	0.0	11.4
Shinyanga	0.0	3.6	0.0	3.6	0.0
Kagera	0.0	9.2	0.0	9.2	0.0
Mwanza	10.8	0.0	0.0	0.0	10.8
Mara	0.0	35.5	0.0	35.5	0.0
Tanzania[3]	99.6	270.7	33.7	237.0	65.9

[1]Total urban demand less NMC sales.

[2]Marketable surplus less NMC purchases.

[3]The difference between the national parallel market supply and national parallel market demand is identical to the sum of unofficial exports less the sum of unofficial imports.

Source: Sigma One Corporation

Table 24: Unofficial Flows of Maize into Urban Areas: 1982/83 Marketing Year ('000 MT grain equivalents)

	Urban Parallel Market Demand[1]	Parallel Market Supply[2]	Unofficial Intra-Regional Trade	Unofficial Inter-Regional Trade	
				Exports	Imports
Dodoma	0.0	0.0	0.0	0.0	0.0
Arusha	0.0	37.0	0.0	37.0	0.0
Kilimanjaro	0.0	25.9	0.0	25.9	0.0
Tanga	0.0	27.2	0.0	27.2	0.0
Morogoro	14.8	0.0	0.0	0.0	14.8
Coast	0.0	4.6	0.0	4.6	0.0
Lindi	0.0	0.0	0.0	0.0	0.0
Mtwara	0.0	0.0	0.0	0.0	0.0
Ruvuma	8.8	18.6	8.8	9.8	0.0
Iringa	7.2	12.4	7.2	5.2	0.0
Mbeya	3.9	48.5	3.9	44.6	0.0
Singida	0.0	0.0	0.0	0.0	0.0
Tabora	12.8	0.0	0.0	0.0	12.8
Rukwa	24.7	97.0	24.7	72.3	0.0
Kigoma	20.4	4.8	4.8	0.0	15.6
Shinyanga	0.7	11.5	0.7	10.8	0.0
Kagera	0.0	0.1	0.0	0.1	0.0
Mwanza	12.1	0.0	0.0	0.0	12.1
Mara	0.0	54.7	0.0	54.7	0.0
Tanzania[3]	105.4	342.3	50.1	292.2	55.3

[1]Total urban demand less NMC sales.

[2]Marketable surplus less NMC purchases.

[3]The difference between the national parallel market supply and national parallel market demand is identical to the sum of unofficial exports less the sum of unofficial imports.

Source: Sigma One Corporation

maize in at least two of the three years considered here, and for the latter three regions, the volume of unofficial exports has grown considerably. For Arusha and Kilimanjaro this increase has been due to the severe drop in sales to the NMC; in Rukwa, NMC purchases have been growing slightly each year, but marketed surpluses have skyrocketed since 1979/80. Because the NMC has satisfied a very large portion of total urban maize demand in Mara, Arusha and Kilimanjaro, practically all of those regions' maize surpluses not procured by the NMC have been exported unofficially in each year.

In the other important surplus-producing regions--Mbeya, Rukwa, Iringa and Ruvuma--NMC's "low profile" in urban maize markets has meant that the bulk of urban maize demand has usually been met by the intra-regional parallel market. In Mbeya and Rukwa there have usually been large enough unofficial surpluses to allow for sizeable exports. This has not been the case in either Ruvuma or Iringa. In these two regions, NMC's ability to capture the great bulk of marketable surpluses, combined with sizeable urban parallel market demand has--until the current marketing season--limited the scope for unofficial exports. Indeed, the estimates for 1979/80 and 1981/82 indicate that in those years there was some amount of urban maize demand which could only have been met by unofficial imports.*

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*Such imports may well have occurred in Iringa (conceivably from neighboring Mbeya region). For Ruvuma, however, it is unlikely that much (if any) maize would have been imported into the region, due to the very poor quality of the road connecting it with the rest of the country.

Several regions have consistently been large unofficial importers. These include Mwanza, Tabora, Kigoma and--in 1981/82 and 1982/83--Morogoro. These regions are characterized by low NMC sales relative to urban demand and intra-regional parallel markets which capture all or nearly all available surpluses.*

In the other regions in Tanzania there appears to have been rather little parallel market activity in the years considered here. In Dodoma and Singida this has probably been a function of vigorous law enforcement in combination with the low level of maize surpluses available to the parallel market.** In Lindi and Mtwara, law enforcement is apparently more lax, but these regions' remoteness has effectively precluded much in the way of unofficial maize imports outside of small quantities trickling in from Ruvuma region. Finally, in the two cities best served by the official market--Dar es Salaam and Tanga--there has been little or no parallel market demand for maize, while the rural areas adjacent to these urban centers have produced little, if any, surpluses available for unofficial export.

The assumptions underlying the preceding analysis are based on a general assessment of how Tanzania's parallel markets

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*For Mwanza region, estimates of urban parallel market demand are probably understated due to two reasons. First, not all NMC sales are made in urban areas. This was particularly true in 1980/81 when large parts of the region were stricken by drought. Second, there is known to be a non-urban parallel market for maize in the gold mining areas of Geita district (Barret, 1982).

**In the current (1982/83) marketing year, there have been reports of traders from other regions purchasing maize in Singida, Manyoni and Mpwapwa districts for unofficial export to other regions (Keeler, 1982).

function. It should be recognized, however, that there are substantial differences in the way in which parallel markets function in different regions in Tanzania. To varying degrees, regional differences in communications infrastructure impinge on the transmission of market information from consumers to marketers; likewise, law enforcement activities and a deteriorating transport infrastructure constrain the flow of commodities from producers to consumers. Such differences in the degree to which the various parallel markets are articulated are not reflected in the regional estimates presented in Tables 22, 23 and 24; incorporation of these differences into the analysis is simply not possible, given the limited amount of information available. Nonetheless, some very general observations may be made.

First, while it has been assumed that 100 percent of urban parallel market demand is met in any year, the constraints affecting parallel market operations imply that this is probably not the case. In many instances, there will be unmet urban demand for maize. At the same time, it is entirely possible (but probably less common) that in some instances traders will bring more maize into an urban area than is necessary to meet urban demand.

Second, the accuracy of the assumption that inter-regional parallel market activity occurs only after intra-regional urban demand has been met depends on the vigor of law enforcement activities within a given region. A good examaple of this is Dodoma region. There, regional authorities have greatly

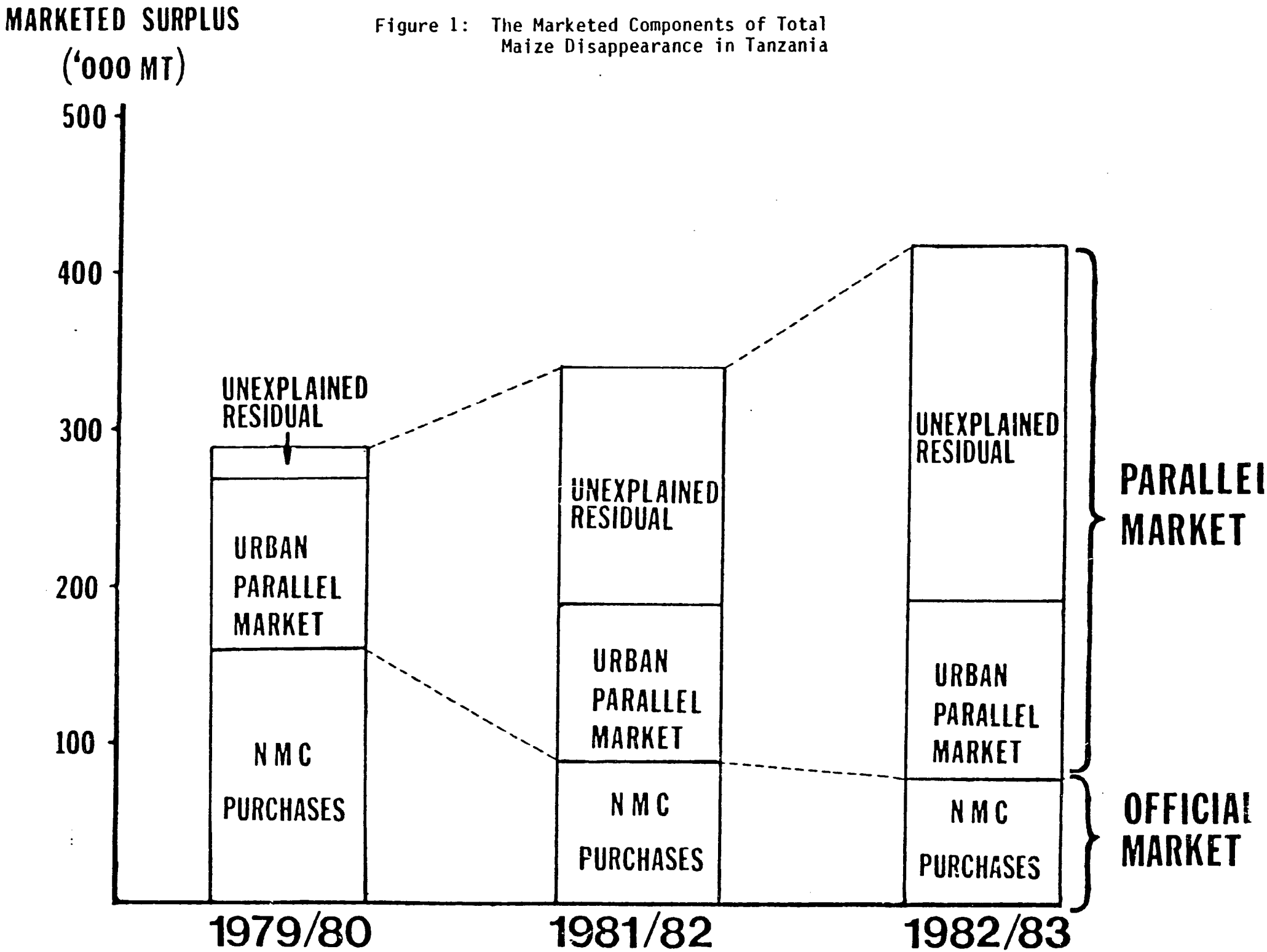
restricted unofficial trade in town markets. Given these restrictions, it is easier for parallel market traders to export maize from the region than to supply Dodoma town.

Finally, the existence of rural deficits in many areas of the country suggests that there is some scope for unofficial flows of maize within rural areas. A priori, it appears unlikely that much in the way of unofficial inter-regional trade has developed to meet this rural maize demand. It is more likely, however, that intra-regional flows might exist in rural areas. To the extent that such trade occurs, maize which might otherwise enter urban markets would instead remain within the rural areas, thereby intensifying the reliance of urban parallel markets on unofficial imports from other regions. This in no way negates the conclusions on the level of overall parallel market activity; it only suggests that the structure may be somewhat different than that presented in the preceding analysis. To the extent that it exists, parallel market trade within rural areas would increase the importance of the parallel market for the country as a whole.

2.3.5 Unexplained Elements of Maize Disappearance

Figure 1 illustrates the components of surplus maize disappearance for the three years which have been analyzed. One is immediately struck by the growth of the share of marketable surpluses being disposed of through unofficial channels and the dwindling importance of the official market. Equally striking is the fact that while the amount of maize entering the parallel

Figure 1: The Marketed Components of Total Maize Disappearance in Tanzania



market has been growing each year, urban parallel market demand has remained fairly steady. For a given year, the difference between the supply of maize available to the parallel market and urban parallel market demand may be termed an "unexplained residual", and represents a measure of what remains unknown about maize disappearance in Tanzania. Three likely sources of these unexplained residuals are considered here. These are offered as hypotheses which merit future study but which, at the present level of knowledge, remain unverifiable.

First, a possible source for the unexplained residual may be that the production figures used in the preceding analyses are overestimates and/or the consumption figures from the HBS subsample are underestimates. With regard to the production data, it is possible that in some areas the amount of total production required for seed and feed plus post-harvest losses amounts to more than 10 percent--the figure used in the analyses. As for the consumption estimates, it is possible that the information generated by the sampling procedure did not capture all maize consumption. However, the fact that the unexplained residual has grown over time implies that these residuals might represent a real phenomenon that is changing in some systematic fashion, perhaps in response to economic factors.

A second element of unexplained residual could be illegal international trade. While the volumes involved in this type of trade are unquantifiable, it is widely reported that large and growing amounts of Tanzanian maize have been illegally exported into neighboring countries each year. Two sources have noted

that much of the surplus maize produced in certain areas located on the Kenya border (especially Tarime, Rombo and Arumeru districts) is being sold in Kenya at prices much higher than those prevailing in Tanzanian markets (Keeler, 1982; and Barrett, 1982). In addition to the trade with Kenya, there are also believed to be substantial illegal flows of maize from Rukwa and Mbeya regions into northern Zambia. It is likely that this international trade accounts for a substantial increment of the unexplained residual for 1981/82 and 1982/83. The fact that the unexplained residuals have increased over time seems to confirm the notion that this type of trade has become progressively more common in the past few years.

A final likely component of unexplained residual is intra-rural unofficial trade. In all years there have been substantial shortages of maize in certain rural areas due to production shortfalls. To the extent that these deficits are not met by official sales, there has been significant demand for maize in these areas which could only have been met by parallel market trade. Moreover, there are substantial (albeit scattered) numbers of rural dwellers who depend on markets for some or all of their food needs. These include agricultural laborers such as estate workers, miners, petty traders in what were formerly termed "minor settlements", and professionals (such as teachers and health workers) based in rural areas. Finally, in some areas of the country farmers have become rather specialized to specific crops and typically depend on markets to satisfy their maize

needs*. All of the above indicate that there is significant scope for rural parallel markets for maize. Such trade no doubt accounts for an important part of the unexplained residuals. At the same time, however, it is likely that rural markets--to an even greater degree than their urban counterparts--do not accommodate large numbers of rural dwellers due to both physical limitations (e.g. poor roads in rural areas) and economic factors (e.g. relatively lower purchasing power in rural areas). As such, it appears that these rural dwellers have borne the greatest part of the burden imposed by the nation's inability to adequately distribute its maize production.

It is suggested, as a matter for further investigation, that the so-called unexplained residuals represent a real economic phenomenon that has evolved in response to the distortions in the markets for maize. This phenomenon is probably composed of growing unofficial international trade and growing unofficial rural trade.

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*Examples include coffee growers in Mbinga district and rice producers in Kyela district.

Section 3

A Synthetic Model of Marketed Supply Response to Price

In this chapter, a simple model of the supply response of rural households to changes in product and factor prices is estimated for a number of different areas in Tanzania. The model explicitly accounts for the interaction of changes in any or all of four exogenously determined policy variables--the price of food crops, the price of cash crops, the cost of purchased inputs, and the price level of consumer goods. In addition to estimating the proportional changes in real household income and output of two types of crops resulting from changes in these policy variables, the model also supplies information concerning alterations in the relative intensities of the use of different factors of production brought about by these changes.

The first section of this chapter describes the logic and simplifying assumptions which underlie the model's derivation. The second section presents the parameters used in operationalizing the model, as well as describing the method whereby they were estimated. The third section presents elasticities of marketed supply generated by the model. In the final section, results of a sensitivity analysis of the parameters are presented.

3.1 The Logic of the Household Production Model

The comparative statics model derived here makes the following assumptions about the nature of production activities within households:

- There are two types of crops grown--food crops and cash crops. Cash crops include both export crops, of which 100 percent of output is marketed, and, in some cases, crops of which a small part of output is retained but which are primarily grown for the purpose of generating cash income.
- A household satisfies its nutritional needs only through its own production of food crops; that is, households cannot purchase food in the market. That increment of food production in excess of household nutritional requirements is the household's marketable surplus.
- The only sources of income available to the household are crop production. It is assumed that other agricultural activities (e.g., livestock production) and non-agricultural wage labor do not exist as means of generating household income. Food output which is consumed is considered both as an element of the household's income and its cost of living (i.e. the household buys food from itself).
- There are two factors of production--capital (i.e. purchased inputs) and labor. Capital is available in an infinitely elastic supply at a given price, whereas the supply of household labor is fixed. Labor is allocated between food and cash crop production such that the value of the marginal products in the two productive activities are equated. In other words, it

is assumed that the opportunity cost of devoting a man day of labor to food production is the return to that man day of labor which would have resulted from its allocation to cash crop production.

- Both food and cash crop production functions are characterized by constant returns to scale. Moreover, farmers equate the marginal rates of substitution with respect to the prices of food and cash crops and the marginal rates of transformation with respect to the prices of purchased inputs and labor.
- Households spend all of their cash income on purchased inputs and consumer goods. In other words, it is assumed that there are no savings within households.

At the heart of the model lie eleven fixed parameters which measure various aspects of household behavior with regard to production, income and expenditure (consumption) patterns. Taken in sum, these parameters describe the entirety of household activities (subject, of course, to the assumptions noted above). Parameters relating to production are the labor cost shares in food and cash crop production, the share of total work time allocated to food production, the share of all purchased inputs used in food production, and the elasticities of substitution of capital for labor in food and cash crop production. Income parameters are the share of net income* derived from cash crop

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*"Net income" is the value of total crop production less the cost of purchased inputs used in production.

production and the share of food production marketed. Consumption and expenditure parameters include the value of food consumption as a percent of net income, the consumption elasticity of substitution between food and consumer goods, and the percentage of net income spent on purchased inputs. These parameters (and the method in which they were estimated) are presented in Section 3.2 and Appendix C.

