AN ECONOMIC ANALYSIS OF SMALL-HOLDER AND LARGE-SCALE MECHANISED WHEAT PRODUCTION IN NORTHERN TANZANIA

by

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Department of Agricultural Economics and Farm Management
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PREFACE

Over the years Canada and Tanzania have cooperated extensively in developing the research and production potential of wheat in Tanzania. These development efforts have involved contact at all levels of government and have been strengthened by the exchange of personnel between the two countries. The University of Manitoba has been involved in the development of wheat production in Tanzania for many years.

This study arose out of a Contribution Agreement between CIDA and the University of Manitoba in order to better understand the overall structure of wheat production in Tanzania. A number of people provided invaluable assistance in the completion of this project. The participation of officials in the Anglophone Africa Division of CIDA in recognizing the need for and initiating the study and drafting the report was essential. The assistance of Wheat Project personnel in Tanzania, especially Bob Gillis and Loyce Kapaliswa, greatly eased the problems of data collection in that country. We must also acknowledge the contribution of the Department of Agricultural Economics at the University of Manitoba at all stages of this study, as well as the contributions of two reviewers of this manuscript.

While CIDA provided the entire funding for this study the conclusions drawn in this report are those of the authors and do not necessarily reflect the views of CIDA or the University of Manitoba. The authors are grateful to CIDA for allowing this research to be published.

Winnipeg, March 1990

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SUMMARY AND CONCLUSIONS

This study has examined small-holder and large-scale mechanised wheat production in northern Tanzania for the 1987/88 crop year using cost-benefit analysis. The specific objectives of the study were to **compare the two scales of technology** in terms of:

1. costs of production;
2. levels of production that can be expected;
3. foreign exchange requirements;
4. effects on domestic employment and income;
5. infrastructure requirements; and
6. incentives provided by government policy.

Small-holder production data were collected through a primary survey of small-holder producers in 1988 and were based on those farmers using ox-drawn technology in their farming operations. **Large-scale mechanised production** data were derived from the Hanang farms, a large parastatal farming complex operated by the National Agricultural Food Corporation. Production data were, in both cases, drawn from the 1987/88 crop year. Despite the use of Hanang farm data, this study was not intended to be, and should not be interpreted as, an analysis of this particular project as many of the costs associated with the project have not been included in this analysis.

While the specific objectives of the study did not require it, the Tanzanian domestic market was divided into an **inland market** and a **coastal market** to allow for the high cost of domestic transportation which has the effect of creating a series of isolated geographical markets in the country. This approach is seldom utilized in studies in developing countries but its adoption here provides valuable additional information on the nature of the Tanzanian domestic market and is therefore felt to be a significant contribution to the overall usefulness of this study.

The **financial analysis** compared small-holder and large-scale mechanised wheat production in terms of net financial profitability (NFP) and benefit-cost (B/C) ratio. The **economic analysis** compared the two domestic production alternatives with each other and with direct importation of wheat in terms of net economic profitability (NEP), B/C ratio and domestic resource cost (DRC) ratio.

The objectives of the study called for a comparison of the two scales of technology in terms of their **foreign exchange requirements** only. While conducting the analysis it was felt that this approach would give a somewhat circumscribed view of the real resource costs involved in domestic wheat production. As a result of this consideration, the two scales of technology were compared in terms of their **DRC ratios**. The DRC ratio goes a step beyond a simple comparison of foreign exchange requirements as it measures the cost of saving a unit of foreign exchange in terms of domestic resource utilization. Results of the analysis show small-holder wheat production to be more financially and economically profitable in producing wheat for either the inland or coastal market compared to large-scale mechanised production based on 1987/88 conditions. Large-scale mechanised

production is not quite financially profitable but, based on the economic analysis, is able to serve the inland market more efficiently than imports. While small-holder wheat production can serve either market at less real resource cost than imports, it makes more economic sense for Tanzania to import wheat directly for the coastal market rather than attempting to use large-scale mechanised technology in its present location (Hanang) for this purpose.

Small-holder wheat production is a more efficient generator of foreign exchange savings than large-scale mechanised production, as measured by a lower DRC ratio. Both small-holder and large-scale mechanised wheat production are more effective in saving foreign exchange compared to direct importation into the inland market but only small-holder production is able to retain this advantage in the coastal market; using large-scale mechanised production to serve the coastal market does not make efficient use of domestic resources in the saving of foreign exchange.

Sensitivity tests of the results of the analysis indicate that the conclusions drawn from these results are stable across a relatively wide range of conditions. This stability allows increased confidence in both the representativeness of the data and its use as a base for future analyses. The results support what has been said about the Hanang farms by other studies, but provide a significant new dimension to wheat production potential in Tanzania by indicating a much more favourable **economic potential for small-holder production**.

Direct measurement of domestic employment and income effects and infrastructure requirements of the two scales of technology proved to be impossible in this study. A review of the development literature on technology, employment and income, however, clearly indicates that the adoption of a larger scale of technology generates less employment and income amongst the poorest sectors of the population relative to that generated by a more labour intensive technology. It is, therefore, impossible to justify large-scale mechanised agricultural development on equity grounds, a fact which supports the conclusion of this study, namely that, on grounds of economic efficiency alone, the Tanzanian government should promote small-holder wheat production if it wishes to achieve domestic self-sufficiency at the lowest possible cost. Promotion of small-holder production also would increase rural employment in agriculture and small industry and raise the incomes of people in the countryside compared to large-scale mechanised agricultural production.

I. INTRODUCTION

This report presents the results of an analysis of small-holder and large-scale mechanised wheat production in northern Tanzania. The purpose of the study was to gain a more complete picture of wheat production in the country and to examine the two scales of technology according to a given set of criteria.

The specific objectives of the study were to compare the two scales of technology in terms of:

1. costs of production;
2. levels of production that can be expected;
3. foreign exchange requirements;
4. effects on domestic employment and income;
5. infrastructure requirements; and
6. incentives provided by government policy.

The study was divided into three distinct phases. The first phase involved a review of the literature on wheat in the agricultural development of Tanzania and on the appropriate methodology for studies of this type. The second phase consisted of a three and one-half month field trip to Tanzania to collect the necessary information and conduct a survey of small-holder wheat producers. In the final phase, the data were compiled and analyzed and the results reported.

Three different methodological approaches were evaluated in the first phase of this study--econometrics, linear programming and cost-benefit analysis. The first two techniques involve explicit generation of a production function (input-output relationships) and subsequent application of cost and price information to determine the economic efficiency

of the initiative being analyzed. While econometrics and linear programming have a theoretical appeal they require more and better quality data than cost-benefit analysis, data which are frequently not available in developing countries. These two approaches were rejected because the type of data required were not available in Tanzania.

Cost-benefit analysis was selected as the appropriate analytical technique because of (1) its reduced data requirements, (2) its widespread use in development studies which makes it more readily understood by those involved in development and (3) the ability to conduct sensitivity tests on the results to determine the stability of the conclusions over a range of parameter values.

The application of cost-benefit analysis in this study is a multi-stage process involving both financial and economic analysis. In financial analysis, price data are applied (implicitly) to technical input-output relationships to generate the profitability of wheat production for each scale of technology from the individual farmer's point of view. Economic analysis goes a step beyond this by adjusting for transfer payments and price distortions to arrive at the costs and benefits of wheat production under each scale of technology in terms of real resource utilization. The result is a measure of the profitability of domestic wheat production under each scale of technology for the economy as a whole.

II. THE PHYSICAL AND ECONOMIC SETTING

BACKGROUND

Wheat fulfills a variety of needs within the food economy of Tanzania. It is a staple preferred by both the wealthier urban sector and the subsistence farmers of such districts as Makete. Wheat is grown on all types of farms in Tanzania using technology ranging from complete manual cultivation on plots of less than one acre to large four-wheel drive tractors on farms of 10,000 acres. The use of purchased inputs and improved seed varieties also varies widely with both tending to increase as farm size increases. Wheat is seen by small-holder farmers both as a subsistence crop (Makete district) and a cash crop (Arumeru district) and is grown for crop rotation purposes in many areas of the country.

Wheat was introduced into Tanzania around the turn of the century by German missionaries.[1] It was first grown in the southern highlands using traditional small-holder techniques. Farmers in the south looked on wheat as a food crop and produced little marketable surplus. Between the first and second World Wars modern wheat production began to emerge in northern Tanzania with production being introduced and dominated by foreign settlers. While most of the production in the north occurred on large mechanized farms a number of small-holders also began to grow the crop at this time.

The majority of farmers in Tanzania still produce using such traditional tools as the jembe (hoe) and panga (machete). A 1978 study by UNIDO estimated that of the total agricultural acreage in Tanzania, 85 percent was still cultivated with the jembe while only

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[1]United Republic of Tanzania, Ministry of Agriculture National Wheat Development Strategy: 1984-2000, (Dar-es-Salaam: Ministry of Agriculture and Livestock Development, 1984), p. 3.