The model estimates the impact of changes in four policy variables (i.e. the prices of food crops, cash crops, purchased inputs, and consumer goods) on the household's production of the two types of crops, intensity of the use of the two factors of production, the amount of consumer goods purchased, real income, and the level of food retained for consumption by the household. The manner in which these are estimated is as follows:

- Given a set of parameters and a set of real price (i.e. policy variable) changes, the income effects of the price changes are computed by means of Laspeyre's index.
- Changes in the household's demand for food and consumer goods are then computed. Income and own-price elasticities of food demand of 0.4 and -0.3, respectively, (as estimated from the HBS data) were imposed on the system to account for income and substitution effects on household demand for food and consumer goods.
- Given changes in the prices of food crops, cash crops and purchased inputs, the model solves the derived

demand for labor by equating the value of the marginal products of labor in food and cash crop production. Given the altered allocation of labor between food and cash crop production, new derived demand for purchased inputs is calculated by equating the marginal rates of substitution with respect to food and cash crops with the marginal rates of transformation with respect to the prices of two factors of production.

- The computed allocations of labor and capital to the two productive activities are then entered into the respective production functions; this yields new levels of cash crop and food crop output. Through a Picard iteration technique, the computed output changes are re-inserted into the income equation and the food, consumer goods and factor demand equations are re-solved. The iterative process is repeated until numerical convergence is achieved and a new equilibrium solution is obtained.

While this model is obviously a greatly simplified representation of household production behavior in rural Tanzania, it does capture the fundamental elements which determine how, on aggregate, farmers react to various economic stimuli. As such, the output of the model provides us with a broad indication of the likely effects of certain policy changes.

3.2 Estimation of Parameters for the Household Production Model

To estimate the parameters for the household production

model, the following farm management data was needed:

- total food crop production by households,
- the amount marketed of each food crop,
- the average (sales-weighted) price received for each food crop,
- total cash crop production,
- the price received for each cash crop,
- the cost of purchased inputs (including hired labor) used in food production,
- the cost of purchased inputs (including hired labor) used in cash crop production,
- the amount of family labor used in food production, and
- the amount of family labor used in cash crop production.

Parameters were estimated for specific areas in five regions in Tanzania. Appendix C presents farm budgets for each of these areas; these budgets contain the information needed to estimate the parameters. Appendix C also presents the actual formulas used in calculating the parameters. With one exception, the required information was taken from recent farming systems studies (Bo and Rasmussen, 1982; Mwaipyana, 1982; Due and Anandajayasekerem, 1982; Loft and Oldevelt, 1981; and Oates, 1982). Data for all food crops grown in a given area were aggregated into a composite. For those areas in which more than

one cash crop is grown, data were similarly aggregated*. Finally, in most cases the cash crops grown are export crops, for which 100 percent of production is marketed. However, in four of the areas under consideration, a small percentage of the cash crop is retained for home consumption**. In these instances the portion retained by the household was included with the food crops in estimating labor-cost and income shares. Table 25 presents the areas for which parameters were estimated and the crops grown in those areas.

In all cases, prices used in valuing output were sales-weighted average market prices received by farmers. For the most part, the sales-weighted average food crop prices were markedly higher than official prices, reflecting the difference between official and parallel market prices. Table 26 presents average prices of the major crops grown in the areas analyzed.

In some cases, information concerning purchased input use or labor use was unavailable. In these cases, assumptions based on field observations were made in order to estimate certain parameters. These are noted in the tables in Appendix C. Admittedly, this detracted from the rigor of the exercise; but given the paucity of farming systems information available in Tanzania at present, this was unavoidable. Moreover, given the simplicity of the model, this limited amount of "educated

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*These areas are southern Iringa, Njombe, Rungwe, southern Mbeya and Kilosa districts.

**These crops are potatoes in Njombe, potatoes and cabbage in southern Iringa, finger millet, and sunflower seeds in Kilosa.

Table 25: Areas for which Parameters were Estimated

Area	Food Crops	Cash Crops
S. Iringa District	Maize, Cowpeas, Beans, Groundnuts	Potatoes, Cabbage
Rungwe District	Maize, Bananas, Beans	Coffee, Tea
C. Mbozi District	Maize, Finger Millet, Beans, Groundnuts	Coffee
E. Mbozi District	Maize, Beans, Finger Millet	Coffee
Songea District	Maize, Cassava, Finger Millet, Sorghum, Groundnuts	Tobacco
Kigoma Region	Maize, Beans	Cotton
Lindi Region	Maize, Paddy, Sorghum, Cassava	Cashewnuts

Source: Various farm management publications.

Table 26: Average Prices Received by Producers for Various Crops and Years

Area	Marketing Year	Crop	Official Producer Price (Tsh/kg)	Average Price Received (Tsh/kg)
S. Iringa District	1980/81	Maize	1.00	1.75[3]
S. Iringa District	1980/81	Potatoes	-	1.00[3]
Rungwe District	1981/82	Maize	1.50	2.42
Rungwe District	1981/82	Coffee	9.00	9.00
Central Mbozi District	1981/82	Maize	1.50	1.65
Central Mbozi District	1981/82	Coffee	9.00	9.00
Eastern Mbozi District	1981/82	Maize	1.50	1.66
Eastern Mbozi District	1981/82	Coffee	9.00	9.00
Songea District	1981/82	Maize	1.50	1.50
Songea District	1981/82	Tobacco	12.60	12.60
Kigoma Region	1978/79	Maize	0.85	1.25
Kigoma Region	1978/79	Beans	3.50	3.45
Kigoma Region	1978/79	Cotton	2.28[1]	2.28
Lindi Region	1981/82	Maize	1.50	3.41
Lindi Region	1981/82	Paddy	2.30	6.62
Lindi Region	1981/82	Sorghum	1.00	4.40
Lindi Region	1981/82	Cassava	0.70	1.51
Lindi Region	1981/82	Cashewnuts	4.70[2]	4.70

[1]Assumes 90 percent AR grade, 10 percent BR grade.

[2]Assumes 80 percent SG grade, 20 percent UG grade.

[3]Prices for Iringa Region are assumed. For maize, a TRDB survey states that 75 percent of private production is sold through unofficial channels. We have assumed that the average unofficial price was Tsh 2.00 that year--double the NMC price. Potato prices were estimated to be the same as current (1982/83) prices.

guesswork" has not impinged on the validity of the results to a significant degree.

In sum, the parameters (presented in Appendix C) provide a broad description of a rather diverse socioeconomic cross-section of rural Tanzanian households in terms of the degree of crop specialization in agriculture, income level, and the modernity of farming techniques. The areas surveyed range from those in which farmers tend to specialize in cash crops (e.g. Eastern Mbozi) to those in which food crop production is of a more commercial nature (e.g. central Mbozi district) to those which are more subsistence-oriented (e.g. Lindi and Kigoma regions).

3.3 Food Supply Response

Table 27 presents own-price elasticities of marketed food supply as generated by the household production model for the seven areas under consideration. The calculated elasticities range from about +0.1 in eastern Mbozi to +0.7 in Lindi. The most frequently occurring (modal) elasticity is +0.4. It is very important to bear in mind that these measures of the increases in output resulting from real price increases can only be effected through an alteration of the existing pattern of allocation of labor and other factors of production to both food and cash crop production. Depending on the factor's cost share and the elasticities of substitution of capital for labor in both productive activities, the re-allocation of labor and capital between food and cash crop production, may have a negative impact on cash crop output as well.

Table 28 presents the simulated effect on the marketed output of food and cash crops given a ten percent increase in real producer prices for food crops (ceteris paribus). As can be seen, in six of seven cases an increase in marketed food output is accompanied by a decline in cash crop production. That this implies that farmers perceive a "trade-off" between the two types of production is not surprising; nevertheless, the fact that in most cases increasing the supply of marketed food comes about at the expense of cash crop production has important implications which will be addressed in the next section.

Table 28 also presents changes in factor use in both activities given a ten percent increase in the real producer

Table 27: Own-Price Marketed Food Supply Elasticities Calculated by a Household Production Simulation Model

Area	Marketed Supply Elasticity
S. Iringa District	+.43
Rungwe District	+.44
C. Mboze District	+.30
E. Mbozi District	+.11
Songea District	+.52
Kigoma Region	+.39
Lindi Region	+.74

Source: Sigma One Corporation

Table 28: The Simulated Effect on Output and Factor Use of a Ten Percent Increase in Real Producer Prices of Food Crops (%)

Area	Percentage Change in Marketed Food Output	Change in Cash Crop Output	Change in Labor Used in Food Prod.	Change in Labor Used in Cash Crop Prod.	Change in Purch. Input Use in Food Prod.	Change in Purch. Input Use in Cash Crop Prod.
S. Iringa	+4.3	-7.8	+1.3	-9.0	+3.3	-5.2
Rungwe	+4.4	-0.8	+2.1	-1.1	+3.0	+1.8
C. Mbozi	+3.0	-1.7	+0.7	-2.1	+2.0	+0.9
E. Mbozi	+1.1	+0.4	-0.5	+0.5	+0.1	+2.3
Songea	+5.2	-2.7	+1.7	-3.9	+3.3	-0.2
Kigoma	+3.9	-4.8	+1.4	-7.2	+2.9	-2.6
Lindi	+7.4	-10.5	+2.9	-11.7	+6.0	-8.7

Source: Sigma One Corporation

price of food crops. It is the re-allocation of factors embodied in these figures which yields the changes in output of both types of crops. As can be observed, increased producer prices for food crops leads in all cases to greater input use and in most cases to greater labor use in food crop production. Interestingly, in half the cases, input use in cash crop production also increases. This is largely a function of the elasticity of substitution of capital for labor; the higher this elasticity, the more likely a farmer is to replace labor shifted into food crop production with increased use of capital in cash crop production.

As may be recalled, the household production model has been specified such that the amount of available household labor is assumed to be fixed, but that purchased inputs are available in unlimited quantities at a given price. It is of interest to calculate the change in the total amount of inputs used in both activities, given an increase in the producer price of food crops. This is done by weighting the change in input use in each activity by the share of total input use accounted for by that activity.

Table 29 presents the changes in total input use resulting from a ten percent increase in real producer prices of food crops. In all cases the price-induced changes in the pattern of resource allocation depend on increases of up to 3.1 percent in the use of purchased inputs. The supply response predicted by the model thus hinges on the ability of those

Table 29: Changes in Total Purchased Input Use Resulting from a Ten Percent Increase in Real Producer Prices of Food Crops

Area	Change in Total Input Use
S. Iringa District	+2.3%
Rungwe District	+2.1%
C. Mbozi District	+1.4%
E. Mbozi District	+1.7%
Songea District	+1.2%
Kigoma Region	+0.2%
Lindi Region	+3.1%

Source: Sigma One Corporation

institutions charged with the distribution of purchased inputs to make those inputs available to farmers. If increased supplies of inputs are not available, the output responses to price changes will be smaller than those predicted by the model.

3.4 Sensitivity Analysis

The sensitivity analysis of the elasticities generated by the household production model for the different cases included a simulation analysis in which the elasticity of substitution in food demand and the elasticities of substitution of capital for labor in food crop and in cash crop production were allowed to vary. The simulation generated ten values for each of the elasticities in each of the cases. Also included were an analysis of the variance components of the elasticities generated by the simulation and analysis of the trade-off between the elasticity of food crop production and each of the other elasticities generated by the model.

The analysis shows that the model will yield robust solutions for the elasticities of food crop production and of the marketed surplus of food in almost every case. Values for the elasticities of cash crop production and of food consumption will be less reliable due to greater variability among those values generated by the simulation. Elasticities of the allocations of labor to food and cash crop production will generally yield reliable values while solutions for the allocation of purchased inputs to food and cash crops and the value of the marginal product of labor in food and cash crop production would not be reliable in some of the cases.

The analysis of variance shows that the elasticities are most sensitive to the case or area for which they are being estimated. The variation across cases is expected because of the differing characteristics and types of production of each area. Any interpretation which would attach the results of a specific case to a more general perspective may prove unreliable without having first assured the similarity of the parameter estimates for the broader case.

Elasticities of food crop production, the marketed surplus of food, the allocations of labor and purchased inputs to food crops and the value of the marginal product of labor in cash crops are significantly affected by changes in the elasticity of substitution in food demand and in the elasticities of substitution of capital for labor in both food and cash crop production. Elasticities of cash crop production, the allocations of labor and purchased inputs to cash crops, and the value of the marginal product of labor in food crops are significantly affected by the elasticities of substitution of capital for labor in both food and cash crop production. Food consumption is significantly affected by the elasticity of substitution in food demand.

The model consistently demonstrates the clear trade-off between food and cash crop production (see Figure 2). Large increases in food production generally result in correspondingly large decreases in cash crop production and increases in the marketed surplus of food (Figure 3). Increasing allocations of

Figure 2: The Relationship Between Food Crop Production and Cash Crop Production

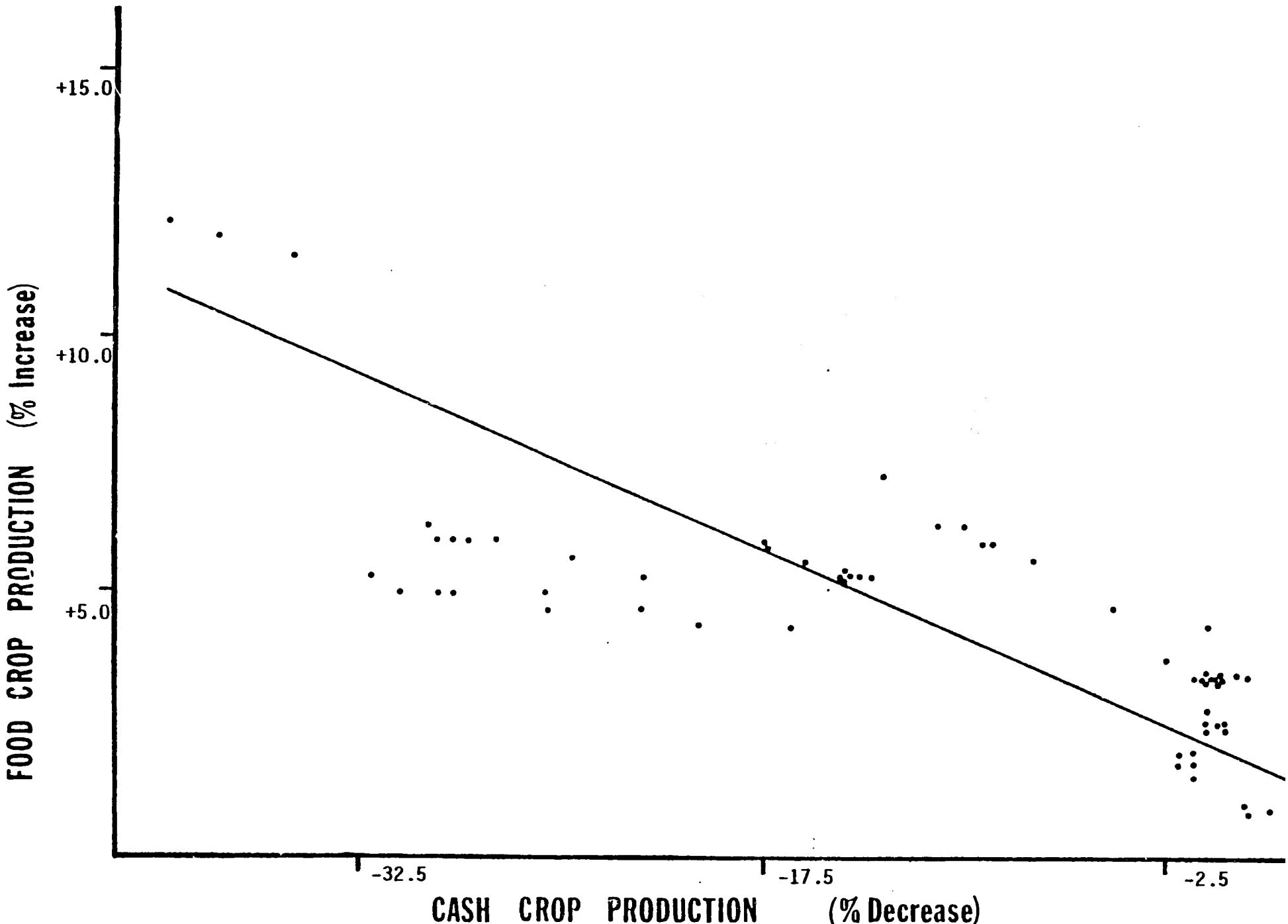
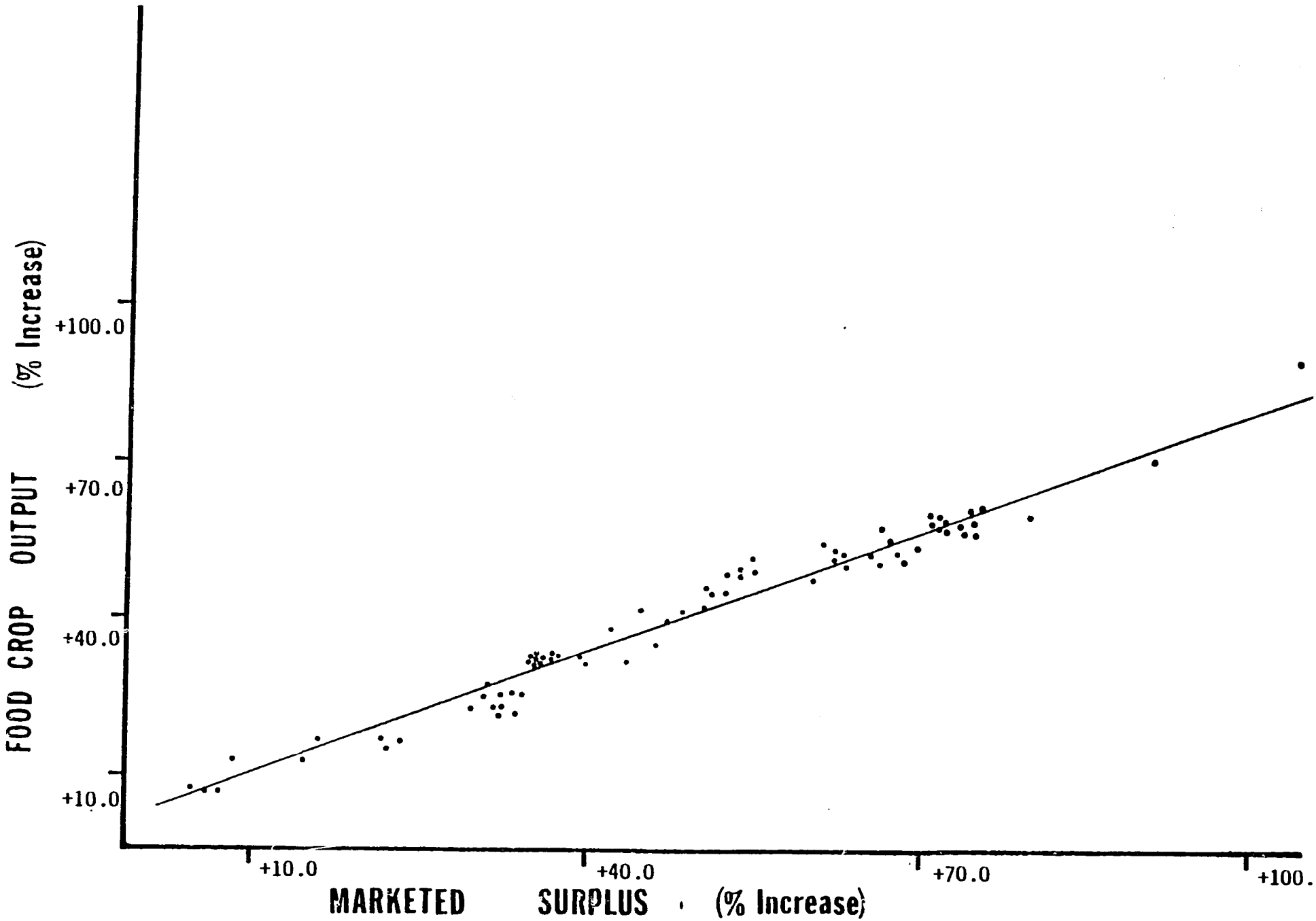


Figure 3: The Relationship Between Total Food Crop Production and Marketed Surplus



labor and purchased inputs to food crop production result in increasing production of food crops, as would be expected (Figures 4 and 5). On the other hand, there appears to be little correlation between changes in the elasticities of substitution of capital for labor in food or cash crop production and food or cash crop output.