10 and 5 percent was cultivated by animal traction and tractors respectively.[2] The total number of trained oxen in use in Tanzania is estimated to be only 300,000 head compared to approximately 5,000 tractors.[3]

THE PHYSICAL SETTING

Present day wheat production in Tanzania occurs on small hand-cultivated plots in areas where topography, population or culture prevent the use of other techniques. Oxen farmers grow wheat in all wheat production zones in Tanzania where this form of technology is utilized. Large-scale[4] mechanised private and parastatal farms grow significant amounts of wheat, mostly in the northern highlands. Although exact figures are not available it appears that wheat production in Tanzania is evenly split between mechanised farms on the one hand and jembe and oxen farms on the other.

As wheat is a temperate crop, the most suitable ecological areas for its production are the mountain slopes and high plateaus of the temperate highlands. In general, wheat does poorly in Tanzania at altitudes below 1,300 metres because of the associated high temperatures, high evapotranspiration and increased incidence of disease in these areas. It has been estimated that at elevations close to 1,300 metres successful rainfed wheat

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[2]UNIDO, as quoted in F. Stewart, Macroeconomic Policies and Agricultural Performance: The Case of Tanzania, (Paris: Development Centre of the Organization for Economic Cooperation and Development, 1979), p. 56.

[3]FAO/Kilimo, Agro-Mechanisation Survey, 21 November, 1976 to 30 June, 1979, (Dar-es-Salaam: FAO, 1981), p. 5.

[4]The term scale as used in this study refers to the size of the operation and the type of technology used. Large-scale mechanised farms are ones covering more area than can be hand (or animal) cultivated by the family and using mechanised traction for tillage and other farming operations.

production requires at least 500 millimetres of precipitation.[5] These constraints of altitude and precipitation, in combination with suitable soils are the main determinants of feasible areas for rainfed wheat production in Tanzania.

Seeding of wheat occurs in northern Tanzania from late January to April, depending on location, having been preceded by two or three pre-plant tillage operations to kill weeds and prepare the seedbed. Cultivation on large-scale farms involves the use of chisel ploughs, cultivators or disk ploughs. Small-holders do almost all pre-plant tillage with ox-drawn ploughs and simple wooden or metal harrows. A number of different varieties are seeded, not all of which are recommended for the area. Some small-holders did not know the name of the variety they were using. Large-scale farmers plant with mechanical seeding equipment while small-holders broadcast seed by hand. Weed control on small-holder farms involves a combination of chemical spraying and hand-weeding. Large farms use chemical weed control only. Chemical fertilizer is not used for wheat production in northern Tanzania. Harvest occurs from June to September during the prolonged dry season. All grain is harvested in a dry, readily storable condition.

THE ECONOMIC SETTING

At the time of independence Tanzania's economy was similar to many other countries in Africa. One quarter of GDP was accounted for by subsistence food production while economic growth was dependent on primary resource exploitation.[6] The country was

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[5]Information in this paragraph is taken largely from: Wheat Production in Northern Tanzania, L.A. Loewen-Rutgers, ed., (Arusha: Tanzania-Canada Wheat Project, 1988), p. 6-7.

[6]R. Young, Canadian Development Assistance to Tanzania, (Ottawa: North-South Institute, 1983), p. 2.

a net exporter of food and animal feed.[7] The decade of the sixties saw a reasonably balanced and sustained growth of the economy. Exports were dominated by agricultural primary products while imports consisted mostly of industrial, intermediate and consumer goods.

The 1970's present a more negative picture of economic performance in Tanzania. There were substantial negative external shocks to the system, most significantly in terms of increased oil prices, droughts, decreased terms of trade and a costly war with Uganda.[8] These shocks resulted in an increasing dependence on external sources of finance (aid and loans) in order to maintain development efforts. The annual growth rate of per capita GDP averaged less than one percent during this time period.

The official position of the government of Tanzania was that the poor performance of the economy was due to the external shocks being experienced at this time. This opinion is questioned by others such as the World Bank who note that

> while external developments have dealt Tanzania a hard blow, the basic weakness of the economy lies in the structure and performance of the national economy and the inappropriateness of economic policy...inadequate rates of return to manufacturing and agricultural investment; poor management in the public sector; insufficient growth of agricultural exports, caused primarily by deteriorating real producer prices for export crops; and poor export growth which has aggravated recurring foreign exchange crises and placed an ever-tightening constraint on the economy's ability to import inputs for restructuring and improving manufacturing and agricultural performance.[9]

This relatively poor economic performance carried forward into the 1980's and, aggravated by the world economic recession in 1981-82 and increased energy costs as a

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[7]FAO, Trade Yearbook, 1963, (Rome: FAO, 1963), pp. 10-11.

[8]World Bank, op.cit., pp. 12-13.

[9]World Bank, op.cit., p. 15.

result of higher prices for imported oil, caused the early years of the decade to became the most difficult period for the country since independence. The first five years of the decade all showed declines in real per capita GDP with 1983 being considered the worst year overall. The result of this recession was a decline in exports, a shortage of any type of consumer good and declining living standards throughout the nation.

The Economic Recovery Program (ERP) introduced by the government of Tanzania in 1986 loosened government controls on the economy and opened up imports into the country, The economy is still critically short of foreign exchange, however, and development is hindered by this constraint.[10] This scarcity of a resource so necessary for economic development indicates the need for well-focussed planning on the part of the government. Efforts to increase food production by capital intensive, imported agricultural technology such as that seen on the Hanang farms must be evaluated in terms of this foreign exchange constraint.

The publicly stated policy of the government of Tanzania has been one of encouraging the development of small-holder production using more labour intensive technology. Government actions, however, have frequently favoured more capital-intensive techniques, i.e., importation of tractors and equipment rather than development of ox-drawn cultivation.[11] This lack of a singular and cohesive government policy, and gap between

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[10]Tanzanian Government, "1988/89 Government Budget Proposals," (Dar-es-Salaam: Daily News, 24 June,1988), p. 6.

[11]For example, between 1981 and 1982 the Head Office of the Tanzanian Rural Development Bank authorised outlays of 7 million shillings for tractors but only 1 million shillings for ox ploughs and other implements. F. Stewart, op.cit., p.58.

economic reality and government programs results in a diffusion of development efforts and potential substantial resource use inefficiency.

In terms of food production, the policy objectives of the government are to increase self-sufficiency and food security while at the same time saving foreign exchange.[12] In light of these objectives, an important problem facing the government is to determine which scale of technology, small-holder or large-scale mechanised, makes the most efficient use of national resources in the production of wheat for domestic consumption.

Recent theories of agricultural development, most notably the high-payoff input model,[13] maintain that production techniques developed in and for the industrialized economies are not necessarily transferable directly to developing countries because of differences in the physical and economic environment. These theories support the need for detailed analysis of the different production technologies currently available in the wheat sub-sector of Tanzanian agriculture.

Studies in the early 1980's, for example, concluded that the Hanang wheat farms were financially and economically profitable thus supporting the concept of large development projects based on industrialized agricultural technology in contrast to contemporary development theory.[14] A more recent study of the Hanang farms, however,

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[12]C.K. Omari, "Politics and Policies of Food Self-Sufficiency in Tanzania," Social Science and Medicine 22:7 (1986): 769.

[13]Y. Hayami and V.W. Ruttan, Agricultural Development: An International Perspective, revised and expanded edition, (Baltimore: Johns Hopkins University Press, 1985), p. 59-62.

[14]See H. Monaghan, R. Dalgleish and H.G Dion, "Tanzania-Canada Wheat Development Program: Interim Review," 1983, Unpublished CIDA report, pp. 3 and 21. and James L. Stone, "Project Evaluation: A Case Study of the Canada-Tanzania Wheat Project," M.A. Thesis, University of Guelph, 1982.

contradicts these results by concluding that the farms, while technically successful and financially profitable (Appendix Table A7), are uneconomic in their use of domestic and foreign resources for large-scale mechanised wheat production.[15] These studies have been conducted on a specific aid project and leave unanswered the broader question of the appropriate scale of technology for wheat production in Tanzania.

Both scales of technology must also be compared to the cost of imported wheat in terms of satisfying the different geographical markets in the country.[16] This latter analysis is required to determine the costs or savings involved in producing wheat for import substitution versus direct importation of the commodity, the other main option of the Tanzanian government.

WHEAT IN THE TANZANIAN ECONOMY

Originally, government involvement in the wheat sub-sector was confined to the policy and program level with no direct involvement in production. Initiatives were limited to such areas as the setting of minimum prices for wheat, issuing of agricultural loans or assistance in opening up new areas for production.

Beginning in the late 1960's the government increased its involvement in all sectors of the economy, including wheat production. The main government thrust into active

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[15]R.M.A. Loyns, et al., "Final Report of the Benefit-Cost Study Team on the Tanzania-Canada Wheat Project," 1986, Unpublished CIDA report.

[16]Wheat production in Tanzania occurs some distance from the coast and largest city, Dar-es-Salaam. Population distribution within the country results in substantial markets upcountry, in closer proximity to wheat growing areas in the north and south. This distribution of population combined with the high cost of domestic transportation creates a series of isolated geographical markets in the country. This point is discussed more fully in Section 3 of this report.

production occurred with the setting up of the Hanang complex under NAFCO in 1969/70. This project eventually grew to encompass over 63,000 acres on seven farms in the Hanang district. The Canadian government through its development agency, CIDA, has been actively involved in research and production at the complex since 1970.

Some of the reasons for the Tanzanian government taking an active role in wheat production date from the colonial era. The emphasis of the colonial government favoured the production of export crops at the expense of food crops such as maize, rice and wheat.[17] As a result, following independence the newly formed government placed a priority on increased food crop production. The plan was to increase food crop production among peasant farmers. One of the main objectives at this time was "national self-sufficiency in food crops"[18] Despite this objective, in the early years of independence government actions favoured export crop production at the expense of food crops.[19]

Droughts in the 1960's and 1970's also led to an increased dependence on food imports and greater awareness of the importance of food crop production. The droughts of 1973 and 1974 occurred at a time of rapidly rising world cereal prices with the result that cereal imports increased over tenfold in value during these years.[20]

Food shortages and subsequent increases in imports resulted in national insecurity and international dependency in Tanzania. Such a situation encouraged the government to strive for national self-sufficiency in food production. The operational mechanisms were,

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[17]R. Young, op.cit., p. 17.

[18]C.K. Omari, op.cit., p. 769.

[19]Ibid., p. 769.

[20]World Bank, Tanzania Agricultural Sector Report, (Washington,D.C.: Report no. 4052-TA, 1983), p. 15.

first, increased producer prices for food crops combined with consumer subsidies to hold down prices and, second, increased food production on large state-owned wheat and rice farms.[21]

Since 1970, the major direct government involvement in the wheat sector has been in terms of research in Arusha and production at Hanang in the northern highlands. These efforts have been sustained since their beginning with the financial, infrastructural and technical assistance of the Canadian government.

As Table 2.1 shows, wheat production in Tanzania has fluctuated somewhat in the past 15 years but has experienced no real growth. Imports, especially aid shipments, have continued throughout the period. The difference between the official and open market producer prices indicates the probability that a significant amount of small-holder wheat production does not enter official marketing channels. One result of this is that wheat production estimates are somewhat underestimated with annual production probably being in excess of 100,000 tonnes.

Table 2.2 shows the trend in nominal and real official producer prices for maize and wheat since 1969/70. The period of the mid 1970's did contain some of the highest real official producer prices for wheat, however, the trend over the entire period has been strongly downward. This decline is a major factor helping to explain the lack of growth in wheat production and the consequent maintenance of significant wheat imports over the past 20 years (Table 2.1).

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[21]R. Young, op.cit., p. 18.

Table 2.1

TANZANIAN WHEAT PRODUCTION AND IMPORTS 1969/70 TO 1987/88

Imports Year	Wheat Prod'n '000mt	Pref'd[a] Staples Prod'n '000mt	Wheat Imports '000mt	Pref'd Staples Imports '000mt	Wheat Prod'n as % of Pref'd Staples Prod'n	Wheat Imports as % of Pref'd Staples Imports	CIF Value of Wheat Tsh/kg
1969/70	41	661	35.7	86.2	6.2	43	0.5
1970/71	57	947	11.6	11.6	6.0	10	0.5
1971/72	60	868	45.4	137.7	6.9	33	0.5
1972/73	88	1276	8.2	87.1	6.9	9	0.8
1973/74	85	1069	91.0	454.7	8.0	20	1.5
1974/75	82	1714	28.8	268.5	4.8	11	1.4
1975/76	69	1864	61.0	189.0	3.7	32	1.2
1976/77	64	2024	34.0	80.6	3.1	42	1.1
1977/78	55	1907	41.0	124.3	2.9	33	1.1
1978/79	70	2052	78.0	119.0	3.4	66	1.3
1979/80	87	2104	33.0	120.5	4.1	27	1.7
1980/81	90	2129	48.7	388.5	4.2	13	1.8
1981/82	95	2069	83.1	387.9	4.6	21	1.8
1982/83	58	2059	29.4	182.2	2.8	16	1.8
1983/84	74	2369	46.3	297.7	3.1	16	2.1
1984/85	83	2603	33.3	197.9	3.2	17	2.9
1985/86	72	2830	21.8	60.8	2.5	36	3.0
1986/87	72	3075	53.5	230.8	2.3	23	3.9
1987/88	N/A[b]	N/A	N/A	N/A	N/A	N/A	17.8

[a]Preferred staples include maize, rice and wheat.
[b]N/A = Not available.

Source: International Wheat Council, International Wheat Statistics, various issues.

Table 2.2

TANZANIAN WHEAT AND MAIZE PRODUCER PRICES 1969/70 TO 1988/89

Year	Off.[a] Wheat Price (Tsh/kg) Nominal	Real	Off. Maize Price (Tsh/kg) Nominal	Real	O/M[b] Wheat Price (Tsh/kg) Nominal	Real
1969/70	.57	14.86	N/A[c]	N/A	N/A	N/A
1970/71	.57	14.35	"	"	"	"
1971/72	.57	13.67	.24	5.76	"	"
1972/73	.57	12.64	.26	5.76	"	"
1973/74	.57	10.98	.33	6.36	"	"
1974/75	.77	12.06	.55	8.62	"	"
1975/76	1.00	13.51	.80	10.80	"	"
1976/77	1.20	14.84	.80	9.89	"	"
1977/78	1.25	13.86	.85	9.42	"	"
1978/79	1.25	11.94	.85	8.12	"	"
1979/80	1.35	10.10	1.00	7.48	"	"
1980/81	1.65	9.79	1.00	5.93	"	"
1981/82	2.20	10.47	1.50	7.14	"	"
1982/83	2.50	8.87	1.75	6.21	"	"
1983/84	3.00	8.79	2.20	6.45	9.70	28.42
1984/85	4.50	9.48	4.00	8.42	12.00	25.28
1985/86	6.00	9.75	5.25	8.53	22.20	36.08
1986/87	7.20	9.00	6.30	7.88	26.10	32.63
1987/88	9.00	9.00	8.20	8.20	29.30	29.30
1988/89	10.35	7.96	9.00	6.93	N/A	N/A

[a]Off. = Official
[b]O/M = Open market
[c]N/A = Not available
Tanzanian consumer price index used as deflator

Source: Marketing Development Bureau, Annual review of Maize, Rice and Wheat, various issues.

Table 2.1 also shows that wheat is not a major crop in terms of production, accounting for between 2.5 and 8 percent of the total production of preferred staples[22] over time. The importance of wheat to Tanzania is more clearly seen when wheat imports as a percentage of imports of preferred staples is examined. Although wheat accounts for a small percentage of preferred staples production it frequently accounts for greater than 25 percent of the total imports of preferred staples.

The CIF value of wheat imports has risen dramatically in recent years as a result of two factors. The first was the devaluation of the Tanzanian shilling that began in 1983 at a rate of 9.1 to the Canadian dollar and had fallen to a value of 75 shillings to the Canadian dollar by 1988.[23] The effect of the devaluation of the shilling on the CIF value of wheat imports was partly offset by the decline in world wheat prices from 1981 to 1987. The second factor was the increase in world wheat prices that occurred in the early months of 1988.

The true vulnerability of the economy to international conditions is seen in the CIF value for 1987/88 when the effect of the 1988 devaluation was combined with an increase in the world price of wheat. These two factors caused the CIF value of wheat imports to rise from 3.8 to 17.7 shillings per kilogram between 1986/87 and 1987/88. During the same time period the nominal official producer price of wheat rose from 6.3 to 9.0

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[22]Preferred staples include maize, rice and wheat.

[23]Since the data for this research were collected the Tanzanian shilling has been further devalued to approximately 100 to the Canadian dollar. This was the first devaluation in almost one year and merely served to accommodate higher inflation in the Tanzanian economy relative to international inflation. Real resource costs (and, hence, the results of this analysis) will not change significantly in response to this correction for a pecuniary effect.

shillings per kilogram (see Table 2.2). This caused the ratio of the Tanzanian domestic wheat price to the world wheat price to fall from 1.66 in 1986/87 to 0.51 in 1987/88. Devaluations of this magnitude that are not offset by increases in producer prices act as a significant disincentive to domestic production, especially for import intensive production technologies.

The majority of wheat imports into Tanzania have always consisted of aid at a CIF cost of zero. However, even aid shipments have a cost to the country in terms of their reliability, political acceptability and adverse effects on local production. They also represent a significant opportunity cost if this aid would have been available to Tanzania in alternative productive forms. Aid shipments must be negotiated between Tanzania and a donor country and are therefore subject to foreign political willingness to donate and to international market conditions. The food aid budgets of donor countries are calculated in monetary terms with the result that as prices increase quantities available for donation decrease. This can place a recipient country in a vulnerable position in terms of domestic food security during times of international supply restrictions or price increases.

Tanzania has for years had a dual marketing system for food grains, an official, government controlled market and an open (parallel) market. The open market has not always enjoyed legal status in the country although, currently, producer deliveries to the open market are tolerated and there are no restrictions on the movement of food grains within the country. The official market operates through the National Milling Corporation (NMC) and primary cooperatives. Panterritorial prices and transportation rates are set annually by the government in consultation with the private sector. The official market is most active in isolated regions of the country (because of panterritorial pricing) and in

purchases from large-scale and parastatal farms, especially wheat farms.[24] The open market operates throughout the country but is particularly active in surplus areas that are adjacent to areas of deficit.[25]

Table 2.2 indicates the spread that has existed between the official producer price and the open market price of wheat since 1983/84. The open market price has varied between 2.7 and 3.7 times the official price during this time. This is an indication that domestic production plus imports have not been able to keep up with demand at the official price level. This price discrepancy also diverts marketings from the official to the parallel market thus reducing government control over wheat production and depriving the government of potential tax revenues.