Underlying the results of the synthetically-predicted supply response to increased producer prices is the notion that higher prices for maize would mobilize resources into maize production from other uses. These resources, of course, include land, labor, implements, tilling power, fertilizers, other chemicals and packaging and storage materials. These factors of production would have to be forthcoming, otherwise the increased supplies may not materialize. This study has not analyzed the potential for these resources to be mobilized, but it would be unwise to assume that their mobilization would ensue without significant effort by the appropriate public and parastatal institutions which control the allocation of resources to agriculture.

While it is generally true that land would not be a major constraint, it should be recognized that higher prices for maize could, in some regions, divert land and other resources away from cash crops and perhaps other food crops. Furthermore, the analysis suggests that significant re-allocations of labor and other inputs would be diverted from other productive activities unless institutional and market forces were to bring new or formerly idle resources into agriculture. Thus, there is a strong need for complementary actions in providing needed inputs

Figure 4: The Relationship Between Time Spent in Food Crop Production and Food Crop Output

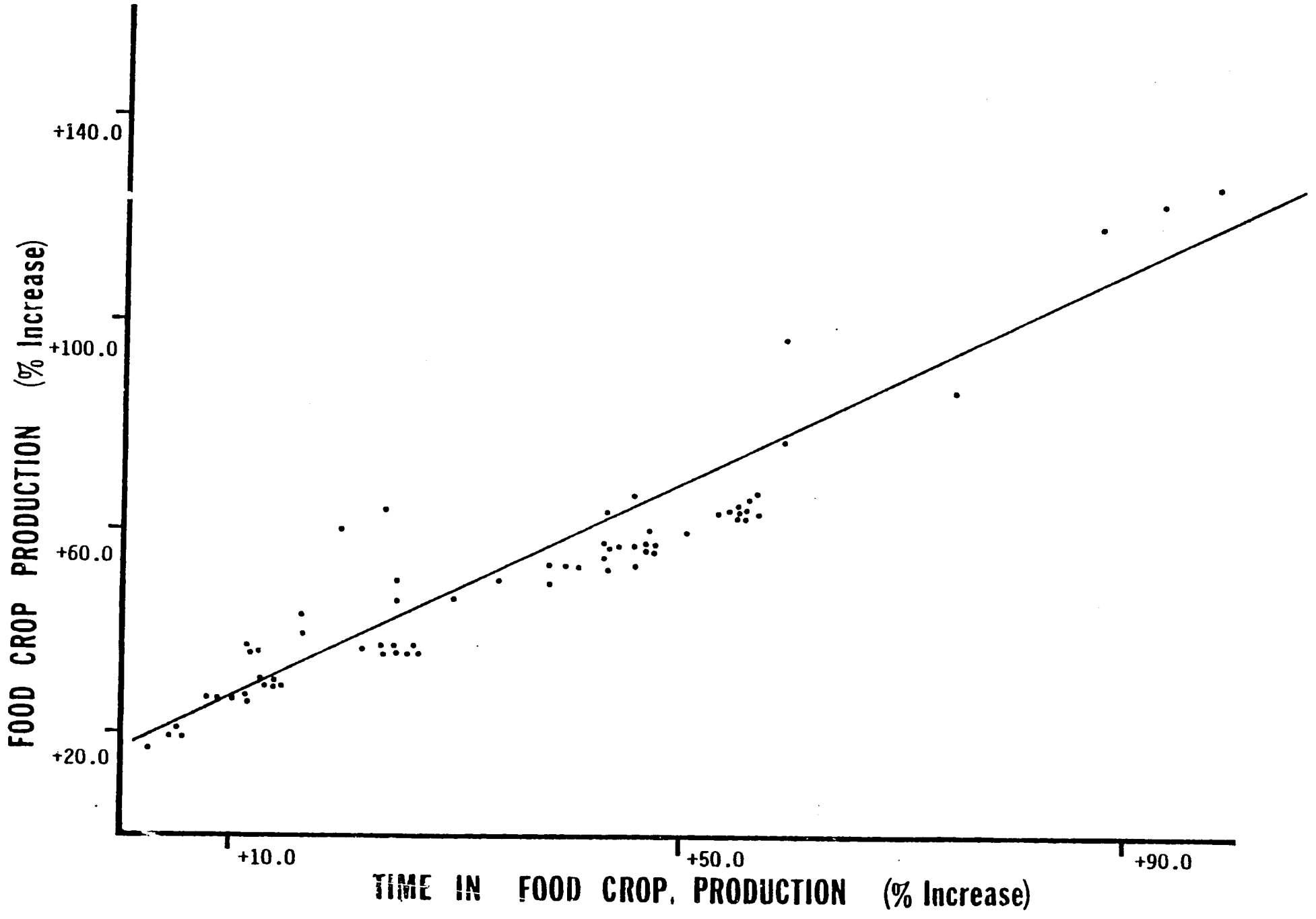
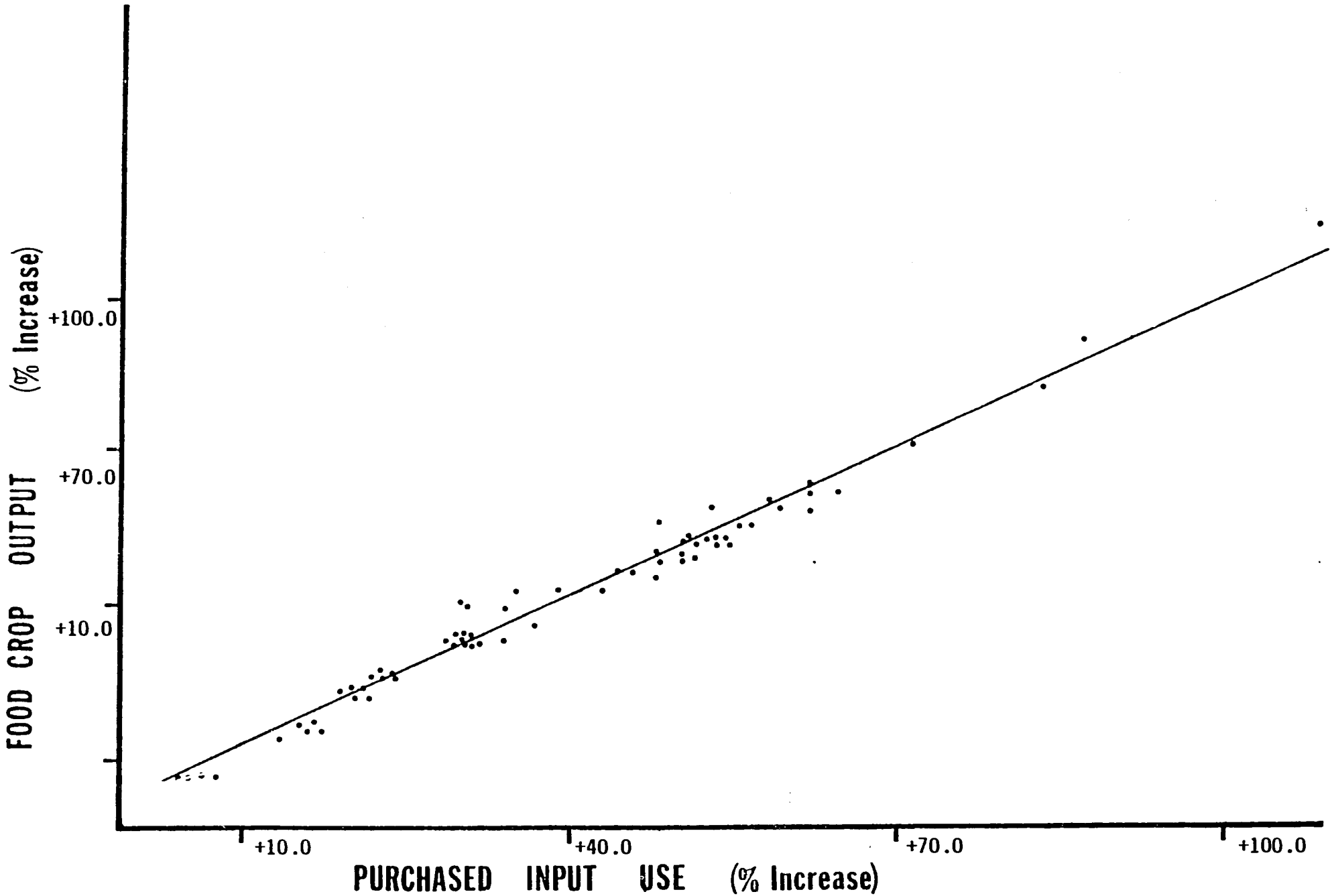


Figure 5: The Relationship Between Food Crop Output and Purchased Input Use



and agricultural services in order to facilitate the farmers' ability to respond to the improved incentives. In the longer run there is a need for further research and extension to enhance the farmers' ability to substitute less scarce for more scarce productive resources.

Section 4

Policy Analyses

With the first quantitative information on the size and scope of the parallel market as a basis, it is now possible to analyze the policy issues regarding the markets for maize in Tanzania. The information on the parallel market, the econometric estimates of demand parameters and the synthetic estimates of supply response have been integrated into an economic model of supply and demand for maize.* This model was used to simulate the likely impacts of alternative producer and consumer pricing policies, market structures, and import regimes on different segments of the Tanzanian population. The results of the simulation analysis are presented in Sections 4.1 and 4.2. At this point, it is necessary to consider the logic underlying the model.

The economic model of the markets for maize attempts to represent the structure and interaction of the official and parallel markets as they currently operate in Tanzania. Under the present market structure there is no necessary equilibrium between official demand and official supply since prices are set arbitrarily on both sides of the market. Official procurements are determined by the official producer price. Since consumer prices in the official market are subsidized below the cost which

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*The mathematical structure of the model is presented in detail in Appendix D.

reflects the official producer price, the logic of the model predicts that excess demand conditions would generally occur. Part of this excess demand is met through the sale of imported maize. However, official sales do not meet all demand nor do official purchases account for all marketed production. The parallel market acts to equilibrate the unofficial supply and demand.

The model considers the parallel market to be a residual phenomenon. That is, it implicitly assumes that consumers initially attempt to satisfy demand by purchasing maize from the NMC.* The residual maize demand in excess of official supplies is met by the parallel market. The unofficial price is an equilibrium price which, unlike official prices, adjusts to varying supply and demand conditions such that it clears the market.

The underlying logic of the model may be best understood through graphical illustration. Figure 6 presents a graph of the supply/demand model for the market for maize. The supply schedule S^D represents the aggregate marketed surplus response to farmgate prices by Tanzanian maize producers. At an official producer price P_0, the NMC captures a quantity of domestic production equal to Q_0^{SD}. Since the consumer price is subsidized, aggregate demand exceeds this quantity, and the NMC

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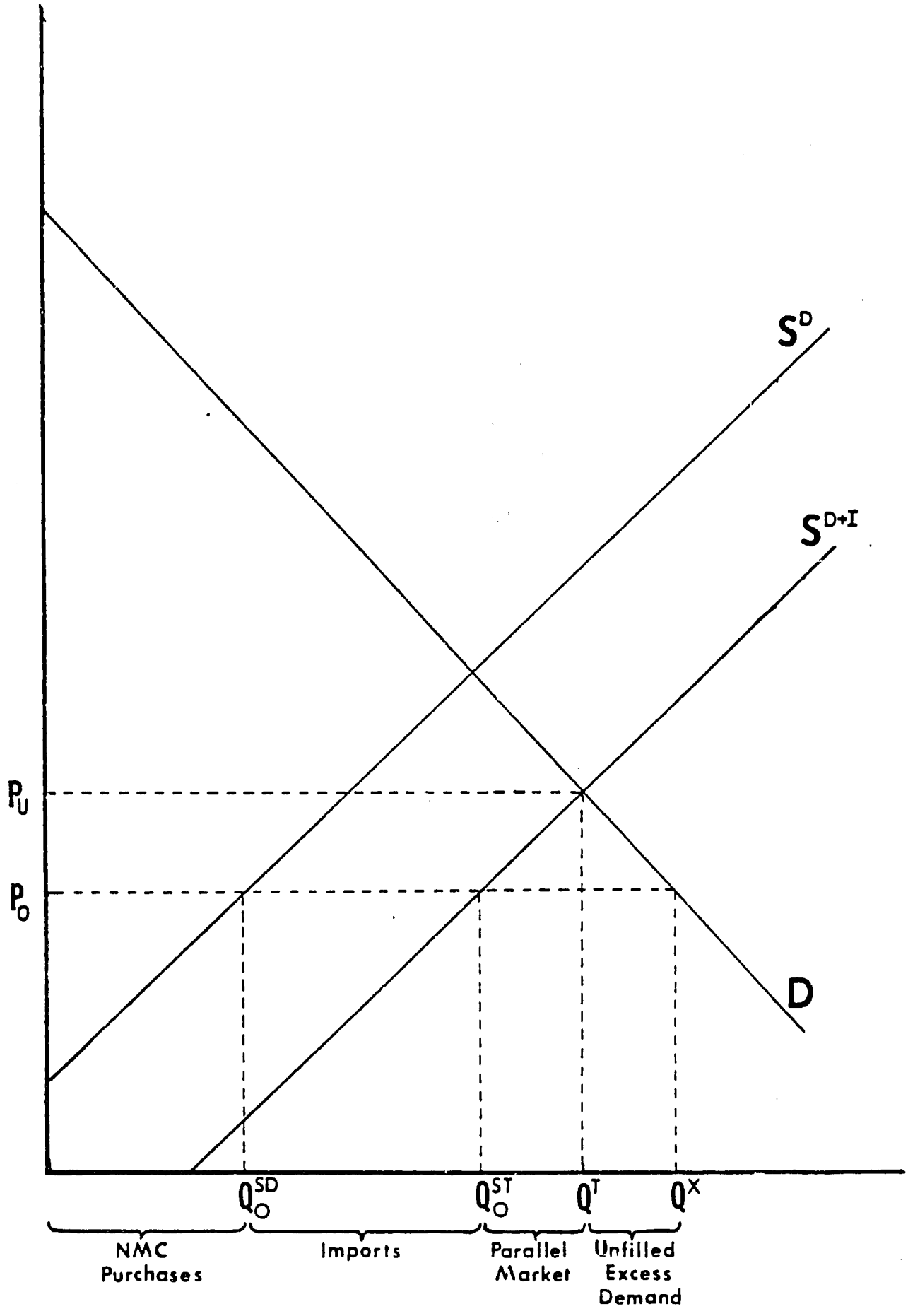
*The model is based on maize equivalents, and is thus a derived demand model. Throughout this discussion, "maize" is used to denote maize and sembe.

Figure 6


S^D
S^{D+I}
P_U
P_O
D
Q_O^{SD}
Q_O^{ST}
Q^T
Q^X
NMC Purchases
Imports
Parallel Market
Unfilled Excess Demand

attempts to meet the excess demand through imports. This effectively shifts the supply curve to the right so that domestic official supply, Q_0^{SD}, plus imports equals total official supply, Q_0^{ST}. The fact that parallel markets exist indicates that total official supply does not meet aggregate demand. The remaining excess demand must be met by the parallel market at unofficial price P_u, with the difference between total official supply and the total amount of maize available within the country, Q^T, being the size of the parallel market.