While the government publicly supports small-holder production, government pricing and administrative decisions have frequently favoured more capital intensive techniques. In addition to the steady decline in real official producer prices for wheat over the past two decades, the government maintains a two price policy for wheat deliveries.
Parastatals and large private farms are allowed to deliver directly to NMC while small-holders must deliver to their primary cooperative if they choose to use the official marketing channel. For wheat delivered in the 1987/88 fiscal year this resulted in a price difference of 4.2 shillings per kilogram (13.2 shillings for large farmers versus 9.0 shillings for small-holders). The government also maintains a subsidy of approximately 10 percent on diesel fuel which effectively lowers the financial cost of tractor farming.

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[24]Marketing Development Bureau, Annual Review of Maize, Rice and Wheat, (Dar-es-Salaam: Ministry of Agriculture and Livestock Development, 1987), p. 11.

[25]World Bank, Tanzania Agricultural Sector Report, op.cit., p. 17.

Support for capital intensive wheat production extends beyond Tanzanian government policy into foreign aid projects as well. Canada has been actively involved in large-scale mechanised wheat production at Hanang for nearly 20 years. During this time a total of over 53 million dollars has been spent by the Canadian government in support of wheat research and production in the northern highlands. A complete breakdown of Canadian aid to the Hanang wheat project is presented in Appendix Table A3. The contradictory policies of the government of Tanzania combined with a national desire for food self-sufficiency and food security and the relative importance of wheat in certain sectors of the economy and in food imports all indicate the need for a clear and consistent policy on wheat production. Such a policy should make effective use of scarce resources and must therefore address the question of the appropriate scale of technology to utilize in wheat production. While questions of resource use efficiency are of primary importance to the Tanzanian government, they are also of interest to bilateral aid donors such as Canada and multilateral institutions such as CIMMYT,[26] the International Monetary Fund (IMF) and the World Bank (IBRD). Bilateral and multilateral organizations have an interest in assisting economic development to the greatest extent possible and, to that end, seek to apply aid funds to those sectors generating the most efficient use of domestic and foreign resources. Therefore, an analysis which can provide information on the relative resource use efficiency of different productive technologies is of significant interest to aid donors as well as recipients.

[26]International Centre for Maize and Wheat Research.

III. FINANCIAL AND ECONOMIC VALUES OF WHEAT PRODUCTION IN NORTHERN TANZANIA

INTRODUCTION

Two forms of analysis are conducted on the data. The first, "financial analysis" of the two scales of technology,[27] will determine the profitability of each category on the basis of actual market prices and costs occurring in that category. The result will be a measure of private profitability (or loss) per unit area (or per tonne) given current market conditions in Tanzania. This will determine the relative monetary producer incentives to grow wheat under each scale of technology. In economic terms, private profitability provides a measure of the relative supply incentives given existing prices.

While financial analysis looks at costs and returns as faced by the individual or firm, the second form of analysis, "economic analysis", examines all costs and benefits from the point of view of society as a whole. More specifically: "...economic analysis omits transfer payments...and values all items at their opportunity cost to the society..."[28]. The results of this economic analysis give the relative resource use efficiency in the production of wheat under each scale of technology. It answers the question as to whether or not it makes economic sense to produce wheat in Tanzania by either small-holder or large-scale mechanised techniques relative to direct importation of the commodity.

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[27]Use of Hanang farm production data to represent large-scale mechanised wheat production should not cause the results of this analysis to be interpreted as being indicative of the performance of the Tanzania-Canada Wheat Project. Many of the administrative and foreign aid costs of that project have been excluded from this analysis as they are not applicable to private large-scale mechanised wheat producers in northern Tanzania.

[28]J.Price Gittinger, Economic Analysis of Agricultural Projects, 2nd ed.,(Baltimore: Johns Hopkins University Press, 1982), p.468.

In conducting an economy-wide analysis of any initiative involving private and public participation both financial and economic analyses are required. The financial analysis must indicate private profitability in order to induce individuals to devote resources to the initiative. If a financial analysis does not indicate the potential for profit, private individuals will shift their resources to other uses. In this regard financial viability as shown by a financial analysis can be considered a necessary condition for successful implementation of the initiative.[29]

Economic analysis, by contrast, indicates the profitability of the initiative from the point of view of society as a whole and as such is also a necessary condition for success in the economic sense, i.e., if the economic analysis does not indicate that overall welfare gains will exceed (or at least equal) overall welfare losses, the initiative is uneconomic from society's point of view. Taken together the two conditions provide the sufficient condition for an economically sustainable initiative.[30] In other words, the initiative must be both privately profitable and economically efficient to be justified on economic grounds and to achieve the necessary support of private participants.

The difference between the financial and economic analyses also gives an indication of the subsidies (positive or negative) flowing to each production category. Direct subsidies are measured by transfer payments while indirect subsidies are measured by price distortions in traded and nontraded goods.

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[29]A necessary condition is defined as a condition the presence of which is required for, but does not ensure, success.

[30]A sufficient condition is defined as a condition the presence of which ensures success.

Location of production and high transportation costs have effectively created a series of isolated geographical markets within the country with significant price differences and product availability across each. In response to these conditions the economics of wheat production under each scale of technology are compared to direct importation in two markets, inland and coastal, as represented by Arusha and Dar-es-Salaam respectively. This breaking down of the analysis on the basis of geographical markets more clearly approximates the actual marketing situation in the country making the results more representative and, hence more useful for policy purposes.

Current replacement values of assets were used because the recent large devaluations of the Tanzanian shilling and concurrent inflation have rendered historical data, such as book values of assets, of limited usefulness in determining real resource costs.

Successful completion of this study required the undertaking of the following analyses, all based on 1987/88 data:

1. measurement of the financial profitability of small-holder and large-scale mechanised wheat production in northern Tanzania;

2. measurement of the economic profitability to the nation as a whole of small-holder and large-scale mechanised wheat production in northern Tanzania;

3. determination of the relative efficiency of small-holder and large-scale mechanised wheat production in saving foreign exchange compared to direct importation;

4. carrying out these last two analyses for wheat production used to satisfy domestic demand in (i) the inland market and (ii) the coastal market;

5. determination of the domestic wheat production levels that can be expected in Tanzania in future;

6. evaluation of the relative employment and income effects of wheat production under the two scales of technology;

7. estimation of the relative infrastructural requirements under the two scales of technology.

In order to complete the first four analyses a number of evaluation criteria had to be developed which enabled comparison of the two scales of technology with each other and with imports of wheat. These criteria are outlined below and are followed by presentation of the financial and economic data and analysis of the base results. Sensitivity testing of the results and discussion of the last three analyses are presented in subsequent sections.

EVALUATION CRITERIA

The basic theory behind financial and economic analysis within the cost-benefit framework was presented earlier in this section. Operationalizing these concepts required the development of specific evaluation criteria; net financial profitability (NFP) and benefit-cost (B/C) ratio for the financial analysis; net economic profitability (NEP), B/C ratio and domestic resource cost (DRC) ratio for the economic analysis.

Net Financial Profitability

An initiative can be considered financially profitable if the returns from the initiative exceed its costs, both being measured from the producer's point of view. In single-period analysis (and assuming all outputs are tradeable) this concept can be expressed mathematically as:

$$NFP = \Sigma (E_i - M_i)*OER - \Sigma N_j$$

where:

NFP = Net financial profitability of the initiative measured in domestic currency

E_i = Exported (or exportable) outputs measured in foreign currency

M_i = Imported inputs measured in foreign currency

OER = Official exchange rate for tradeables

N_j = Nontraded inputs measured in domestic currency

Net Economic Profitability

An initiative can be considered economically viable from the national perspective if the economic benefits to society exceed the economic costs, i.e., both benefits and costs being measured in terms of real resource allocations. In single-period analysis (and assuming all outputs are tradeable) this concept can be expressed mathematically as:[31]

$$NEP = \Sigma (E_i - M_i)*SER - \Sigma N_j$$

where:

NEP = Net economic profitability of the initiative measured in domestic currency

E_i = Exported (or exportable) outputs measured in foreign currency

M_i = Imported inputs measured in foreign currency

SER = Shadow exchange rate for tradeables

N_j = Nontraded inputs measured in domestic currency

Net benefits (profitability) measured in this manner may be greater than, less than or equal to those accruing to an entity under financial analysis. This potential disparity is

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[31]Adapted from A. Ray, Cost-Benefit Analysis: Issues and Methodologies, (Baltimore: Johns Hopkins University Press, 1984), p. 68. In the case of import substitutes, the above equation can be applied by substituting imports displaced in place of exported outputs. This study uses cross-sectional for the 1987/88 crop year and, therefore, presents an undiscounted measure of worth.

due to the difference in numeraire between the two methods. Financial analysis uses market prices (inclusive of subsidies and taxes) as indicators of value while economic analysis uses real resource costs. The difference between these two measures is, hence, due to price distortions in the domestic market. A principal cause of such distortions is government intervention in the market in the form of regulations, taxes, subsidies and trade policies.

Benefit-Cost (B/C) Ratio

One of the first measures of project worth to be widely used in developed countries was the benefit-cost ratio. In multi-period analysis this ratio is simply the present value of the benefit stream divided by the present value of the cost stream. In analyses such as this one where the data relate to a single time period there is no need to discount either benefits or costs. In this latter case the benefit-cost ratio can be expressed mathematically as:[32]

$$BCR = \frac{\Sigma B_t}{\Sigma C_t}$$

where:

BCR = Benefit-cost ratio

B_t = Benefits in year t

C_t = Costs in year t

The selection criteria for this measure of project worth is to accept those projects with a benefit-cost ratio of one or greater.

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[32]Adapted from J.P. Gittinger, op.cit., p. 361.

Use of the benefit-cost ratio also provides a convenient indicator for the calculation of two switching values[33] of use in project selection and monitoring. First, the ratio can be used to calculate how much costs would have to rise (or fall) before the project becomes economically or financially unacceptable (acceptable). For example, a benefit-cost ratio of 1.25 would mean that costs would have to rise by more than 25 percent before the benefit-cost ratio would become less than one. Second, the benefit-cost ratio can be used to calculate how much revenue would have to fall (rise) before the ratio becomes less than (greater than) one. The same ratio of 1.25 indicates that revenue would have to fall by more than 20 percent $(1-\frac{1}{1.25})$ to reduce the benefit-cost ratio to less than one.

Domestic Resource Cost (DRC) Ratio

A third criterion for evaluation of a given initiative is its domestic resource cost (DRC). The DRC simply measures the cost in domestic resources required to produce a unit of foreign exchange.[34] This concept is useful in developing countries facing balance of payments problems and contemplating projects with import substitution or export enhancement objectives. Calculation of the DRC of a project reveals to the government the cost of saving or earning a unit of foreign exchange in terms of its domestic currency.

In comparing two export commodity promotion (or import substitution) projects, for example, the larger project may generate greater overall savings of foreign exchange. This would lead planners to favour this project. A comparison of the DRC's of the two

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[33]A switching value is defined by Gittinger, op.cit., p.501, as "the value an element of a project would have to reach as a result of a change in an unfavourable direction before the project no longer meets the minimum level of acceptability".

[34]T.N. Srinivasan and J. Bhagwati, "Shadow Prices for Project Selection in the Presence of Distortions: Effective Rates of Protection and Domestic Resource Costs," Journal of Political Economy 86 (1978):97-116.

projects may reveal that the larger project generates savings of foreign exchange only at a very high domestic resource cost which would make it an inefficient generator of foreign exchange while the smaller, more efficient project may generate a unit of foreign exchange with fewer domestic resources.

There are several ways of expressing the DRC including (1) as a pure ratio, and (2) as a foreign exchange rate. The parameters required for estimation of the DRC are the foreign exchange value of the output, the foreign exchange cost of imported inputs, the domestic cost of local inputs and the opportunity cost of capital. Expressing this as a pure ratio leads to the formula:[35]

$$DRC = \frac{\Sigma N_j}{\Sigma (E_i - M_i)*SER}$$

where:

DRC	=	Domestic resource cost
N_j	=	Nontraded domestic inputs in domestic currency, equivalent to unsubsidized domestic costs
E_i	=	Exported (or exportable) outputs in foreign currency, equivalent to revenue
M_i	=	Imported inputs in foreign currency, equivalent to economic foreign exchange costs
SER	=	Shadow exchange rate for tradeables

The denominator gives the net saving (earning) of foreign exchange converted into domestic currency at the shadow exchange rate. The numerator gives the domestic input costs required to generate this saving (earning). A ratio of less than (greater than) one indicates that the project is an efficient (inefficient) user of domestic resources in the saving or earning of foreign exchange.

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[35]Adapted from A. Ray, op.cit., pp. 68-69. For use of this formula in the case of import substitutes see footnote 31.

SAMPLING FRAMEWORK AND DATA COLLECTION

Analysis of small-holder and large-scale mechanised wheat production on the basis of the framework and criteria outlined above required the collection of specific types of data. Data were collected on technical and price coefficients, yield statistics, world wheat prices and importation costs, shadow prices, foreign exchange components of production and government policies and pricing regimes.

The sample of small-holder wheat producers was drawn from those farmers growing wheat using ox-drawn cultivation in Arusha region. The difficulties of data collection in rural areas of developing countries require flexibility in collection techniques and multi-source confirmation of information whenever possible. Problems encountered included lack of understanding of questions, lack of recall, uncertainty about production practices actually used, etc. In order to minimize these difficulties the data collected from the sample of oxen farmers were supplemented by information collected through Rapid Rural Appraisal (RRA) techniques. RRA is

> a simple and relatively quick method of identifying key constraints and problems that operate in a defined area and which are responsible for preventing farmers in the area from increasing their agricultural production.[36]

The technique involves discussions and interviews with those actually involved in agricultural production and those in a support or advisory role.

Random sample data were collected from 23 farmers in 5 villages in Arusha region. From this sample 7 were rejected leaving a total of 16 farmers in the final sample. The

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[36]G.O.I. Abalu, N.M. Fisher and Y. Abdullahi, "Rapid Rural Appraisal for Generating Appropriate Technologies for Peasant Farmers: Some Experiences from Northern Nigeria," Agricultural Systems 25:1 (1987): 311-324.

RRA consisted of interviews and discussions with agro-mechanisation officers, district agricultural development officers, bwana shambas,[37] mwenyekitis[38] and farmers. Information gathered from the RRA was used as a cross-check for that collected in the random sample to give a more accurate representation of wheat production on oxen farms in northern Tanzania.

Data for large-scale mechanised wheat production were taken from the Hanang farms. The complex comprises seven farms, each operating as a semi-autonomous subsidiary of NAFCO, plus a central maintenance and service centre.

The technical coefficients are, as far as possible, representative of average practices under small-holder and large-scale mechanised wheat production in northern Tanzania. Average values were used in the analysis wherever possible in order to avoid inclusion of any costs or returns that may have occurred in the 1987/88 crop year but which are not typical of wheat production in most years in northern Tanzania. Yields are, for example, based on recent historical averages for the region, not the 1987/88 yield which was below average. Information on average practices was collected with the survey data and through RRA techniques.

The problem of pricing inputs and outputs in an economy being subjected to high domestic inflation and large currency devaluations is more difficult to deal with as time series data are of limited use in such a situation. Updating production and price data will

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[37]A bwana shamba is an agricultural specialist operating at the ward or village level. The closest counterpart in Canada would be an agricultural representative.

[38]Village chairmen.

provide a measure of the current situation in the country as well as a base for future projections.

Data were collected during a field trip to Tanzania in the summer of 1988 and relate to the 1987/88 crop year. The government of Tanzania operates on a July-June fiscal year while wheat production in northern Tanzania occurs from about February (planting) to August (harvest). The result of this is that some prices for 1987/88 production may relate to the 1987/88 government fiscal year while others may relate to the 1988/89 fiscal year, i.e., announced input prices may be from the 1987/88 fiscal year while official wheat producer prices are from the 1988/89 fiscal year.

FINANCIAL COSTS OF WHEAT PRODUCTION

The financial costs for the two scales of wheat production are based on those costs actually faced by the operating unit. The numeraire is the change in income of the unit expressed in Tanzanian shillings.

Variable Costs

The variable costs of wheat production for small-holder and large-scale farms are shown in column III of Tables 3.1 and 3.2 respectively.

Seed costs are based on farmer and RRA estimates of seeding rates for small-holders and on production records for the Hanang farms. The seeding rates for small-holders and large-scale farms were 60 and 44.5 kilograms per acre respectively. The higher rate for small-holders is due to the seeding method used. Small-holders broadcast seed by hand and tend to apply a heavier rate to compensate for poorer seed placement and uneven seed distribution across the field. The price of seed was based on the official 1987/88 producer price adjusted to reflect the cost of carrying the seed from harvest in

Table 3.1

SMALL-HOLDER WHEAT PRODUCTION COSTS PER ACRE (Tsh)