An important objective of the simulation analysis was to gauge the price and quantity impacts of the removal of the sembe subsidy. As illustrated in Figure 7, removal of the subsidy would effectively shift the aggregate demand curve from D to D'.* As the official producer price (and hence the level of official procurements) would remain unchanged, the shifting of the demand curve would reduce the excess demand within the official market. This in turn would exert downward pressure on prices and quantities traded in the parallel market and reduce import requirements.

The model was also used to simulate the effects of removing restrictions on private trade. Such a policy is identified by

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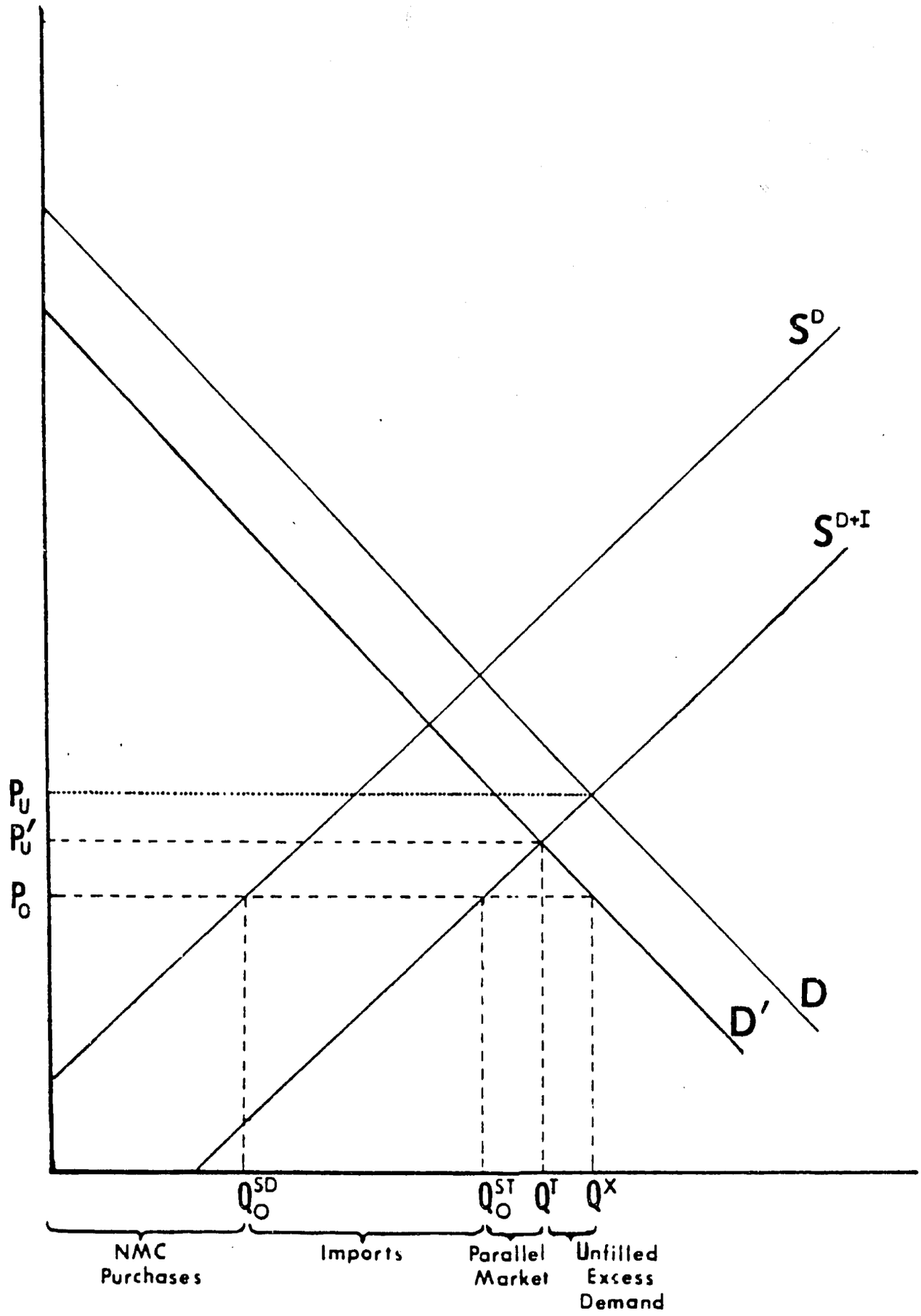
*Note that the prices depicted in Figure 7 are those faced by producers. Prices faced by consumers after removal of the subsidy are assumed to be a fixed percentage mark-up over producer prices, so the model does not yield estimates of consumer prices directly. Removal of the subsidy means that for any given official producer price, the "new" official consumer price is greater and demand is lower. Hence the shift in the demand curve.

Figure 7


S^D
S^{D+I}
P_U
P_U'
P_O
D
D′
Q_O^{SD}
Q_O^{ST}
Q^T
Q^X
NMC Purchases
Imports
Parallel Market
Unfilled Excess Demand

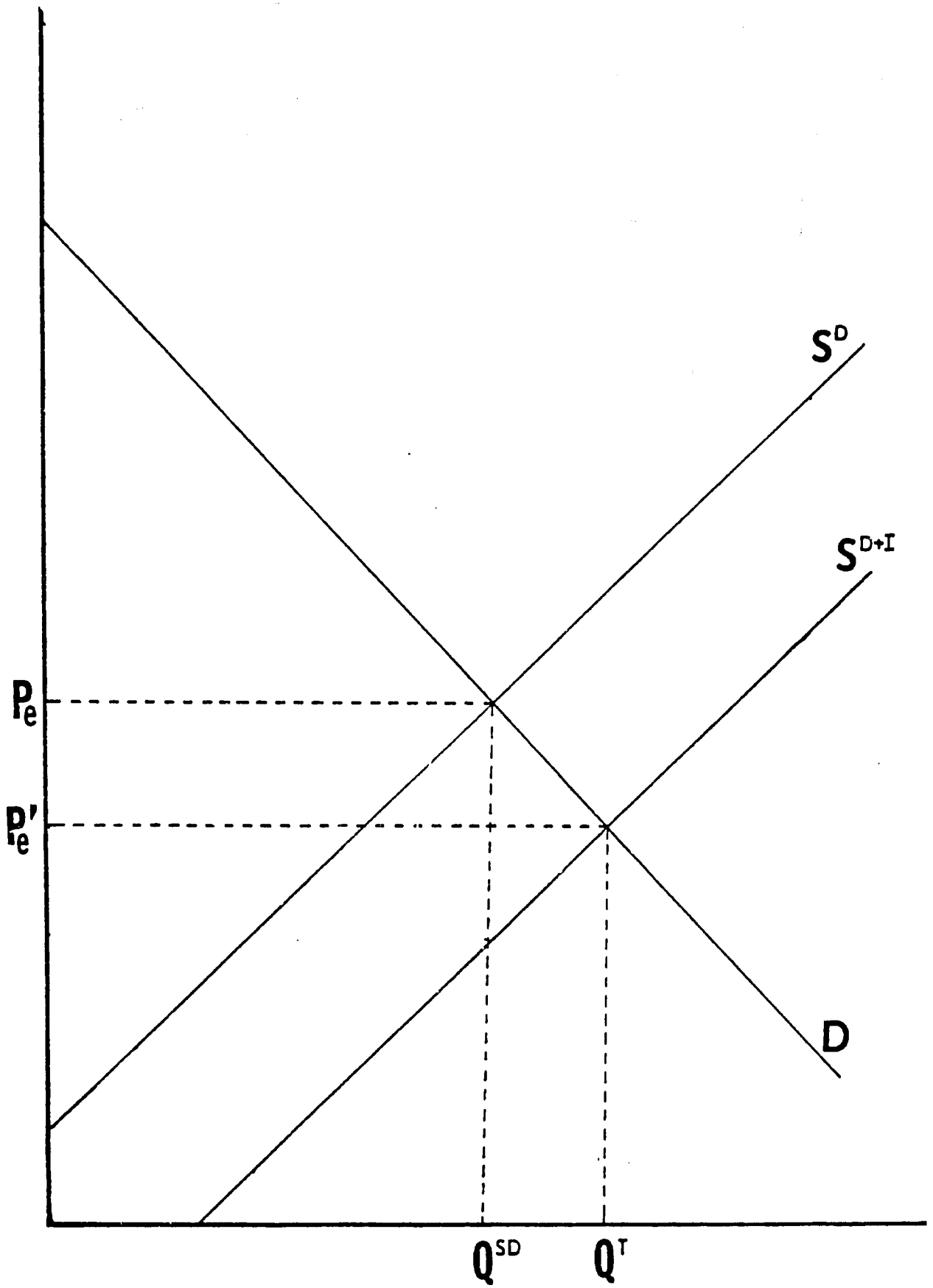
the rubric "market unification". Market unification does not imply an elimination of the NMC, nor does it imply elimination of the parallel market; rather, scenarios pertaining to market unification simulate the effects of competition between the private and public sectors. As such, it represents a policy which has frequently been termed "the NMC as buyer/seller of last resort."

As modelled, a unified market would be characterized by a single market clearing price determined by the intersection of the aggregate supply and demand schedules (see Figure 8).* All other things being equal, total disappearance of maize, Q^T, would be the same as in a dual market structure, but the supply schedule would no longer be segmented into official and unofficial marketings. The domestic supply is given by the supply schedule S^D. It can be seen from Figure 8 that imports would serve to shift the supply curve out to S^{D+I} thereby lowering the market clearing price from P_e to P_e'.

The model was calibrated to fit the data for the 1979/80 marketing year--a year considered normal in terms of growing conditions. In the next two sections, the model is used to develop estimates of what might have occurred had different policies been pursued. The model and its use are policy analysis tools--not a projections apparatus. Its principal value is to

*This equilibrium price is identical to the parallel market price within the dual market structure.

Figure 8



indicate the qualitative nature of alternative policies as opposed to being used to make quantitative forecasts.

4.1 Removal of Consumer Subsidies

The simulated effects of eliminating the consumer subsidy on sembe under two assumptions about the marketed supply response to price by farmers are presented in Table 30. According to the simulation analysis with the 1979/80 marketing year as the base case, removal of the subsidy on sembe would have reduced the required level of imports even if the official producer price had remained fixed. The reduction in the conditions of excess demand would have also reduced the parallel market producer price and led to a net reduction in the total volume of marketed supplies within the country.

Removal of the subsidy would have reduced the effective demand on the part of consumers with access to NMC supplies by 14 percent. In each case, the volume and price in the parallel market would have been reduced because the excess demand pressures generated in the urban areas by the subsidy would have eased. Domestic parallel marketings would have dropped by 58 percent in the low supply elasticity case and by 38 percent in the high elasticity case. Parallel market prices would have fallen by 36 percent and 17 percent, respectively.

The principal effects of such a policy, had it been implemented in 1979/80, would have been to reduce maize consumption of those currently being served by the NMC and to

Table 30: Simulated Effect of Removal of Consumer Subsidies on the Markets for Maize in Tanzania Assuming the Same Level of Imports (Base Case 1979/80 Marketing Year)

Effect		With Consumer Subsidy (Base Line)	Without Consumer Subsidy
Low Supply Elasticity Assumption (0.4)	Official Producer Price	1.00	1.00
	Unofficial Producer Price	2.68	1.71
	Official Domestic Supply	161.10	161.10
	Imports	61.90	29.80
	Total Official Sales	223.00	190.90
	Unofficial Supply	108.50	45.70
	Total Disappearance	331.50	236.60
High Supply Elasticity Assumption (0.8)	Official Producer Price	1.00	1.00
	Unofficial Producer Price	1.84	1.53
	Official Domestic Supply	161.10	161.10
	Imports	61.90	29.80
	Total Official Sales	223.00	190.90
	Unofficial Supply	108.50	67.70
	Total Disappearance	331.50	258.60

Prices are expressed in Tanzanian shillings per kilo. Quantities are expressed in thousands of metric tons.

reduce the level of required imports*. At higher consumer prices for NMC sembe, NMC customers would have reduced their demand through the substitution effect and the negative impact on their real income from higher prices.

4.2 Market Unification

Within the recent debate and commentary among analysts of Tanzanian food policy, there has been discussion of the concept whereby the role of the National Milling Corporation (NMC) would be altered. Specifically, it has been suggested that NMC specialize its areas of procurement and sales and that in those areas it assume the role of market stabilizer (i.e. become the buyer and seller of last resort). This proposal, it is argued, would result in reduced NMC overheads, reduced foreign exchange costs and a net gain in national welfare. The proposal, however, implies that private trade at all levels (i.e. retail and wholesale) must be allowed and in fact encouraged. Furthermore, the proposal implies a redistribution of real income within the country.

The simulation analyses for the concept of market unification are presented in Tables 31, 32 and 33. Table 31 presents the simulated effect of operating a unified market with the same level of consumer subsidies and the same level of imports. The table clearly shows that under both supply

*This assumes that the NMC would be able to detect the change in effective demand and respond by reducing imports. In absence of this effective response, NMC would have been left with substantial unsold stocks in its traditional sales areas (e.g. Dar es Salaam and Tanga).

Table 31: Comparison of Simulated Effects of Market Unification Versus a Dual Market Structure at the Same Levels of Imports and Consumer Subsidies (Base Case: 1979/80 Marketing Year)

		Price and Quantity Effects	
		Dual Market Structure	Unified Market Structure
Low Supply Elasticity Assumption (0.4)	Official Producer Price	1.00	2.68
	Unofficial Producer Price	2.68	2.68
	Official Domestic Supply	161.10	269.60
	Imports	61.90	61.90
	Total Official Supply	223.00	331.50
	Unofficial Supply	108.50	-
	Total Urban Disappearance	331.50	331.50
High Supply Elasticity Assumption (0.8)	Official Producer Price	1.00	1.84
	Unofficial Producer Price	1.84	1.84
	Official Domestic Supply	161.10	269.60
	Imports	61.90	61.90
	Total Official Supply	223.00	331.50
	Unofficial Supply	108.50	-
	Total Urban Disappearance	331.50	331.50

Prices are expressed in Tanzanian shillings per kilo. Quantities are expressed in thousands of metric tons.

elasticity assumptions, NMC would have to compete directly with the private traders and that the price prevailing in the parallel market would become the unified market price. This situation would greatly increase NMC costs since it would pay almost three times as much to producers and therefore would have to increase the per unit subsidy to its customers in order to maintain the same consumer price. It is highly unlikely that NMC would ever be allocated the required level of resources. Furthermore, the customers of private traders would still be paying the high private (but legal) price for maize and sembe. It is clear that equity and cost considerations would preclude market unification without first eliminating consumer subsidies.

Table 32 presents the comparison of effects from different market structures after removal of the subsidy but with the same level of imports*. The table shows again that the principal effect of the dual market structure is to bias the distribution of the consumption of maize towards NMC customers (i.e. principally residents of Dar es Salaam and Tanga), at the expense of producers and consumers who do not have access to NMC sales. For example, the market structure and prices that prevailed during the 1979/80 marketing year when compared to what might have occurred under market unification and removal of consumer subsidies for sembe indicate that urban food demand was overstated by between 17 and 22 percent (relative to equilibrium) as

*By specifying the level of imports, the model must solve for a new official producer price (see Appendix D).

Table 32: Comparison of Simulated Effects of Market Unification Versus a Dual Market Structure without Consumer Subsidies at the Same Level of Imports (Base Case: 1979/80 Marketing Year)

		Price and Quantity Effects	
		Dual Market Structure	Unified Market Structure
Low Supply Elasticity Assumption (0.4)	Official Producer Price	1.31	1.54
	Unofficial Producer Price	1.54	1.54
	Official Domestic Supply	181.10	195.90
	Imports	61.90	61.90
	Total Official Supply	243.00	257.80
	Unofficial Supply	14.80	-
	Total Urban Disappearance	257.80	257.80
High Supply Elasticity Assumption (0.8)	Official Producer Price	1.21	1.40
	Unofficial Producer Price	1.40	1.40
	Official Domestic Supply	188.10	212.60
	Imports	61.90	61.90
	Total Official Supply	250.00	274.50
	Unofficial Supply	24.50	-
	Total Urban Disappearance	274.50	274.50

Prices are expressed in Tanzanian shillings per kilo. Quantities are expressed in thousands of metric tons.

a result of the subsidy and that there was a welfare transfer from producers to NMC customers in the order of Tsh. 87 million.* Furthermore, incremental foreign exchange costs arising from the overstatement of official urban demand amounted to approximately seven million U.S. dollars. To these costs must be added the direct costs of the subsidy plus the foregone opportunity to allocate domestic resources in a more nearly optimal manner. These costs borne by the treasury, producers and selected consumers served to depress the measured cost of living in urban areas by 11 percent at most.**

Another important result of this analysis is that the simulated levels of total urban consumption are 93 percent and 101 percent of estimated urban requirements in the absence of the oversupply by NMC to certain urban areas. The oversupply in the 1979/80 marketing year is estimated to have been 56.2 thousand metric tons, a level not much different than the level of imports. A serious implication of this is that in that year imports were largely required to meet the additional supply requirements which were the result of the distorted pattern of official distribution for maize. This result might have occurred in a normal marketing year such as 1979/80, but should not be

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*Note that in this model the transfer from non-NMC urban consumers to NMC consumers is effected through fiscal and monetary mechanisms rather than directly.

**This income effect is computed from the percentage of the cost of sembe represented by the subsidy multiplied by the expenditure share for maize.

interpreted to be the sole cause of the need for imports. It does, however, pose the question of whether Tanzania can achieve self-sufficiency in maize at reasonable prices and at acceptable levels of food consumption.