I	II	III	IV	V	VI	VII	VIII
Investment	Forex[a] (%)	Total Cost/Acre	Unsub[b] Cost/Acre	Unsub Domestic Cost/Acre	Unsub Forex Cost/Acre	Economic Forex Cost/Acre	Total Economic Cost/Acre
Oxen	10.00	6,034.00	6,034.00	5,430.60	603.40	814.59	6,245.19
Machinery	90.00	1,024.00	1,368.00	136.80	1,231.20	1,662.12	1,798.92
Land clearing	20.00	2,250.00	2,250.00	1,800.00	450.00	607.50	2,407.50
Sub-Total		9,308.00	9,652.00	7,367.40	2,284.60	3,084.21	10,451.61
Variable Costs							
Seed	35.00	1,257.60	1,257.60	817.44	440.16	594.22	1,411.66
Seedbags	50.00	23.10	23.10	11.55	11.55	15.59	27.14
Herbicide	80.00	134.00	134.00	26.80	107.20	144.72	171.52
Herbicide app'n	80.00	13.90	13.90	2.78	11.12	15.01	17.79
Machinery r&m	80.00	58.00	110.00	22.00	88.00	118.80	140.80
Bird scaring	10.00	53.00	26.50	23.85	2.65	3.58	27.43
Harvesting	80.00	1,300.00	1,300.00	260.00	1,040.00	1,404.00	1,664.00
Grainbags	50.00	0.00	176.00	88.00	88.00	118.80	206.80
Crop transport	70.00	60.00	60.00	18.00	42.00	56.70	74.70
Sub-Total		2,899.60	3,101.10	1,270.42	1,830.68	2,471.42	3,741.84
Seasonal int. (30%)	0.00	434.94	465.17	465.17	0.00	0.00	465.17
Total Variable Costs		3,334.54	3,566.27	1,735.59	1,830.68	2,471.42	4,207.00
Fixed Costs							
Depreciation:							
Oxen	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Machinery	90.00	82.00	111.00	11.10	99.90	134.87	145.97
Maintenance (oxen)	10.00	855.00	855.00	769.50	85.50	115.43	884.92
Interest:							
Oxen (12%)	0.00	687.93	687.93	687.93	0.00	0.00	687.93
Machinery (12%)	0.00	73.20	97.60	97.60	0.00	0.00	97.60
Land (12%)	0.00	270.00	270.00	270.00	0.00	0.00	270.00
Total Fixed Costs		1,968.13	2,021.53	1,836.13	185.40	250.29	2,086.42
Sub-Total		5,302.67	5,587.80	3,571.72	2,016.08	2,721.71	6,293.42
Mgmt.allowance	0.00	265.13	279.39	279.39	0.00	0.00	279.39
Total Costs	41.00	5,567.80	5,867.19	3,851.11	2,016.08	2,721.71	6,572.81

Source: Selian Agricultural Research Institute
World Bank
Author's estimate

Notes: [a]Forex = Foreign exchange component of production
[b]Unsub = Unsubsidised
Col.V = col.IV x 1 - (col.II/100)
Col.VI = col.IV - col.V
Col.VII = col.VI x 1.35
Col.VIII = col.V + col. VII

Table 3.2

LARGE-SCALE WHEAT PRODUCTION COSTS PER ACRE (Tsh)

I	II	III	IV	V	VI	VII	VIII
Investment	Forex[a] (%)	Total Cost/Acre	Unsub[b] Cost/Acre	Unsub Domestic Cost/Acre	Unsub Forex Cost/Acre	Economic Forex Cost/Acre	Total Economic Cost/Acre
Machinery	90.00	20,856.00	19,019.19	1,901.92	17,117.27	23,108.32	25,010.23
Buildings	90.00	5,632.14	5,632.14	563.21	5,068.93	6,843.05	7,406.27
Land clearing	80.00	6,528.00	6,528.00	1,305.60	5,222.40	7,050.24	8,355.84
Sub-Total		33,016.14	31,179.33	3,770.73	27,408.60	37,001.61	40,772.34
Variable Costs							
Seed	65.00	804.56	804.56	281.60	522.96	706.00	987.60
Seedbags	50.00	17.40	17.40	8.70	8.70	11.74	20.45
Chemical	80.00	850.80	850.80	170.16	680.64	918.86	1,089.02
Chemical app'n	80.00	75.60	75.60	15.12	60.48	81.65	96.77
Machinery r&m	80.00	1,260.89	1,149.70	229.94	919.76	1,241.68	1,471.62
Buildings r&m	80.00	94.40	94.40	18.88	75.52	101.95	120.83
Fuel,oil,lube	70.00	1,213.90	1,260.10	378.03	882.07	1,190.79	1,568.82
Labour	10.00	507.00	342.22	308.00	34.22	46.20	354.20
Grainbags	50.00	0.00	241.00	120.50	120.50	162.68	283.18
Power & water	70.00	271.60	287.30	86.19	201.11	271.50	357.69
Insurance	0.00	69.80	0.00	0.00	0.00	0.00	0.00
Levies & taxes	0.00	184.60	0.00	0.00	0.00	0.00	0.00
Sub-Total		5,350.55	5,123.09	1,617.12	3,505.97	4,733.05	6,350.17
Seasonal int. (30%)	0.00	802.58	768.46	768.46	0.00	0.00	768.46
Total Variable Costs		6,153.13	5,891.55	2,385.58	3,505.97	4,733.05	7,118.64
Fixed Costs							
Depreciation:							
Machinery	90.00	2,305.30	2,068.69	206.87	1,861.82	2,513.46	2,720.33
Buildings	90.00	253.45	253.45	25.34	228.10	307.94	333.28
Interest:							
Machinery (12%)	0.00	1,501.82	1,369.38	1,369.38	0.00	0.00	1,369.38
Buildings (12%)	0.00	371.72	371.72	371.72	0.00	0.00	371.72
Land (12%)	0.00	783.36	783.36	783.36	0.00	0.00	783.36
Total Fixed Costs		5,215.64	4,846.60	2,756.68	2,089.92	2,821.40	5,578.07
Sub-Total		11,368.78	10,738.15	5,142.26	5,595.89	7,554.45	12,696.71
Mgmt. allowance	0.00	568.44	536.91	536.91	0.00	0.00	536.91
Total Costs	57.00	11,937.21	11,275.06	5,679.17	5,595.89	7,554.45	13,233.62

Source: Selian Agricultural Research Institute
Regional Development Director
World Bank

Notes: [a]Forex = Foreign exchange component of production
[b]Unsub = Unsubsidised
Col.V = col.IV x 1 - (col.II/100)
Col.VI = col.IV - col.V
Col.VII = col.V x 1.35
Col.VIII = col.V + col.VII

1987 to planting in 1988. This figure was further adjusted to reflect farmer purchases of improved seed in some years. Seedbags are entered as a cost as they are required to store the seed from harvest until planting.

Herbicide and chemical application rates were based on actual farm applications of the relevant chemical. Prices were based on primary cooperative prices for small-holders and farmgate prices for large-scale farms. Herbicide application costs for small-holders were based on estimated repair and maintenance costs of backpack sprayers. Chemical application costs for large scale farms included both own and contracted (i.e., aerial spraying) application services. Fuel, oil and lube expenses were based on farm financial data for the 1987/88 crop year.

Labour costs were based on farm financial data. Seventy percent of total labour costs are for permanent salaried employees (equipment operators, etc.) with the remaining 30 percent for temporary workers. Pay scales are approximately 94 and 60 shillings per day for permanent and temporary workers respectively. The only labour cost reported by small-holders involved the hiring of local youths by some farmers for bird scaring--keeping birds away from the grain between heading and harvesting.

Harvesting costs for small-holders were based on per acre hire rates for custom combining with modern self-propelled combines. This is the only type of mechanised wheat harvesting practised in the entire country. No farmers or extension specialists reported the hand-harvesting of wheat in northern Tanzania. All grain in Tanzania is handled in bags of between 90 and 100 kilograms. Farmers are reimbursed by the purchaser for the cost of the grainbags with the result that bags have been entered at a cost of zero in the financial accounts.

Power and water costs for large scale production were based on the cost of diesel generators and water haulage to the Hanang farms as reported in farm financial accounts. Insurance, levies and taxes are based on actual costs of these inputs as reported in farm financial data.

Crop transport for small-holders was based on the cost of transporting harvested grain from the farm to the primary cooperative. This has been included to ensure comparability with large-scale production where the cost of transporting grain from the field to farm storage is included under variable costs. This method places wheat produced under both scales of production at the point of first collection for transportation to market.

Seasonal interest was based on the rate charged by the Cooperative and Rural Development Bank for agricultural loans. This interest rate was applied to variable costs and prorated over the life of the growing season.

Fixed Costs

Fixed costs for small and large-scale wheat production are shown in column III of Tables 3.1 and 3.2 respectively. Depreciation costs are based on straight-line depreciation of cost less salvage value over the life of the asset. Details of depreciation charges are shown in Appendix Table A1. The high inflation rates experienced in Tanzania recently have reduced the usefulness of asset book values as a measure of the fixed costs of production. Use of book values in such a situation would seriously underestimate the actual (opportunity) cost of production by failing to reflect the true market value of fixed assets. To overcome this problem current asset replacement values were used for all fixed assets. The replacement costs for fixed assets used in large-scale wheat production were

obtained from Selian Agricultural Research Institute. Those for small-holders were obtained from farmers and equipment suppliers.

Oxen are a unique type of fixed asset as they do not depreciate over time. The maintenance costs of oxen are, however, treated as a fixed cost as these costs are not significantly related to the amount of work done by the oxen. This is in contrast to other fixed assets in this analysis where maintenance costs are shown as a variable cost of production. A detailed breakdown of oxen maintenance costs is shown in Appendix Table A2. Small-holders employ different tillage practices for the different crops in their rotation. To reflect this practice, the costs for oxen and tillage equipment were prorated on the basis of acre-ploughings or acre-harrowings depending on the farmer's tillage practices.[39]

The interest charged to fixed assets represents an opportunity cost of capital for those assets. The interest rate chosen to discount the return to fixed assets is the real (pre-inflation) rate of interest.[40] This is different from revolving assets where the opportunity cost is calculated at the nominal rate of interest. The discount rate for fixed assets is applied to the average value of the asset during its useful life. The formula is purchase price plus salvage value divided by two. Calculations of the opportunity cost of capital used in large-scale mechanised wheat production are shown in Appendix Table A1.