As a partial answer to this question, a self-sufficiency scenario is presented in Table 33. The low elasticity case implies per capita urban consumption of approximately 20 percent below estimated requirements and 35 percent below the estimated per capita consumption during the 1979/80 marketing year if the level of NMC oversupply is included. A less drastic but still appreciable reduction in per capita intake is implied by the high elasticity case which yields a 10 percent reduction relative to estimated requirements and 26 percent from the estimated per capita consumption that includes NMC oversupply. Since the scenarios imply substantial redistribution, these figures in turn imply very large decreases in maize consumption for low income urban households that have had access to NMC subsidized maize. When the direct price effects are combined with the resulting income effects the deleterious nutritional consequences for a significant segment of the urban population could be severe.

The magnitude of the nutritional and income effects under a regime of self-sufficiency--which itself seems plausible only under market unification--implies the long term need for imports even in normal years. Tanzania's susceptibility to production fluctuations as a result of weather variability reinforces the need for imports. Furthermore, there is evidence that pursuit of self-sufficiency objectives for maize would cause significant

Table 33: Simulated Effects of National Self-Sufficiency Under Alternative Market Structures and without Consumer Subsidies (Base Case: 1979/80 Marketing Year)

		Price and Quantity Effects	
		Dual Market Structure	Unified Market Structure
Low Supply Elasticity Assumption (0.4)	Official Producer Price	1.76	1.87
	Unofficial Producer Price	1.87	1.87
	Official Domestic Supply	210.00	217.10
	Imports	0.00	0.00
	Total Official Supply	210.00	217.10
	Unofficial Supply	7.10	-
	Total Disappearance	217.10	217.10
High Supply Elasticity Assumption (0.8)	Official Producer Price	1.52	1.65
	Unofficial Producer Price	1.65	1.65
	Official Domestic Supply	228.10	244.80
	Imports	0.00	0.00
	Total Official Supply	228.10	244.80
	Unofficial Supply	16.70	-
	Total Disappearance	244.80	244.80

Prices are expressed in Tanzanian shillings per kilo. Quantities are expressed in thousands of metric tons.

resource misallocations (Keeler et al, 1982). Imports must therefore be considered as a direct and powerful policy instrument rather than what currently appears to be a gap-filling measure.

Through explicit control of the level of food imports the public sector can significantly affect the price level and distribution of food grains even if a unified market structure is established. Perhaps the most important role that NMC would fill within a unified market structure would be that of price and quantity stabilization through the distribution of imported grains. In such a role NMC could assure adequate supplies of food at reasonable prices, particularly to the more vulnerable segments of the population.

The issues relating to the appropriate levels of imports of grain and pricing of those imports as well as the composition of imports is beyond the scope of this study since these issues are affected by the exchange rate regime, international price variability, opportunities for food aid and other aspects regarding domestic resource mobilization. It is important, however, to recognize that an important criterion for pricing imported grains is the concept of import parity. A move towards market unification is in and of itself a move which implies that import parity will become reflected in domestic grain prices. The mechanisms for this are several. On the one hand, traders will view their opportunities to export maize to neighboring countries as one element in their allocative decisions; on the other hand, the production and marketing of maize has a

relatively high import intensity and unless the costs involved are subsidized or otherwise controlled, domestically produced maize will tend to reflect the economic value of all the resources involved. Significant components of the cost of sembe are transport and processing, both of which are quite import-intensive. To the extent that these functions are in the hands of private entrepreneurs, they will tend to reflect the economic costs involved. It would appear almost inevitable that import parity pricing would be an important criterion for assessing the adequacy of a pricing system for maize.

Import parity pricing and market unification both imply spatially differentiated pricing*. The Marketing Development Bureau (MDB) has developed a set of estimates of the economic value of maize in each region. The pattern of prices implied by the MDB analysis has been used to estimate likely deviations from the national average price for each region under an import parity pricing regime. These have been used to estimate the proportional change in regional marketed supply patterns indicated by the analysis in Section 2 of this report. These have been applied to the data for the 1979/80 and 1981/82 marketing years in Tables 34 and 35. The objective of this exercise is to assess the food security consequences of regionally differentiated producer prices.

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*Since import parity pricing depends on the exchange rate, and the exchange rate is overvalued by the criterion of purchasing power parity, this issue cannot be addressed in detail in this study.

Table 34: Projected Levels of Regional Marketed Surpluses Under Import Parity Pricing: 1979/80 ('000 MT)

Region	Index[1]	Estimated Actual Marketed Surplus	Projected Marketed Surplus[2]		
			Low Elasticity[3]	High Elasticity[4]	Worst Case[5]
Dodoma	141	27.5	32.0	36.5	32.0
Arusha	141	57.7	67.2	76.7	67.2
Kilimanjaro	139	7.8	9.0	10.2	9.0
Tanga	125	0.0	0.0	0.0	0.0
Morogoro	154	12.5	15.2	17.9	15.2
Coast	134	0.0	0.0	0.0	0.0
Lindi	134	0.0	0.0	0.0	0.0
Mtwara	125	0.0	0.0	0.0	0.0
Ruvuma	55	21.8	17.9	14.0	14.0
Iringa	104	17.3	17.6	17.9	17.6
Mbeya	105	31.1	31.7	32.3	31.7
Singida	169	0.0	0.0	0.0	0.0
Tabora	149	0.0	0.0	0.0	0.0
Rukwa	77	16.9	15.3	13.7	13.7
Kigoma	158	13.5	16.6	19.7	16.6
Shinyanga	153	0.0	0.0	0.0	0.0
Kagera	162	3.8	4.7	5.6	4.7
Mwanza	175	10.5	13.7	16.9	13.7
Mara	162	52.2	65.1	78.0	65.1
Tanzania	100	272.6	306.0	339.4	300.5

[1]Index of regional economic farmgate value under import parity pricing with the national weighted average equal to 100. Source: MDB, "Proposals for Staple Food Prices Under the Structural Adjustment Programme," 1982.

[2]These are projections of the quantities of marketed surplus which would have been produced in 1979/80 (under different supply response assumptions) had producer prices been spatially differentiated by the criterion of import parity but with the weighted national average price having been the same.

[3]Marketed supply elasticity equals 0.4.

[4]Marketed supply elasticity equals 0.8.

[5]For Ruvuma and Rukwa marketed supply elasticity equals 0.8; for all other regions marketed supply elasticity equals 0.4.

Table 35: Projected Levels of Regional Marketed Surpluses Under Import Parity Pricing: 1981/82 ('000 MT)

Region	Index[1]	Estimated Actual Marketed Surplus	Projected Marketed Surplus[2]		
			Low Elasticity[3]	High Elasticity[4]	Worst Case[5]
Dodoma	141	0.0	0.0	0.0	0.0
Arusha	141	56.8	66.1	75.4	66.1
Kilimanjaro	139	14.8	17.1	19.4	17.1
Tanga	125	0.0	0.0	0.0	0.0
Morogoro	154	0.0	0.0	0.0	0.0
Coast	134	0.0	0.0	0.0	0.0
Lindi	134	0.0	0.0	0.0	0.0
Mtwara	125	0.0	0.0	0.0	0.0
Ruvuma	55	15.4	12.6	9.8	9.8
Iringa	104	26.9	27.3	27.7	27.3
Mbeya	105	57.7	58.9	60.1	58.9
Singida	169	0.0	0.0	0.0	0.0
Tabora	149	0.0	0.0	0.0	0.0
Rukwa	77	112.1	101.8	91.5	91.5
Kigoma	158	7.8	9.6	11.4	9.6
Shinyanga	153	3.8	4.6	5.4	4.6
Kagera	162	9.2	11.5	13.8	11.5
Mwanza	175	0.0	0.0	0.0	0.0
Mara	162	35.8	44.7	53.6	44.7
Tanzania	100	340.3	354.2	368.1	341.1

[1]Index of regional economic farmgate value under import parity pricing with the national weighted average equal to 100. Source: MDB, "Proposals for Staple Food Prices Under the Structural Adjustment Programme," 1982.

[2]These are projections of the quantities of marketed surplus which would have been produced in 1981/82 (under different supply response assumptions) had producer prices been spatially differentiated by the criterion of import parity but with the weighted national average price having been the same.

[2]Marketed supply elasticity equals 0.4.

[3]Marketed supply elasticity equals 0.8.

[4]For Ruvuma and Rukwa marketed supply elasticity equals 0.8; for all other regions marketed supply elasticity equals 0.4.

If a pattern of regionally differentiated pricing similar to that developed by the MDB were to be applied to the marketed surplus estimates for the two reference marketing years--1979/80 as a normal year and 1981/82 as a poor year--and either the high or low elasticity from the synthetic model is used, the aggregate supply would increase in both the normal and the poor year. It would seem that regionally differentiated pricing would enhance rather than detract from food security. This effect could be further enhanced with timely weather, production and marketing information that would allow the NMC and private traders to better deploy available stocks. A worst case scenario considers the possibility that the remote regions, Rukwa and Ruvuma, that produce a large proportion of the national marketed surplus are characterized by relatively high price responsiveness and that the regions closer in are characterized by low price responsiveness. In this situation, high prices during bad years would have little effect on drawing out more maize from the more favorably located regions, while regionally differentiated and thus lower prices for Rukwa and Ruvuma would depress output. Even in this worst case, the impact of regionally differentiated pricing would be no worse than would have been the case in a drought year under the present market structure, so that regionally differentiated pricing is not seen as a serious threat to food security and may in fact lead to more stable food supplies.

4.3 Summary and Conclusions

Significant new information regarding the current structure

of the markets for maize in Tanzania emerges from the analyses in this report. This section summarizes the most important findings of the analyses and discusses their implications for the food policy and food security issues currently under consideration under the Structural Adjustment Programme.

Analyses of regional production and consumption data revealed that between 17 percent and 25 percent of total national maize production (net of seed, feed and waste) has been marketed in three of the past four years. Regional levels of marketed surplus production vary widely, with some regions producing little or no marketable surplus while others produce surpluses well above the national average. The share of these marketed surpluses procured by NMC has declined sharply--from over 50 percent in 1979/80 to less than 20 percent in the present marketing year. The amount of maize sold unofficially in Tanzania's urban parallel markets has remained rather steady at 100 to 110 thousand metric tons per year. An increasing percentage of total marketed surplus appears either to have been lost to the country through spoilage or through illegal international trade, or has been sold in rural parallel markets.

Average per capita consumption of maize in Tanzania has grown significantly since 1969. An important reason for this has been the increasing level of subsidization of NMC sembe. For urban areas well-served by the offical market (principally Dar es Salaam and Tanga), the low price of NMC sembe has induced a certain amount of demand in excess of the consumption

requirements implied by 1976/77 consumption patterns. Estimates presented in this study indicate that in 1979/80 the amount of NMC oversupply was about 20 percent higher than consumption requirements. This result is consistent with predictions from the econometric estimates of demand elasticities. It is somewhat coincidental, but noteworthy, that for the year in which the level of NMC oversupply was calculated the physical volume of the oversupply to urban areas was almost equal to the volume of imported maize sold by NMC. At the same time, however, it is true that the overstatement of urban maize needs induced by the sembe subsidy has led to an overstatement of the nation's need to import maize.

Calculations of the national balance between production and consumption of certain staple foods indicates that in normal years national surpluses of sorghum and millet have exceeded national deficits in maize and rice. This implies that Tanzania normally has the capability to be food self-sufficient, but only if consumers are willing to substitute less-preferred drought staples for maize and rice. Analysis of the HBS data indicated that in fact the national trend has been increased per capita consumption of preferred staples, and (in all but the major sorghum-producing regions) decreased per capita consumption of drought staples. An important reason for these trends has been that official consumer prices (especially for sembe) have been artificially determined such that the relative prices of preferred and drought staples do not reflect the true value to consumers.

The simulation analysis indicated that the present dual market structure combined with the subsidization of NMC sembe has served to drive parallel market prices and import requirements higher than would have been the case had a unified national market for maize existed. The primary effects of official intervention into the marketplace have been to exaggerate import requirements and to bias maize consumption in favor of that segment of the population with access to NMC maize and sembe at the expense of maize producers and market-dependent consumers with limited access to NMC sales. In 1979/80 the computed value of the net welfare transfer to NMC customers was approximately Tsh. 87 million. The existence of a dual market structure in that year led to a national outlay of foreign exchange of about seven million U.S. dollars greater than would have been spent had an unsubsidized unified market existed. At the same time, the existence of an unsubsidized unified market for maize in 1979/80 would have produced a real income decline of no more than 11 percent for that part of the population which had benefitted from the dual market structure, while average per capita urban consumption of maize would not have been grossly different (i.e., approximately 93 to 100 percent of estimated requirements).

In interpreting the results of the simulation analysis, it is important to bear in mind that the present beneficiaries of the present dual market structure (mainly residents of Dar es Salaam and Tanga) represent a wide cross-section of socioeconomic

strata. Contemplation of policy measures which would reduce or eliminate consumer subsidies and/or remove restrictions on private trade in maize and other grains must consider the likely effects of such policy changes on low income urban dwellers who are fortunate enough to currently have access to NMC sales. Unless these policy changes were accompanied by specific measures to shelter these low income households, their nutritional status would undoubtedly fall below acceptable levels.

For example, in Dar es Salaam the average budget share for maize is 13 percent and the share of calorie requirements provided by maize (in the form of sembe) is 37 percent. For lower income consumers these shares are likely to be larger. The most optimistic scenario for market unification, import levels at recent trend levels, and removal of the subsidies for sembe implies that the real consumer price for sembe in Dar es Salaam would have to rise by approximately 80 percent. If the demand for sembe is price inelastic, this would represent a fall in real income equal to 10 percent. Even if sembe demand is also income inelastic, consumption would have to fall. This study has estimated income elasticities in the range of 0.1 to 0.6 for maize, rice and wheat. By these latter estimates, calorie intake from these cereals would drop by approximately 5 percent. Even if there is scope for substitution of less preferred drought staples for sembe and the other preferred grains (for which prices have recently been raised), the resulting adverse real income and price effects imply significant reduction in caloric intake for low income urban households currently consuming

subsidized sembe. The important effect is that nationwide sembe demand has a low but significant elasticity of at least -0.3. The combined price and income effects could reduce calorie intake from maize by a third.

The income and nutritional implications of such an adjustment in consumer prices for sembe are likely to be politically and socially unacceptable. So the question arises, if maize becomes expensive what will the people eat? This question and its complexities are beyond the scope of this study, but the analyses do yield some insights on possible approaches which may be considered and analyzed further.

First and foremost, additional data and analysis from the 1976/77 HBS are urgently required. These data are needed to estimate consumption and expenditure patterns for the various cities and for different income levels within Dar es Salaam. These data and other data are needed to estimate the scope for substitution between preferred and less preferred staples. With these estimates, better assessments of the size and distribution of deleterious nutritional and income effects can be accomplished. If there exists scope for substitution--and there must exist some--the phasing out of the subsidy on maize could be accomplished through cross-subsidization of less preferred staples, by using food aid in the preferred staples to generate treasury resources to finance the subsidization of less preferred staples.

A cross-subsidization scheme should only be used during a

transitional period; ultimately it is necessary to increase national productivity in all sectors. Within the agricultural sector, measures should be accepted which will guide the mobilization of domestic resources towards economically efficient uses. In some cases, this will imply further reductions in domestic food production, particularly in those areas with international comparative advantage in the production of crops for export. The need for real resources to subsidize less preferred staples, the need for food imports to replace any reduction in food supplies which may ensue from allocation of resources according to economic efficiency criteria, the need for imports to provide stability and security in food markets, and humanitarian and equity considerations all suggest that there is ample scope for the effective utilization of food aid as a tool for development and economic recovery. Food import policy and food assistance from international donors should be used explicitly as a tool for promoting the objectives of the Structural Adjustment Programme.

On the matter of national self-sufficiency in preferred staples, it is implausible that it is achievable under the present dual structure, particularly with subsidized consumer prices for sembe. But even with market unification and elimination of the subsidies, self-sufficiency, in the short run, would be accomplished through large reductions in per capita consumption and severe income redistribution effects. Self-sufficiency at adequate nutritional levels and without major redistribution of income may be achievable in the longer run if efficient resource allocation and aggressive institutional

actions could lead to a highly price responsive food production sub-sector. The achievement of such conditions would require major changes in the structure of incentives facing farmers and traders. These conditions imply a continuing need for imports of preferred staples on highly concessionary terms and the need for material and other assistance to mobilize resources to, and within, the agricultural sector. Judiciously programmed and targetted food assistance could buy time for Tanzania to restructure its agricultural sector. Consultation with the donor community on creative aproaches for the use of food aid should begin at once.

Finally, the analyses in this report suggest that policy changes that would lead to market unification and more efficient allocation of resources could, in the long run, contribute to domestic food security, or at least not seriously exacerbate the effects of droughts. The process of adjustment, however, would undoubtedly be unstable. On the one hand, the role of the NMC would change substantially. This would require the redeployment of its resources and the development of entrepreneurial capacity within its personnel. On the other hand, private entrepreneurs would be acting with imperfect information and would therefore make allocative errors. These two sets of conditions would at first lead to market instability. The NMC would therefore need to be provided with food and financial resources to become a credible and effective buyer and seller in a more competitive environment. Again, this represents an opportunity for donor

assistance and judicious use of imported food aid.

The various issues which have been treated in these analyses and the foregoing discussion all point towards the continuing need for concessionary imports of food and the use of food imports as a policy tool. The outlines of a program to use concessionary food assistanace as a purposive tool for economic and structural adjustment should include the following components:

- A substantial level of maize imports (e.g., 100 - 150 thousand metric tons) would be used to maintain the equilibrium prices at an acceptable level; part of this would be kept in reserve for stabilization purposes and the rest sold by the NMC to any buyers in any quantities at the prevailing market price. The level of imports and sales as well as the forecasted (but not controlled) producer price for each region should be announced far in advance of planting decisions.
- Other preferred grains, principally rice and wheat, would be imported for sale on a fully costed basis in the major cities. These imports would have two purposes, first to absorb the purchasing power of higher income consumers and second to generate revenues for use in a cross-subsidy scheme for less preferred staples.
- The revenues generated by the sale of donated or concessionary maize, rice and wheat would be used to provide targetted food assistance to very low income

urban consumers (say through a subsidy on cassava flour and sorghum meal and grain) and to generate domestic currency for counterpart activities in internationally funded agricultural development programs.

- Additional maize imports would also be needed to create regionally deployed buffer stocks to provide for food security during the adjustment process.

In achieving this, economic pricing would have to be pursued lest the program of food imports further distort the allocation of resources within the agricultural sector. Pricing the imports too low in real terms could lead to unfair competition with domestic producers and perhaps to illegal re-exporting of the imported foods.

Appendix A: Sources of Production Data

A1. Maize

Fundamental to any attempt to analyze Tanzania's true surplus/deficit status with respect to maize are consistent and believable regional production figures. While various time series of maize production statistics have been published by Kilimo and other government organizations, there is widespread skepticism as to the reliability of such data; as such, these have not been used in our analyses.

There are two sources of acceptable maize production estimates that exist for the past three growing seasons. The first is the recent National Food Strategy publication. This document contains regional estimates of area and yield of 24 crops for the 1979/80 growing season.

The second source of acceptable maize production estimates is unpublished data furnished by the Early Warning Systems and Crop Monitoring Project (EWS). For the 1981/82 season, EWS has collected yield and area estimates in each district in Tanzania for maize and at least one other food crop. These estimates form the basis of the regional maize production figures presented in Table 8.

The EWS has developed a method of assessing cropping conditions in specific locations by analyzing the amount and distribution of rainfall during the growing season. This basic weather information is reported weekly by monitoring stations in nearly all districts. Using a "crop specific water balance"

approach (CSWB), EWS computes an index measuring the degree to which a crop's water requirements are met. Although not perfect*, the CSWB method provides the best existing information on how "good" a growing season was in a given area.

We have converted the CSWB indices for 1980/81 and 1981/82 into yield reduction indices, taking a CSWB index of 100 to be the maximum achievable yield anad a CSWB index of 61 or less to be complete crop failure (Table A1). By combining the yield reduction indices with the recorded yield data for the 1981/82 season, maximum achievable yields for each district have been computed (Table A2). Finally, by applying yield reduction indices for the 1980/81 growing season to the maximum achievable yield data, we have derived district yield estimates for 1980/81 (Table A3).

The derived district yield estimates for 1980/81 were then multiplied by 1981/82 area estimates to produce production estimates. The area estimates used are in most cases virtually the same as those found in the National Food Strategy report. It has thus been assumed that variation in production has been purely a function of environment-induced yield fluctuations.

Comparison of the production figures for 1980/81 and 1981/82 revealed some significant discrepancies between the derived figures and the descriptions of the two seasons found in EWS

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*While the CSWB method describes growing conditions for a particular season, it does not take into account such factors as pest damage, which may have a significant impact on production.

crop assessment publications. It is believed that the source of these discrepancies is two-fold. First, the network of reporting stations was less comprehensive during 1980/81. Second, certain technical improvements have been made in the method of computing the CSWB indices for the 1981/82 season (e.g., inclusion of potential evapo-transpiration into the calculations).

The discrepancy noted above necessitated revision of the production estimates for 41 of the 74 districts covered by the EWS* in order to bring the relative production figures for the two years into conformity with the observations in the EWS documents noted earlier. In all but one case (Tarime district), these revisions were applied to the 1980/81 figures. These revisions are summarized below.

For Coast and Tanga Regions, all calculated 1980/81 figures were revised downward (by an average of 25 percent and 35 percent, respectively) to reflect the large increases in production in the 1981/82 season.

For Mbeya Region, it has been assumed that production totals in 1980/81 and 1981/82 were the same for Mbeya, Mbozi, Rungwe and Ileje districts, necessitating an upward revision of the calculated 1980/81 figure for Mbeya district (17 percent) and downward revision of the calculated 1980/81 figures for Mbozi and Rungwe districts (25 percent and 22 percent). Finally, the

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*The EWS aggregates the reported data for Bunda and Serengeti districts in Mara Region, and Kisarawe and Kibaha districts in Coast Region, Tanga and Muheza districts in Tanga Region, and Monduli and Ngorongoro districts in Arusha Region.

calculated 1980/81 estimate for Kyela district was reduced by 57 percent to account for the fact that the 1981/82 season was slightly better than the preceding one. Overall, the regional figures were reduced by 22 percent.

For Mwanza Region, both the 1980/81 and 1981/82 seasons were marked by prolonged dry spells during January, February and March, which caused early planted crops to yield poorly. However, in contrast to 1981/82, there was little replanting at the beginning of the long rains in 1980/81. Since farmers in the region did not benefit much from the fairly abundant long rains of 1980/81, calculated production figures for that year were much too high, and were thus reduced by a total of 44 percent.

For Tarime district, the 1981/82 production figures furnished by the EWS do not account for the excellent short rains crops harvested in February of 1982. These figures were increased by 95 percent to account for this.

For the West Lake Region, the 1980/81 estimates underestimated production in Muleba and Bukoba districts. These were increased by 50 percent and 83 percent, respectively. This meant an upward revision of 17 percent for the region.

In Morogoro Region, growing conditions were significantly poorer in Kilombero district in 1981/82. To reflect this, the 1980/81 estimates were increased by 63 percent. At the same time, the 1980/81 estimates for Morogoro and Kilosa districts were reduced by 37 percent and 25 percent, respectively.

Other downward revisions ranging from 2 percent to 40 percent were applied to 18 other districts. The net effect of

the revisions was to reduce the calculated production figures for 1980/81 by 12 percent, while the modification of the 1981/82 figure for Tarime district increased the national total for that year by less than 1 percent. Tables A4-A6 present regional area, yield and production estimates for all three years.

Table A1: Yield Reduction Index for Maize

CSWB Index	Yield Reduction[1] Index	CSWB Index	Yield Reduction Index
100	100.0	79	45.0
99	97.5	78	42.5
98	95.0	77	40.0
97	92.5	76	37.5
96	90.0	75	35.0
95	87.0	74	32.5
94	84.0	73	30.0
93	81.0	72	27.5
92	78.0	71	25.0
91	75.0	70	22.5
90	72.5	69	20.0
89	70.0	68	17.5
88	67.5	67	15.0
87	65.0	66	12.5
86	62.5	65	10.0
85	60.0	64	7.5
84	57.5	63	5.0
83	55.0	62	2.5
82	52.5	61	0.0
81	50.0	<61	0.0
80	47.5		

Source: EWS and Sigma One Corporation

[1]The yield reduction index is expressed as percentage of maximum achievable yield. For example, a CSWB index of 91 implies that 75 percent of the maximum attainable yield was achieved.

Table A2: Maize Yield Data for the 1981/82 Growing Season

District	Maximum Achievable Yield (kg/ha)[1]	Yield Reduction Index[2]	Yield (T/ha)[3]
Mbulu	2219	76.6	1.7
Monduli/Ngorongoro	800	100.0	0.8
Arumeru/Arusha	2103	95.1	2.0
Hanang	1814	44.1	0.8
Kiteto	900	100.0	0.9
Bagamoyo	1182	93.1	1.1
Kisarawe/Kibaha	1364	95.3	1.3
Rufiji	1975	81.0	1.6
Kondoa	488	61.5	0.3
Dodoma	456	43.9	0.2
Mpwapwa	1939	36.1	0.7
Mufindi	3444	78.4	2.7
Njombe	2296	87.1	2.0
Iringa	1915	47.0	0.9
Ludewa	2604	76.8	2.0
Ngara	2055	43.8	0.9
Muleba	833	60.0	0.5
Bukoba	1247	96.2	1.2
Karagwe	1800	50.0	0.9
Biharamulo	2000	80.0	1.6
Shinyanga	977	92.1	0.9
Kahama	2725	73.4	2.0
Maswa	899	77.9	0.7
Bariadi	500	100.0	0.5
Iramba	1017	59.0	0.6
Singida	2340	64.1	1.5
Manyoni	600	100.0	0.6
Tabora	1613	55.8	0.9
Urambo	968	93.0	0.9
Igunga	545	55.0	0.3
Nzega	1154	78.0	0.9
Mwanza	1070	65.4	0.7
Kwimba	623	80.3	0.5
Magu	1765	17.0	0.3
Geita	961	93.7	0.9
Sengerema	2154	32.5	0.7
Ukerewe	1695	76.7	1.3
Tarime	1355	73.8	1.0
Bunda/Serengeti	556	90.0	0.5
Musoma	859	58.2	0.5
Masasi	1304	53.7	0.7
Mtwara	969	92.9	0.9
Newala	1944	72.0	1.4
Kigoma	1003	79.8	0.8

Table A2 Continued

District	Maximum Achievable Yield (kg/ha)[1]	Yield Reduction Index[2]	Yield (T/ha)[3]
Kasulu	936	96.2	0.9
Kibondo	947	95.0	0.9
Hai	2326	86.0	2.0
Rombo	2403	70.7	1.7
Moshi	2668	93.7	2.5
Same	474	84.4	0.4
Lindi	737	67.8	0.5
Nachingwea	1685	53.4	0.9
Kilwa	632	47.5	0.3
Liwale	817	61.2	0.5
Mbozi	2778	72.0	2.0
Chunya	1172	76.8	0.9
Mbeya	2342	85.4	2.0
Rungwe	3040	65.8	2.0
Kyela	3809	57.5	2.0
Ileje	900	100.0	0.9
Kilosa	870	57.5	0.5
Ulanga	2639	75.8	2.0
Morogoro	1383	50.6	0.7
Kilombero	1271	70.8	0.9
Sumbawanga	4490	73.5	3.3
Mpanda	900	100.0	0.9
Tunduru	1011	89.0	0.9
Songea	2964	91.1	2.7
Mbinga	2119	75.5	1.6
Handeni	1333	75.0	1.0
Korogwe	1143	87.5	1.0
Lushoto	1678	89.4	1.5
Tanga/Muheza	2258	79.7	1.8
Pangani	1333	75.0	1.0

[1]Maximum achievable yield calculated by dividing yield by the yield reduction index.

[2]Yield reduction indices derived from CSWB indices furnished by EWS.

[3]Yield data furnished by EWS.

Table A3: Maize Yield Data for the 1980/81 Growing Season

District	Maximum Achievable Yield (kg/ha)	Yield Reduction Index[1]	Yield (T/ha)[1]
Mbulu	2219	80.9	1.8
Monduli/Ngorongoro	800	89.9	0.7
Arumeru/Arusha	2103	85.6	1.8
Hanang	1814	93.7	1.7
Kiteto	900	95.2	0.9
Bagamoyo	1182	65.6	0.8
Kisarawe/Kibaha	1364	67.6	0.9
Rufiji	1975	57.6	1.1
Kondoa	488	2.4	neg
Dodoma	456	38.4	0.2
Mpwapwa	1939	44.2	0.9
Mufindi	3444	71.7	2.5
Njombe	2296	77.4	1.8
Iringa	1915	49.2	0.9
Ludewa	2604	68.3	1.8
Ngara	2055	79.8	1.6
Muleba	833	89.4	0.7
Bukoba	1247	100.0	1.2
Karagwe	1800	65.2	1.2
Biharamulo	2000	80.0	1.6
Shinyanga	977	61.4	0.6
Kahama	2725	70.8	1.9
Maswa	899	85.2	0.8
Bariadi	500	100.0	0.5
Iramba	1017	51.4	0.5
Singida	2340	20.1	0.5
Manyoni	600	0.0	0.0
Tabora	1613	65.6	1.1
Urambo	968	89.9	0.9
Igunga	545	35.8	0.2
Nzega	1154	56.0	0.6
Mwanza	1070	46.7	0.5
Kwimba	623	73.0	0.5
Magu	1765	21.4	0.4
Geita	961	93.7	0.9
Sengerema	2154	32.5	0.7
Ukerewe	1695	32.2	0.5
Tarime	1355	80.2	1.1
Bunda/Serengeti	556	85.2	0.5
Musoma	859	55.4	0.5
Masasi	1304	31.4	0.4
Mtwara	969	33.0	0.3
Newala	1944	19.3	0.4
Kigoma	1003	91.4	0.9

Table A3 Continued

District	Maximum Achievable Yield (kg/ha)	Yield Reduction Index[1]	Yield (T/ha)[1]
Kasulu	936	98.2	0.9
Kibondo	947	97.0	0.6
Hai	2326	76.4	1.8
Rombo	2403	58.8	1.4
Moshi	2668	75.4	2.0
Same	474	67.1	0.3
Lindi	737	45.2	0.3
Nachingwea	1685	20.3	0.3
Kilwa	632	25.7	0.2
Liwale	817	49.0	0.4
Mbozi	2778	72.0	2.0
Chunya	1172	86.2	1.0
Mbeya	2342	85.4	2.0
Rungwe	3040	65.8	2.0
Kyela	3809	50.1	1.9
Ileje	900	100.0	0.9
Kilosa	870	65.7	0.6
Ulanga	2639	68.2	1.8
Morogoro	1383	46.3	0.6
Kilombero	1271	76.3	1.0
Sumbawanga	4490	71.7	3.2
Mpanda	900	94.9	0.9
Tunduru	1011	75.1	0.8
Songea	2964	63.9	1.9
Mbinga	2119	68.8	1.5
Handeni	1333	53.4	0.7
Korogwe	1143	63.0	0.7
Lushoto	1678	64.2	1.1
Tanga/Muheza	2258	57.1	1.3
Pangani	1333	52.5	0.7

[1]Yields and yield reduction indices calculated from revised production estimates.

Source: Sigma One Corporation

Table A4: Yield, Area and Production of Maize: 1978/79

Region	Yield (Tons/ha)	Area Planted ('000 ha)	Production ('000 MT)
Dodoma	1.0	57.4	57.4
Arusha	1.5	100.7	151.0
Kilimanjaro	1.2	45.8	55.0
Tanga	1.0	124.7	124.7
Morogoro	1.0	141.4	141.4
Coast	1.0	17.1	17.1
Lindi	1.0	36.3	36.3
Mtwara	1.0	26.7	26.7
Ruvuma	1.5	68.3	102.4
Iringa	1.5	160.0	240.0
Mbeya	1.5	117.0	175.5
Singida	0.8	31.9	25.5
Tabora	1.3	86.0	113.8
Rukwa	1.2	93.6	112.4
Kigogma	1.0	49.9	49.9
Shinyanga	0.8	124.6	99.7
Kagera	1.0	42.3	42.3
Mwanza	1.0	92.8	92.8
Mara	1.0	62.9	62.0
Tanzania	1.2	1478.7	1725.9

Source: National Food Strategy Project

Table A5: Yield, Area and Production of Maize: 1980/81

Region	Yield (MT/ha)	Area Planted ('000 ha)	Production ('000 MT)
Dodoma	0.32	57.0	18.1
Arusha	1.55	100.0	154.9
Kilimanjaro	1.44	45.0	65.0
Tanga	0.97	124.0	120.6
Morogoro	0.92	120.0	110.8
Coast	0.94	29.0	27.3
Lindi	0.30	36.0	10.9
Mtwara	0.38	27.0	10.2
Ruvuma	1.46	68.0	99.0
Iringa	1.64	158.0	258.7
Mbeya	1.83	115.0	210.1
Singida	0.42	31.0	12.9
Tabora	0.63	85.0	53.7
Rukwa	2.39	94.0	224.6
Kigoma	0.92	49.0	45.0
Shinyanga	0.91	125.0	114.1
Kagera	1.32	42.0	55.5
Mwanza	0.67	45.0	30.1
Mara	0.70	63.0	44.0
Tanzania	1.18	1415.0	1673.5

Source: Early Warning System and Crop Monitoring Project (unpublished data)

Table A6: Yield, Area and Production of Maize: 1981/82

Region	Yield (MT/ha)	Area Planted ('000 ha)	Production ('000 MT)
Dodoma	0.37	57.0	21.1
Arusha	1.38	100.0	137.7
Kilimanjaro	1.67	47.0	78.5
Tanga	1.36	124.0	168.3
Morogoro	0.85	120.0	101.6
Coast	1.33	29.0	38.5
Lindi	0.53	36.0	19.2
Mtwara	1.05	27.0	28.3
Ruvuma	1.86	68.0	126.6
Iringa	1.77	158.0	280.1
Mbeya	1.83	115.0	210.2
Singida	0.82	31.0	25.3
Tabora	0.75	85.0	63.9
Rukwa	2.46	94.0	231.0
Kigoma	0.87	49.0	42.4
Shinyanga	1.01	125.0	125.9
Kagera	1.02	42.0	43.0
Mwanza	0.68	45.0	30.7
Mara	1.03	63.0	65.0
Tanzania	1.30	1415.0	1837.3

Source: Early Warning System and Crop Monitoring Project (unpublished data)

A2. Sorghum/Millet

Sorghum/millet production estimates for the 1980/81 and 1981/82 growing seasons were derived from EWS data sources in much the same way as the maize production estimates presented above. CSWB indices for sorghum/millet were converted to yield reduction indices using a different conversion scale than that for maize (see Table A7).