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[39]Acre-ploughings equals number of acres times number of ploughings. This was calculated for each crop in the farmer's rotation. Land to be planted to wheat was on average ploughed more times than land to be ploughed to maize in part because wheat is planted later in the rainy season. The cost of oxen and equipment attributable to wheat production was adjusted upward to account for this agronomic practice.

[40]L. Shashua and Y. Goldschmidt, "The Specific Role of Interest in Financial and Economic Analysis Under Inflation: Real, Nominal, or a Combination of Both," American Journal of Agricultural Economics 67 (1985): 377-383.

There is no charge for land rent under fixed costs. This is based on Tanzanian government policy whereby land has no value and cannot be bought or sold. The only allowable charge in a land transaction is for developments to the land. The opportunity cost of land is based on the cost of clearing one acre of new land under each of the two scales of technology. The value of the land, and, hence, the improvements to that land are assumed not to depreciate over time. The real discount rate for land is thus applied in perpetuity.

Returns to management, family labour[41] and capital can be considered the three residual claimants to farm income. Accounting for each of these three factors allows the analyst to determine if the operation being analyzed is providing a sufficient return to cover all three.[42] In order to net out the return to management from the analysis a management allowance of 5 percent of total costs was estimated and added to the cost of production for each scale of technology.

ECONOMIC COSTS OF WHEAT PRODUCTION

Economic analysis differs from financial analysis in that the latter uses the change in individual income as the numeraire while the former uses the change in national income.

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[41]The timing of operations in the small-holder wheat production cycle in northern Tanzania and employment opportunities for excess agricultural labour reduce the opportunity cost of family labour to low levels, assumed to be zero in the base analysis. This is because at the time of wheat tillage, planting and weeding operations there is less work to be done on other crops such as maize. Sensitivity testing of this parameter will be used to test the effects of different assumptions regarding the opportunity cost of family labour. For more information on pricing family labour see J.P. Gittinger, op.cit., pp. 138-139.

[42]R.D. Kay, Farm Management: Planning, Control and Implementation, 2nd ed. (Toronto: McGraw-Hill, 1986), pp. 155-157.

In economic analysis the costs and benefits to society as a whole are measured. Anything that reduces national income is treated as a cost while anything that increases national income is treated as a benefit. The value attributed to a good or service in economic analysis is based on either its opportunity cost or on willingness to pay.

Gittinger outlines a three step procedure for converting the financial accounts to an economic basis:[43]

(i) adjustment for direct transfer payments,

(ii) adjustment for price distortions in traded items,

(iii) adjustment for price distortions in nontraded items.

These three adjustments lead to a set of prices and costs that reflect real resource flows within an economy.

Adjustments for Direct Transfer Payments

Direct transfer payments include taxes, subsidies and bank interest. Taxes and bank interest are transfers from the farming sector to other sectors in the Tanzanian economy. Subsidies are transfer payments from the government to the farming sector.

Most district councils in Tanzania raise money through a levy on crop movements between districts. The current levy is 0.1 shillings per kilogram. Large-scale farms tend to pay the levy directly to the council. In developing the economic accounts this levy has been removed as a cost to large-scale production. Small-holders do not generally pay the levy directly but rather receive a lower price on their deliveries. The adjustment in this case is to raise farmer revenues from the sale of wheat by the amount of the levy.

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[43]J.P. Gittinger, op.cit., pp. 250-271.

The government of Tanzania applies a series of cross-subsidies on fuel to encourage the use of diesel and discourage the use of petrol (gasoline). Vehicles and equipment using diesel receive a subsidy of 2.317 shillings per litre while users of petrol pay an implicit tax of 10.4664 shillings per litre. Fuel, oil and lube costs along with power and water costs have been adjusted to take account of this cross-subsidy.

One contentious issue relates to the treatment of insurance premiums on vehicles and equipment that is paid by large-scale farmers. Gittinger maintains that insurance can be considered a proportional sharing of the risk of a real economic loss and on this basis should be shown as a cost in the economic accounts.[44] This argument does have theoretical appeal but farm managers on the large-scale farms indicated that although premiums were paid it was almost impossible to collect on any insurance claims. This has led to the treatment of insurance as a transfer payment with its subsequent exclusion from the economic accounts.

Adjustments for Price Distortions in Traded Goods

After completing the adjustments for direct transfer payments the next step is adjusting for price distortions in traded goods. A traded good is one which, if exported, the FOB price is greater than the domestic cost of production or, if imported, the domestic cost of production is greater than the CIF price.[45] The valuing of traded goods presents one of the more difficult problems in economic analysis as it requires the determination of a shadow price for foreign exchange whenever the domestic currency is overvalued in relation to foreign currencies.

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[44]J.P. Gittinger, op.cit., p. 256.

[45]L. Squire and H. van der Tak, op.cit., p. 31-32.

Shadow pricing goods and foreign exchange. Distortions in market prices force the analyst to adopt a shadow or accounting price as a replacement for any market price judged to be inappropriate.

A shadow price can be defined as "the value of the contribution to the country's basic socioeconomic objectives made by any marginal change in the availability of commodities or factors of production."[46] It is important to note that shadow prices "relate to an economic environment in which distortions may be expected to persist: they are not equilibrium prices that would prevail in a distortion-free economy."[47] Although a shadow price is not a distortion-free equilibrium price it does assist in designing policies for the removal of the distortion.

The shadow pricing of foreign exchange follows directly from the general theory of shadow pricing other goods. The result is a shadow exchange rate defined as "the average of duties and subsidies impinging on foreign trade at the margin".[48] If one assumes that an overvalued exchange rate is maintained through import duties, quotas, export subsidies and currency controls and that existing tariff policies will continue, the SER can be determined numerically as:[49]

$$SER = \frac{\Sigma P_{Di} \times Q_i}{\Sigma P_{Wi} \times Q_i}$$

where:

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[46]Ibid., p. 26.

[47]Ibid., p. 26.

[48]A. Ray, op.cit., (Baltimore: Johns Hopkins University Press, 1984), p. 45.

[49]D.W. Pearce and C.A. Nash, The Social Appraisal of Projects: A Text in Cost-Benefit Analysis, (London: The Macmillan Press, 1981), p. 115.

Q_i = the marginal import of good i

P_{Di} = the domestic price of good i in domestic currency

P_{Wi} = the world price of good i in foreign currency

In other words, the SER is the ratio of the domestic price of imports to the world price of imports, both being weighted by the volume of imports.

The usual procedure is to measure these distortions through the calculation of a foreign exchange premium (FXP) which captures the extent of the overvaluation of nontraded goods compared to traded goods. The relationship between these indicators can be expressed numerically as:[50]

SER = OER x FXP

where:

SER = shadow exchange rate

OER = official exchange rate

FXP = foreign exchange premium

The SER is then used to convert traded goods from their CIF border price in foreign currency into their domestic price in domestic currency. World Bank estimates place the current (mid 1988) FXP in Tanzania at 1.35 which results in a SER of 101.25 Tanzanian shillings to the Canadian dollar (at an OER of 75:1).[51]

Wheat produced in Tanzania is an import substitute. The relevant price used in the economic analysis is the CIF price for imported wheat. Even though it can be argued that international wheat prices are distorted by government subsidies and regulations, any

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[50]Adapted from J.P. Gittinger, op.cit., p. 249.

[51]Personal conversation with World Bank personnel, September, 1988.

volume of wheat which Tanzania might import is available at existing CIF prices. Consequently, for purposes of economic analysis the value of wheat in Tanzania is the CIF price. Similarly, for directly imported machinery used on large-scale farms the value in the economic accounts is the border price of the equipment adjusted for trade distortions and domestic transportation and distribution costs.

Small-holders receive an indirect subsidy on machinery to the extent that the local manufacturer of ploughs does not calculate the cost of the imported steel used in its products as the steel is frequently received as foreign aid. The company, Ubangi Farm Implements, is a parastatal and prices its products on the basis of cost of production net of steel, the result is a subsidy to purchasers of their equipment equal to the value of steel used. Current estimates place the price of imported steel at approximately 750 US dollars per tonne.[52] The small-holder economic accounts for machinery depreciation, repairs and maintenance and interest have been adjusted to reflect the true resource cost of this domestically produced equipment.

After removing domestic subsidies from tradeable goods, their values are further adjusted to take account of the current foreign exchange premium in Tanzania. This is accomplished by multiplying the foreign exchange component of the good (column II in Tables 3.1 and 3.2) by the unsubsidised cost per acre (column IV) with this result (column VI) multiplied by the foreign exchange premium of 1.35. This is the economic foreign exchange cost per acre (column VII). This last value is added to the unsubsidised domestic cost per acre (column V) to yield the total economic cost per acre (column VIII).

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[52]Personal conversation with Ubangi Farm Implements personnel.