For the 1981/82 growing season, district yield and area estimates were not available for Kigoma and Iringa regions. For those regions, 1980/81 and 1981/82 production was assumed to be equal to 1978/79 production. District production estimates for the 1981/82 growing season existed for all other regions. In a number of districts yield, area, or CSWB indices were unavailable for 1980/81 and/or 1981/82. In all but one of those districts, 1980/81 production was assumed to have been equal to 1981/82 production.* This is noted in Table 9 in the text. Tables A8 and A9 present district yield, area, and production estimates for 1980/81 and 1981/82.

*The exception was Kilombero district, in which 1980/81 production was assumed to be 90 percent of 1981/82 production.

Table A7: Yield Reduction Index for Sorghum Millet

CSWB Index	Yield Reduction Index	CSWB Index	Yield Reduction Index
100	100.00	58	42.00
99	98.00	57	41.00
98	96.00	56	40.00
97	94.00	55	39.00
96	92.00	54	38.00
95	90.00	53	37.00
94	88.50	52	36.00
93	87.00	51	35.00
92	85.50	50	34.00
91	84.00	49	33.00
90	82.50	48	32.00
89	81.00	47	31.00
88	79.50	46	30.00
87	78.00	45	29.00
86	76.50	44	28.00
85	75.00	43	27.00
84	73.75	42	26.00
83	72.50	41	25.00
82	71.25	40	24.00
81	70.00	39	23.00
80	68.75	38	22.00
79	67.50	37	21.00
78	66.25	36	20.00
77	65.00	35	19.00
76	63.75	34	18.00
75	62.50	33	17.00
74	61.25	32	16.00
73	60.00	31	15.00
72	58.75	30	14.00
71	57.50	29	13.00
70	56.25	28	12.00
69	55.00	27	11.00
68	53.75	26	10.00
67	52.50	25	9.00
66	51.25	24	8.00
65	50.00	23	7.00
64	49.00	22	6.00
63	48.00	21	5.00
62	47.00	20	4.00
61	46.00	19	3.00
60	45.00	18	2.00
59	43.00	17	1.00
		<17	0.00

Table A8: Sorghum/Millet Yield, Area and Production Data for the 1981/82 Growing Season

	Yield Reduction Index	Yield (T/ha)	Area ('000 ha)	Production ('000 MT)	Maximum Achievable Yield (kg/ha)
Kondoa	80.5	0.30	54.0	16.2	373
Dodoma	70.5	0.30	75.0	25.0	426
Mpwapwa	74.9	0.50	50.0	25.0	668
Mbulu	79.5	2.00	11.0	22.0	2516
Monduli	100.0	0.50	7.0	3.5	500
Arumeru	93.2	0.90	16.0	14.4	966
Hanang	60.4	0.80	13.0	10.8	1325
Kiteto	100.0*	0.50	4.0	2.0	500
B'moyo	96.5	1.10	4.0	4.4	1140
Kibaha/ Kisarawe	100.0	1.30	7.0	9.1	1300
Rufiji	99.0	1.30	4.0	5.2	1313
Muleba	85.3	0.80	3.0	2.4	938
Bukoba	97.1	0.90	4.0	3.6	927
Karagwe	78.1	0.90	2.0	1.8	1152
Shinyanga	98.4	0.90	60.0	54.0	915
Kahama	90.4	0.90	42.0	37.8	996
Maswa	87.5	0.80	44.0	35.2	914
Bariadi	100.0*	0.70	44.0	30.8	700
Iramba	83.9	0.60	109.0	65.4	715
Singida	91.0	0.90	109.0	98.1	989
Manyoni	100.0	0.60	45.0	27.0	600
Biharamulo	N/A	0.90	2.0	1.8	N/A
Ngara	N/A	0.90	1.0	0.9	N/A
Tabora	82.6	0.90	20.0	18.0	1090
Urambo	96.5	0.90	16.0	14.4	933
Igunga	72.1	0.70	20.0	14.0	971
Nzega	88.5	0.90	24.0	21.6	1017
Mwanza	89.0	0.60	1.0	0.6	674
Kwimba	90.2	0.60	6.0	3.6	665
Magu	59.1	0.60	5.0	3.0	1015
Sengerema	81.3	0.60	5.0	3.0	738
Geita	100.0	1.30	6.0	7.8	1300
Ukerewe	73.3	0.60	3.0	1.8	819
Tarime	84.8	1.20	30.0	36.0	1415
Bunda/Serengeti	98.5	0.90	24.0	21.6	914
Musoma	70.7	0.90	27.0	24.3	1273
Masasi	82.8	0.70	27.0	18.9	845
Mtwara	83.9	0.90	14.0	12.6	1073
Newala	86.0	1.00	31.0	31.0	1163
Hai	95.0	1.00	0.9	0.9	1053

Table A8 Continued

	Yield Reduction Index	Yield (T/ha)	Area ('000 ha)	Production ('000 MT)	Maximum Achievable Yield (kg/ha)
Rombo	N/A	0.90	0.9	0.8	N/A
Moshi	93.3	1.00	1.9	1.9	1072
Same	91.8	0.60	1.2	0.7	654
Lindi	84.9	0.90	10.0	9.0	1060
Nachingwea	79.9	0.90	4.0	3.6	1126
Kilwa	77.1	0.90	5.0	4.5	1167
Liwale	77.0	0.70	2.0	1.4	909
Mbozi	82.5	N/A	N/A	N/A	N/A
Chunya	92.3	N/A	N/A	N/A	N/A
Mbeya	87.5	N/A	N/A	N/A	N/A
Rungwe	N/A	N/A	N/A	N/A	N/A
Kyela	N/A	N/A	N/A	N/A	N/A
Ileje	N/A	N/A	N/A	N/A	N/A
Kilosa	85.8	0.70	11.0	7.7	816
Ulanga	N/A	1.00	6.0	6.0	N/A
Morogoro	79.4	0.90	19.0	17.1	1134
Kilombero	N/A	0.90	7.0	6.3	N/A
Sumbawanga	93.2	1.00	63.0	63.0	1073
Mpanda	100.0	0.90	34.0	30.6	900
Tunduru	N/A	0.30	7.0	2.1	N/A
Songea	N/A	0.90	11.0	9.9	N/A
Mbinga	N/A	0.30	10.0	3.0	N/A
Korogwe	94.0	0.80	6.0	4.8	851
Lushoto	98.0	1.00	9.0	9.0	1020
Tanga/Muheza	N/A	0.90	7.0	6.3	N/A
Pangani	N/A	0.80	1.0	0.8	N/A
Handeni	N/A	0.80	6.0	4.8	N/A
TANZANIA		0.78	1185.9	922.8	

N/A = not available.

Table A9: Sorghum/Millet Yield, Area and Production Data for the 1980/81 Growing Season

District	Maximum Achievable Yield (kg/ha)	Yield Reduction Index	Yield (MT/ha)	Area ('000 ha)	Production ('000 MT)
Kondoa	373	26.0	0.10	54.0	5.4
Dodoma	425	67.5	0.29	75.0	21.7
Mpwapwa	668	61.2	0.41	50.0	20.5
Mbulu	2516	96.0	2.42	11.0	26.6
Monduli	500	92.0	0.46	7.0	3.2
Arumeru	966	89.7	0.87	16.0	13.9
Hanang	1325	96.0	1.27	10.8	13.7
Kiteto	500	100.0	0.50	4.0	2.0
Bagamoyo	1140	97.0	1.11	4.0	4.4
Kibaha/Kisarawe	1300	97.0	1.26	7.0	9.0
Rufiji	1313	78.1	1.03	4.0	4.1
Muleba	938	76.5	0.72	3.0	2.1
Bukoba	927	81.0	0.75	4.0	3.0
Karagwe	1152	87.0	1.00	2.0	2.0
Biharamulo	N/A	90.0	0.90*	2.0	1.8*
Ngara	N/A	76.5	0.90*	1.0	0.9*
Shinyanga	915	92.0	0.84	60.0	50.4
Kahama	996	76.5	0.76	42.0	31.9
Maswa	914	92.0	0.84	44.0	37.0
Bariadi	700	100.0	0.70	44.0	30.8
Irambo	715	71.2	0.51	109.0	55.6
Singida	989	57.5	0.57	109.0	62.1
Manyoni	600	16.0	0.10	45.0	4.5
Tabora	1090	87.0	0.95	20.0	19.0
Urambo	933	94.0	0.88	16.0	14.1
Igunga	971	71.2	0.69	20.0	13.8
Nzega	1017	72.5	0.74	24.0	17.8
Mwanza	674	84.0	0.57	1.0	0.6
Kwimba	665	90.0	0.60	6.0	3.6
Magu	1015	94.0	0.95	5.0	4.7
Sengerema	738	94.0	0.69	5.0	3.4
Geita	1300	92.0	1.20	6.0	7.2
Ukerewe	819	73.3	0.60	3.0	1.8*
Tarime	1415	87.0	1.23	30.0	36.9
Bunda/Serengeti	914	98.0	0.90	24.0	21.6
Musoma	1273	94.0	1.20	27.0	32.4
Masasi	845	66.2	0.56	27.0	15.1
Mtwara	1073	55.0	0.59	14.0	8.3
Newala	1163	55.0	0.64	31.0	19.8
Hai	1053	92.0	0.97	9.0	0.9
Rombo	N/A	N/A	0.90	0.9	0.8*
Moshi	1072	88.5	0.95	1.9	1.8
Same	654	94.0	0.61	0.7	0.4

Table A9 Continued

District	Maximum Achievable Yield (kg/ha)	Yield Reduction Index	Yield (MT/ha)	Area ('000 ha)	Productic ('000 M
Lindi	1060	66.2	0.70	10.0	7.0
Nachingwea	1126	62.5	0.70	4.0	2.8
Kilwa	1167	67.5	0.78	4.5	3.5
Liwale	909	73.7	0.67	1.4	0.9
Mbozi	N/A	94.0	N/A	N/A	N/A
Chunya	N/A	96.0	N/A	N/A	N/A
Mbeya	N/A	85.5	N/A	N/A	N/A
Rungwe	N/A	N/A	N/A	N/A	N/A
Kyela	N/A	N/A	N/A	N/A	N/A
Ileje	N/A	N/A	N/A	N/A	N/A
Kilosa	816	90.0	0.73	11.0	8.0
Ulanga	N/A	N/A	1.00	6.0	6.0
Morogoro	1134	94.0	1.06	19.0	20.1
Kilombero	N/A	N/A	0.82*	7.0	5.7
Sumbawanga	1073	90.0	0.97	63.0	61.1
Mpanda	900	100.0*	0.90*	34.0	30.6
Tunduru	N/A	88.5	0.30	7.0	2.1
Songea	N/A	84.0	0.90	11.0	9.9
Mbinga	N/A	94.0	0.30	10.0	3.0
Korogwe	851	94.0	0.80	6.0	4.8
Tanga/Muheza	N/A	88.5	0.90	7.0	6.3
Lushoto	1020	98.0	1.00	9.0	9.0
Pangani	N/A	N/A	0.80	1.0	0.8
Handeni	N/A	88.5	0.80	6.0	4.8
TANZANIA					836.1

N/A = not available.

*Indicates that 1980/81 figures assumed to be equal to 1981/82 figures.

Source: Early Warning System and Crop Monitoring Project

Appendix B: Methodology

Data extracted from the 1976/77 Household Budget Survey includes information concerning household characteristics, production and costs of production, consumption, and a summary of household expenditures and sources of income. Consumption data for major cereals, cereal products, starches, pulses and sugars and sweets include quantities consumed, total value of and expenditures on the specific commodities.

Formation of Consumption Patterns

Average calorié shares for the major cereals and cassava were formed into consumption patterns for Dar es Salaam, other urban areas and for rural and urban areas within each region, assuming an average daily requirement of 2,320 calories per person per day. Though actual consumption may be higher or lower than this level, previous analysis[1] of another subsample of the 1976/77 HBS performed by FAO and Kilimo show regional averages closely approximating this requirement. This calorie requirement also aids in addressing food security issues facing Tanzania.

The quantities of foods consumed are in kilograms per household per period, with periods of two months for non-Dar es Salaam households and periods of approximately 10 days for Dar es Salaam households. These quantities can be converted to kilograms per person per day by dividing the given quantities by

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[1] Tanzania National Food Strategy, Ministry of Agriculture, National Food Strategy Project.

the number of days in the period and dividing that result by the number of people in each household. By then applying the appropriate energy value (calories) per kilogram of each food to the quantities per person per day, we determine the number of calories per person per day of each food. Division of these quantities by the 2,320 calories per day requirement yields proportions of total daily calories derived from each particular food. By then averaging the proportions of each food within each region or area we obtain average calorie shares of each food for an area or region, which are used to form consumption patterns for areas or regions. The resulting shares for urban anad rural areas within each region are presented in Tables B1-B2.

Calorie Shares, 1969 vs. 1976/77

Consumption data from the 1969 HBS includes total expenditures on cereals and budget shares and retail prices of specific cereals for nine regional zones in Tanzania. From this data we can determine expenditures on and quantities consumed of each of the major cereals in each zone. This is done by multiplying total expenditures on cereals by the budget shares of each cereal to determine the amount of expenditures on each cereal. These expenditures are then divided by the appropriate retail prices to determine the quantities consumed of each particular cereal in each zone.

The number of zones was reduced to seven by combining the two years which comprise parts of Dar es Salaam into one zone and by eliminating the zone which comprises nine different urban areas by allocating the quantities consumed in each to the

Table B1: Contribution of Cereals to the Daily Calorie Requirements in Other Urban Areas (%)
(1976/77 HBS Data)

Region	Total Cereals	Maize, Sembe	Rice	Wheat	Sorghum, Millet	Cassava
Dodoma	24.9	5.9	0.3	0.0	18.7	0.0
Arusha	32.3	26.2	5.1	0.3	0.0	0.7
Kilimanjaro	25.3	9.7	3.2	10.3	1.6	0.5
Tanga	45.5	24.9	15.5	0.1	0.1	4.9
Morogoro	73.8	48.4	22.8	0.0	0.5	2.1
Lindi	27.8	4.5	17.6	3.4	0.6	1.7
Mtwara	31.4	5.7	10.7	0.1	13.7	1.2
Ruvuma	56.6	47.2	5.8	0.0	0.0	3.6
Iringa	50.4	47.1	2.0	0.0	1.2	0.1
Mbeya	34.3	13.3	20.6	0.0	0.0	0.4
Singida	62.9	5.2	0.6	0.0	56.9	0.2
Tabora	86.9	68.0	18.6	0.0	0.0	0.3
Rukwa	113.0	112.9	0.1	0.0	0.0	0.0
Kigoma	93.8	86.2	2.4	0.0	2.7	2.5
Shinyanga	55.2	35.6	13.4	0.0	6.2	0.0
West Lake	14.1	2.2	8.7	0.0	3.2	0.0
Mwanza	42.6	36.4	4.4	0.2	0.3	1.3
Mara	32.8	28.9	2.1	0.0	0.0	1.8

Table B2: Contribution of Cereals to the Daily Calorie Requirements in Rural Areas (%)
(1976/77 HBS Data)

Region	Total Cereals	Maize, Sembe	Rice	Wheat	Sorghum, Millet	Cassava
Dodoma	42.8	9.1	0.2	1.6	31.9	0.0
Arusha	37.6	33.7	2.8	0.5	0.0	0.6
Kilimanjaro	22.3	18.7	3.2	0.2	0.2	0.0
Tanga	52.0	44.9	4.9	0.1	0.1	2.3
Morogoro	65.9	50.0	14.6	0.1	0.1	1.1
Coast	34.0	21.5	10.5	0.7	0.4	0.9
Lindi	33.3	24.7	3.7	0.0	2.9	2.0
Mtwara	28.0	14.5	4.3	0.0	3.6	5.6
Ruvuma	67.2	45.9	10.9	0.0	2.5	7.9
Iringa	84.2	82.7	1.2	0.0	0.0	0.3
Mbeya	59.2	50.9	3.7	2.4	2.2	0.0
Singida	103.1	56.6	5.7	1.8	39.0	0.0
Tabora	87.0	54.3	14.6	0.0	10.8	7.3
Rukwa	93.0	69.9	2.4	0.0	16.1	4.6
Kigoma	20.1	19.0	0.9	0.0	0.2	0.0
Shinyanga	49.5	25.4	1.2	0.6	22.2	0.1
West Lake	21.4	12.4	3.0	0.0	3.4	2.6
Mwanza	43.6	20.4	20.2	0.7	0.1	2.2
Mara	4.4	1.9	1.0	0.0	0.9	0.6

regional zone in which the particular urban area is geographically situated.

In order to calculate calorie shares and form consumption patterns among the major cereals for each of the zones, we must again assume an average minimum calorie requirement of 2,320 calories per person per day. Calculations would then proceed similarly to those made in analyzing the subsample of the 1976/77 HBS. Quantities would first be converted to consumption on a per capita daily basis and then to calories consumed on a per capita daily basis for each zone by applying the appropriate energy value to each food. Calorie shares are determined by dividing the daily calories by the calorie requirement of 2,320 calories and taken together form the consumption pattern for a regional zone.

To allow a comparison of the calorie shares of the major cereals in 1969 and 1976/77, the regional calorie shares of each cereal in 1976/77 have been assigned to the seven regional zones of the 1969 calorie shares. This was done by calculating the weighted average (relative to regional population) of the calorie shares of each food for the regions comprising a regional zone. For example, to calculate a zonal maize calorie share for a zone of three regions would involve taking an average of the three regional maize calorie shares weighted according to the population of each region. We can then compare the calorie shares as derived from the 1969 and 1976/77 surveys.

Estimation of Quantities Consumed

Using the consumption patterns derived from the 1976/77 HBS

data along with 1978 census data, we can estimate quantities consumed of the major cereals in each region for 1976/77 and future years. These estimated demands are calculated assuming an average minimum calorie intake of 2,320 calories per person per day. Estimates are made of consumption of the major cereals for urban and rural areas within each region.

We first determine the number of daily calories derived from each of the major cereals by multiplying the calorie share of each by the calorie requirement of 2,320 calories. The appropriate energy value (calories) per kilogram of each cereal is then applied to the daily calories to determine the per capita daily consumption. These calculations in effect reverse those used in deriving the calorie shares and consumption patterns. The per capita daily consumption (Kg) of each cereal is then multiplied by the rural or urban population within the region to determine the daily consumption (kg) for the region. This value, when multiplied by 365 days, yields an estimate of total consumption (Kg) for each cereal in each region.

Extraction rates must be applied to these quantities where appropriate to accurately reflect actual quantities necessary for consumption. In the case of maize flour (sembe), an extraction rate of 0.85 was used for urban areas and a rate of 0.75 was used for rural areas. This requires multiplying quantities of sembe by 1.18 in urban areas and 1.33 in rural areas to account for actual quantities of maize. Extraction rates of 0.65 and 0.95 were used for rice and sorghum flour, respectively.

The conversion of the regional quantities of each cereal to metric ton equivalents is done by dividing the quantities (Kg) by 1,000. These consumption estimates can be used to estimate future demand if we assume that calorie shares have remained unchanged since 1976/77. Using population growth rates used by FAO in the Tanzania National Food Strategy for rural and urban areas within each region, we can estimate consumption in future years. This assumes that consumption of each cereal in each region will increase relative to the population growth in each region. By applying the population growth rates to the quantities (MT) consumed of the major cereals, we have estimated consumption of those cereals for the years 1979/80, 1981/82 and 1982/83.

Appendix C: Estimation of Parameters for the Household Production Model

Tables C1-C7 present average farm budgets containing the necessary information for calculating parameters for the household production model. While the production, consumption and technical information contained in each budget was in most cases taken from surveys of a few villages in each area, we believe that it is, in broad terms, representative of all farms in each area. Moreover, there are rough similarities between some of the areas for which we have estimated parameters and other places in Tanzania for which farming systems information is unavailable.*

The formulas used in calculating the parameters are as follows:

(1) $$mu = \frac{\text{value of food consumed}}{\text{value of total crop production - total purchased input cost}}$$

(2) $$sigma = \frac{\text{the own-price elasticity of food demand}}{1 + mu}$$

The national weighted average own-price elasticity of food demand for the six major staples analyzed in this report was estimated to be -0.34. This figure (rounded to -0.3) was used for all areas.

(3) $$chi = \frac{\text{value of cash crop production}}{\text{value of total crop production}}$$

(4) $$\text{marketed surplus} = \frac{\text{amount of food sold}}{\text{total food production}}$$

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*For example, the farming system in Rungwe is in many respects similar to that in parts of Kilimanjaro Region.

(5) alpha = 1 - $\frac{\text{cost of purchased inputs used in food production}}{\text{value of total food production}}$

(6) beta = 1 - $\frac{\text{cost of purchased inputs used in cash crop production}}{\text{value of cash crop production}}$

(7) upsilon = $\frac{\text{cost of purchased inputs used in food production}}{\text{total purchased input cost}}$

(8) tau = $\frac{\text{labor devoted to food production}}{\text{total labor use}}$

(9) kappa = $\frac{\text{total purchased input cost}}{\text{net income}}$

(10) The elasticities of substitution of capital for labor in food crop and cash crop production (Sf and Sx) were used as proxies for the modernity of farming techniques and the availability of purchased inputs. There are substantial structural problems in the distribution system for implements, fertilizers, pesticides and spare parts which have led to widespread shortages of these items. To reflect this, no value above 0.4 was assigned to either parameter in any area. For both food and cash crops, a value of 0.2 was assigned if the relevant labor cost share (alpha or beta) was 0.90 or above; a value of 0.3 was assigned if the relevant labor cost sharae was between 0.80 and 0.89; and a value of 0.4 was assigned if the relevant labor cost share was less than 0.80.

Table C1: Average Household Farm Budget for Southern Iringa District

		Value (Tsh)
(1)	Total Production	9378
(2)	Maize Consumed	2285
(3)	Cowpeas Consumed	882
(4)	Beans Consumed	1953
(5)	Groundnuts Consumed	1152
(6)	Others Consumed	981
(7)	Potatoes Consumed	46
(8)	Cabbage Consumed	13
(9)	Maize Sold	985
(10)	Cowpeas Sold	98
(11)	Beans Sold	217
(12)	Groundnuts Sold	128
(13)	Others Sold	109
(14)	Potatoes Sold	410
(15)	Cabbage Sold	119
(16)	Purchased Inputs Used in Food Production	531
(17)	Purchased Inputs Used in Cash Crop Production	71
(18)	Total Purchased Input Use (16 + 17)	602
(19)	Net Income (1 - 18)	8776

Food Labor: 132 man days
Cash Crop Labor: 25 man days

1. It was assumed that for all food crops except maize, 90 percent of production is retained for home consumption.

2. For potatoes and cabbage, it was assumed that 10 percent of production is retained for home consumption.

3. Of the Tsh 602 spent on purchased inputs, Tsh 445 went into maize production. It was assumed that the balance was split equally between food and cash crops.

Source: Bo and Rasmussen

Table C2: Average Household Farm Budget for Rungwe District

		Value (Tsh)
(1)	Total Production	11656
(2)	Maize Consumed	4587
(3)	Bananas Consumed	723
(4)	Beans Consumed	224
(5)	Maize Sold	1912
(6)	Bananas Sold	45
(7)	Beans Sold	24
(8)	Coffee Sold	2799
(9)	Tea Sold	1342
(10)	Purchased Inputs - Food Crops	308
(11)	Purchased Inputs - Cash Crops	1182
(12)	Total Purchased Inputs (10 + 11)	1490
(13)	Net Income (1 - 12)	10166

Food Labor: 116 man days
Cash Crop Labor: 211 man days

Source: Mwaipyana, Indicative Farm Models for the Major Farming Systems in Mbeya Region, MDB, 1982.

Table C3: Average Household Farm Budget for Central Mbozi District

		Value (Tsh)
(1)	Total Production	12307
(2)	Maize Consumed	4011
(3)	Finger Millet Consumed	1502
(4)	Sorghum Consumed	798
(5)	Beans Consumed	69
(6)	Groundnuts Consumed	9
(7)	Maize Sold	594
(8)	Finger Millet Sold	2540
(9)	Sorghum Sold	30
(10)	Beans Sold	0
(11)	Groundnuts Sold	18
(12)	Coffee Sold	2736
(13)	Purchased Inputs - Food Crops	382
(14)	Purchased Inputs - Cash Crops	516
(15)	Total Purchased Inputs (13 + 14)	898
(16)	Net Income (1 - 15)	11409

Food Labor: 37 man days
Cash Crop Labor: 120 man days

Source: Mwaipyana

Table C4: Average Household Farm Budget for Eastern Mbozi District

		Value (Tsh)
(1)	Total Production	9491
(2)	Maize Consumed	2069
(3)	Beans Consumed	459
(4)	Finger Millet Consumed	108
(5)	Maize Sold	322
(6)	Beans Sold	341
(7)	Finger Millet Sold	45
(8)	Coffee Sold	6147
(9)	Purchased Inputs: Food Crops	411
(10)	Purchased Inputs: Cash Crops	1111
(11)	Total Purchased Inputs (9 + 10)	1522
(12)	Net Income (1 - 11)	7969

Food Labor: 108 man days
Cash Crop Labor: 112 man days

Source: Mwaipyana

Table C5: Average Farm Budget for Songea District

		Value (Tsh)
(1)	Total Production	9450
(2)	Maize Consumed	1800
(3)	Cassava Consumed	500
(4)	Sorghum Consumed	250
(5)	Finger Millet Consumed	500
(6)	Groundnuts Consumed	900
(7)	Others Consumed	500
(8)	Maize Sold	900
(9)	Cassava Sold	200
(10)	Sorghum Sold	0
(11)	Finger Millet Sold	800
(12)	Groundnuts Sold	100
(13)	Others Sold	0
(14)	Tobacco Sold	3000
(15)	Purchased Inputs - Food Crops	600
(16)	Purchased Inputs - Cash Crops	900
(17)	Total Purchased Inputs (15 + 16)	1500
(18)	Net Income (1 - 17)	7950

Food Labor: 70 percent
Cash Crop Labor: 30 percent

Source: Informal survey conducted by one of the authors.

Table C6: Average Farm Budget for Kigoma Region

		Value (Tsh)
(1)	Total Production	1847
(2)	Maize Consumed	622
(3)	Beans Consumed	497
(4)	Maize Sold	93
(5)	Beans Sold	360
(6)	Cotton Sold	275
(7)	Purchased Inputs - Food Production	94
(8)	Purchased Inputs - Cash Crop Production	94
(9)	Total Purchased Inputs (7 + 8)	188
(10)	Net Income (1 - 9)	1659

1. As no labor use data was available, it was assumed that maize/beans cultivation and cotton cultivation are of equal labor intensity. Calculation of the parameter "food time" was estimated by comparing the average amounts of land cultivated in maize/beans and cotton per household.

Source: Loft and Oldevelt, Developments in Post Villagization Agriculture in Kigoma Region, ERB, 1981.

Table C7: Average Farm Budget for Lindi Region

		Value (Tsh)
(1)	Total Production	4570
(2)	Maize Consumed	519
(3)	Paddy Consumed	1275
(4)	Sorghum Consumed	1118
(5)	Cassava Consumed	352
(6)	Maize Sold	64
(7)	Paddy Sold	142
(8)	Sorghum Sold	197
(9)	Cassava Sold	99
(10)	Cashewnuts Sold	804
(11)	Purchased Inputs - Food Crops	377
(12)	Purchased Inputs - Cash Crops	80
(13)	Total Purchased Inputs (11 + 12)	457
(14)	Net Income (1 - 13)	4113

1. Input cost assumed to be 10 percent of the value of production.

Source: Oates, Farming Systems Bulletin 4: Yields and Area of Crop Production in Lindi Region, Lindi RIDEP, 1981.

Appendix D: Supply/Demand Model of the Tanzanian Maize Market

An identity defining total maize equivalent disappearance for mainland Tanzanaia (Q^T) can be broken into two parts. On the demand side:

$$Q^T = Q^{Do} + D^u \quad (1)$$

where Q^{Do} equals demand in the official maraket and Q^{Du} equals demand in the unofficial market. On the supply side:

$$Q^T = Q^{SD} + Q^I + Q^{Su} \quad (2)$$

where

Q_o^{SD} = official domestic supply,

Q^I = imports, and

Q^{Su} = unofficial supply.

<u>Official Market</u>

Supply and demand schedules in the official market are given by the following equations:

$$Q_o^{SD} = A^o + B^o p^o: \text{ Domestic Official Supply} \quad (3)$$

$$Q_o^{ST} = A^o + B^o p^o + Q^I: \text{ Total Official Supply} \quad (4)$$

$$Q^{Do} = C^o - m^o p^o: \text{ Official Demand} \quad (5)$$

$$Q^I = Q^{Po} - Q_o^{SD}: \text{ Identity}$$

<u>Unofficial Market</u>

Supply and demand schedules in the unofficial market are given by the following equations:

$$Q^{Su} = B^u(p^u - p^o): \text{ Unofficial Supply} \quad (7)$$

$$Q^{Du} = C^T - m^T p^u - Q_o^{SD} - Q^I: \text{ Unofficial Demand} \quad (8)$$

The Total Market

Substituting equations (3) and (7) into equation (2), and equations (5) and (8) into equation (1), the aggregate supply and demand equations can be specified:

$$Q^{ST} = A^{o} + B^{o}p^{o} + B^{u}(p^{u} - p^{o}) + Q^{I}: \quad (9)$$

Aggregate Supply

$$Q^{DT} = C^{o} - m^{o}p^{o} + C^{T} - m^{T}p^{u} - Q_{o}^{SD} - Q^{I}: \quad (10)$$

Aggregate Demand

Finally, by expanding the fifth term in equation (10), the aggregate demand equation can be simplified:

$$Q^{DT} = C^{T} - m^{T}p^{u} \quad (11)$$

Solving the Model

Table D1 presents the supply and demand parameters used in solving the model. These were calculated from information on the quantities passing through the official and unofficial markets in the 1979/80 marketing year, official prices for that year, the econometric estimate of the elasticity of demand for urban areas (-0.36), and two estimates of the national average elasticity of marketed supply (0.4 and 0.8).

The model as specified can be used to evaluate official price settings and import regimes. If import levels are given, the model solves for unofficial producer prices, unofficial quantities, official producer prices and official quantities. Given a level of imports, the model solves for estimates of equilibrium prices and quantities in a unified market (with or without consumer subsidies). The model could further be used to solve for either the official quantity given the official price of the necessary official producer price for meeting a given

Table D1: Parameters Used in the Maize Market Model

Low Supply Elasticity Assumption	High Supply Elasticity Assumption
A^o = 96.7	A^o = 96.7
B = 64.4	B = 128.8
C^o = 341.1	C^o = 341.1
C^T = 449.6	C^T = 449.6
m^T = 124.5[1]	m^T = 124.5[1]
m^o = 74.7[1]	m^o = 74.7[1]

[1]Includes an assumed marketing margin of 90 percent. It is further assumed that this margin is the same for both the official and unofficial markets.

level of official demand.

Note that the model cannot be solved if both import levels and the official producer price are imposed. This explains why producer prices within the official market varied among scenarios in which import levels were given. Note also that the model treats the dual market structure in such a way that any decreases in total disappearance come from the parallel market. This is because the model treats the parallel market as a "residual", thereby implicitly assuming that any (unsubsidized) official supplies no longer demanded by NMC's "regular customers" are redistributed to those individuals not previously served by the official market. This is not necessarily true; indeed, a major reason for the existence of parallel markets is precisely because of the differential pattern of distribution of official supplies. This quirk in the model is not of critical importance, however, as it does not affect the estimate of changes in total disappearance stemming from certain policy actions.

References

Barrett, Decline in Cotton Production in the Lake Zone Region, (mimeo), 1982.

Bo and Rasmusson, A Socioeconomic Study in Iringa Region, Tanzanian Rural Development Bank, 1982.

Due, Jean M. and Anandajayasekeram, P., Two Contrasting Farming Systems in Morogoro Region, Tanzania, Department of Agricultural Economics, University of Illinois at Urbana-Champaign, 1982.

Frisch, R., "A Complete Scheme for Computing All Direct and Cross Demand Elasticities in a Model with Many Sectors," Econometrica 27, 1959.

Gommes, R. A., "Final Crop Condition Assessment," Crop Monitoring and Early Warning Systems, (mimeo), 1982.

Gommes, R. A. "Rainfed Crop Conditions in Tanzania as Assessed from 1980/81 Rainfall Analysis," Early Warning Systems and Crop Monitoring Project, (mimeo), 1981.

Jansen, Doris J., An Economic Analysis of Regional Producer Price Determination in Tanzania, Marketing Development Bureau, 1981.

Keeler, Andrew, Safari Report, Marketing Development Bureau, 1982.

Keeler, Andrew, G. M. Scobie, M. A. Renkow, D. L. Franklin, Consumption Effects of Agricultural Policies in Tanzania, Sigma One Corporation, 1982.

Lele, Uma and Wilfred Candler, "Food Security: Some East African Considerations, Alberto Valdes (ed.), Food Security for Developing Nations, Westview Press, Boulder Colorado, 1981.

Loft, M. and J. Oldevelt, Developments in Peasant Agriculture in Kigoma Region During the Post-Villagization Years, Economic Research Bureau, Dar es Salaam, 1981.

Marketing Development Bureau, Price Policy Recommendations for the 1982/83 Agricultural Price Review, Ministry of Agriculture, United Republic of Tanzania, Summary, 1981.

Marketing Development Bureau, Price Policy Recommendations for the July 1982 Agricultural Price Review, Ministry of Agriculture, United Republic of Tanzania, Annex 1, 1982.

Marketing Development Bureau, Proposals for Staple Food Prices Under the Structural Adjustment Programme, Ministry of Agriculture, United Republic of Tanzania, 1982.

Mwaipyana, H., Indicative Farm Models for the Major Farming Systems in Mbeya Region, Ministry of Agriculture, FAO, 1982.

Oates, P., "Farming Systems Bulletin 4: Yields and Area of Crop Production in Lindi Region," Lindi, RIDEP, (mimeo), 1982.

Ortolo, B. and J. Rook, "An Assessment of the Present Pattern of Consumption and Projections of Future Food Requirements Using a Sample from the 1976/77 Household Budget Survey," Tanzania: National Food Strategy Study, (mimeo), 1982.

Stainburn, J. M., Production Costs of Major Agricultural Commodities in Tanzania, Marketing Development Bureau, 1982.

Tanzania Food and Nutrition Center, Data Report on the Food and Nutrition Situation in Tanzania 1974/75 - 1979/80, Department of Planning, Tanzania Food and Nutrition Center, 1982.

United Republic of Tanzania, et al., Tanzania National Food Strategy, Main Report, Ministry of Agriculture, 1982.

United Republic of Tanzania, Income and Consumption: 1969 Household Budget Survey, Vol. 1, Bureau of Statistics, Ministry of Economic Affairs and Development Planning, 1972.

United Republic of Tanzania, 1978 Population Census Preliminary Report, Bureau of Statistics, Ministry of Finance and Planning, 1978.

United Republic of Tanzania, Retail Prices, 1969 Household Budget Survey, Vol. 3, Bureau of Statistics, Ministry of Economic Affairs and Development Planning, 1972.

United Republic of Tanzania, Structural Adjustment Programme for Tanzania, Ministry of Planning and Economic Affairs, 1981.