Adjustments for Price Distortions in Nontraded Goods

Nontraded goods are those for which the domestic cost of production lies between the FOB price and CIF price or which are not traded because of government policies.[53] Where the market price of a good was considered to be a good estimate of its economic value this value was entered directly in the economic accounts. Where this was not the case, a shadow price was estimated and used to revalue the good. Two of the most important nontraded goods are land and labour.

Wheat production was assumed to take place on land that was previously unutilized.[54] Tanzania is a country with abundant resources of unused land that is suitable for agricultural production (see Section 2 of this report). The large-scale farms were developed from previously uncultivated land. Land laws in Tanzania also do not allow the buying and selling of land. As a result of these factors the only cost for land shown in the economic accounts is the cost of land development.

Wage rates in Tanzania are not determined in a distortion-free market. Government wage laws have a strong influence on wages paid for hired labour so that wage rates do not accurately reflect the economic value of labour in terms of the opportunity cost of output foregone. Overvalued wage rates combined with few alternatives for nonagricultural employment mean that the real cost of hired labour is less than the market wage. The

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[53]L. Squire and H. van der Tak, op.cit., p. 31-32.

[54]The Hanang farms were developed from land that had been previously used by the Barabaig for dry season grazing. Consequently, this land does have an opportunity cost greater than zero. However, a lack of data on previous usage of the land prevents the inclusion of an opportunity cost for the land in this case. The basic assumption of this analysis is that there is enough arable land in Tanzania to increase wheat production without decreasing production of other crops, i.e., land is not a binding constraint in Tanzanian food crop production.

method adopted here is consistent with the Loyns study[55] in that the shadow wage rates for permanent employees and casual workers were assumed to be 75 and 50 percent respectively. The total economic cost per acre was determined by adding together the economic cost for nontraded and traded goods as explained above.

In analyzing the economic profitability of small-holder and large-scale mechanised wheat production in Tanzania, the theoretically correct approach is to consider the opportunity cost of production foregone if the resources devoted to wheat production were instead employed in their next best alternative use. The problem comes in identifying this next best use.

While conducting the survey it became clear that the alternative to wheat production on small-holder farms was not increased maize plantings because of labour constraints faced at other times in the maize production cycle. Similarly, no other crop (or animal) was able to be identified as an obvious alternative to small-holder wheat production. It is clear that an alternative use for the resources employed in small-holder and large-scale mechanised wheat production does exist but identification of that alternative requires a more detailed anthropological study than was possible here. The opportunity cost of the family labour used in small-holder wheat production is, therefore, set at zero in the base analysis with the rationale being discussed more fully in the next section. A similar rationale applies to the opportunity cost of land used to produce wheat under either scale of technology. There is no charge for land rent, the opportunity cost of land being based on land development costs.

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[55]R.M.A. Loyns, et al., op.cit., p. 62-63.

IV. ANALYSIS OF RESULTS AND SENSITIVITY TESTS

INTRODUCTION

This section presents the results of the financial and economic analyses. Sensitivity tests are conducted on the results of both analyses to determine the effects of changes in selected parameters on profitability and resource use efficiency. Changes in these parameters can be used to assess the impact of changes in Tanzanian government policy, technical input-output relationships, price relationships and international market conditions.

RESULTS OF THE FINANCIAL ANALYSIS

The purpose of the financial analysis is to determine if it is profitable, from the producer's point of view, to grow wheat in Tanzania. Financial profitability, at least in the long run, is a necessary condition for supplying wheat through domestic production. Table 4.1 presents a summary of the results from the financial analysis on a per tonne basis. Financial results on a per acre basis are shown in Appendix Table A5.

Cost of Production and Yields

The results of the financial analysis indicate that capital investment and nominal cost of production per acre are much lower for small-holder than for large-scale mechanised wheat production. The relative difference between small-holder and large-scale production costs per acre is greater than the relative difference between the same costs on a per tonne basis. This occurs because yields under small-holder production are lower than under large-scale mechanised production. For example, considered on a per acre basis, small-holder production costs are 48.9 percent of large-scale mechanised costs; the comparable figure on a per tonne basis is 63.9 percent.

Table 4.1

RESULTS OF FINANCIAL ANALYSIS FOR 1987/88 CROP YEAR[a, d] (per tonne)

Item	Large-scale	Small-holder
Yield (Kg/Acre)	688.00	526.00
Producer price (Tsh/Kg)[b]	16.30	16.20
Revenue	16,300.00	16,200.00
Capital investment	47,988.58	17,695.82
Variable production costs	8,943.51	6,339.43
Fixed production costs	7,580.88	3,741.69
Total production costs	17,350.60	10,585.18
Profit (NFP)	(1,050.60)[d]	5,614.82
Benefit/cost ratio	0.94	1.53

Source: Authors' calculation from Tables 3.1 and 3.2.

Notes: [a]All figures in shillings unless otherwise indicated
[b]The small-holder price of 16.2 shillings per kilogram reflects the fact that a local levy of 0.10 shillings per kilogram is not collected directly from the small-holders as is the case for the Hanang farms. Primary cooperatives pay the levy to the local council and reduce the price paid to small-holders by that amount.
[c]( ) denotes negative value
[d]To convert results to a per acre basis multiply the relevant value in the table by 1/(yield/1000).

The lower production costs of small-holders are due to less capital investment per acre (resulting in lower fixed costs) and less usage of purchased inputs, particularly fuel, machinery (repair and maintenance) and chemicals, in variable costs of production. Yields are higher under large-scale mechanised production perhaps due to more timely field operations, planting of improved seed varieties, better seed placement because of mechanical tillage and seeding operations and better weed control through increased chemical use.

Net Financial Profitability

The NFP of small-holder wheat production is positive, generating profits of 2,953.40 shillings per acre (5,614.82 shillings per tonne) in the 1987/88 crop year. Large-scale mechanised wheat production has a negative NFP of -722.81 shillings per acre (-1,050.60 shillings per tonne) for the same crop year.[56] These results are due to the substantially lower costs of production for small-holders, the lower costs being more than enough to offset the 24 percent lower yields realized under this scale of technology.

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[56]These results appear to contradict to those obtained in the Loyns et al. study. They concluded that the Hanang farms were financially profitable for the period 1969-85. There are, however, very important differences in the methodology of this study and the Loyns et al. project evaluation, reflecting the difference in purpose of the two analyses. The Loyns et al. study applied the cost-benefit framework (in the financial analysis) using a project appraisal format while this study uses the cost-benefit framework under traditional farm budget analysis. As a consequence, this study includes such things as all equipment purchases and interest on revolving and fixed assets in the cost of production whereas the Loyns et al. study included only those costs actually borne by the farms (in the financial analysis). Additionally, beginning in 1988, the Hanang farms must pay the cost of transporting wheat from the farms to NMC in Arusha, a cost previously borne by the Tanzanian government and consumers. Examining the Loyns et al. study in light of these factors reveals the similarity of the results with those presented here. The earlier Stone analysis (apparently used by Monaglan et al. without citation) was strictly financial project analysis.

Benefit-Cost Ratio

The financial loss suffered under large-scale mechanised production translates into a B/C ratio of 0.94, as costs exceed benefits by 6 percent. The financial profitability of small-holder production translates into a B/C ratio of 1.53. The B/C ratio of 0.94 for large-scale mechanised production indicates that costs would have to fall by more than 6 percent or revenues increase more than 6.4 percent[57] for large-scale production to become financially profitable. The B/C ratio of 1.53 for small-holder production indicates that costs must rise by more than 53 percent or revenues fall by more than 35 percent before the NFP for small-holder production becomes negative.

RESULTS OF THE ECONOMIC ANALYSIS

This section presents the results of the economic analysis for the 1987/88 crop year in terms of the costs of production and the evaluation criteria. The results of the economic analysis (on a per tonne basis) are presented in Table 4.2. Economic results on a per acre basis are shown in Appendix Table A6.

Cost of Production

Eliminating transfer payments and shadow pricing inputs and outputs raises the cost of production for both scales of technology. Per tonne costs of production rise to 19,234.91 shillings and 12,495.84 shillings for large-scale and small-holder production respectively. This is an increase of 10.9 percent for large-scale production and 18.1 percent for small-holder production.

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[57]This switching value is calculated as follows: 1-(1/.94). For an explanation of switching values, see Section 3.

Table 4.2

RESULTS OF ECONOMIC ANALYSIS FOR 1987/88 CROP YEAR[a, d] (per tonne)

Item	----------Basis Arusha---------- Large-scale	Small-holder	-------Basis Dar-es-Salaam------- Large-scale	Small-holder
Yield (Kg/Acre)	688.00	526.00	688.00	526.00
Producer price (Tsh/Kg)[b]	32.90	32.90	27.30	27.30
Revenue	32,899.91	32,899.91	27,297.41	27,297.41
Capital investment	59,262.13	19,869.98	59,262.13	19,869.98
Variable production costs	10,346.85	7,998.10	10,346.85	7,998.10
Fixed production costs	8,107.67	3,966.58	8,107.67	3,966.58
Total production costs	19,234.91	12,495.84	19,234.91	12,495.84
Total costs (prod + dist)[b]	25,131.23	18,392.16	30,733.73	23,994.66
Unsubsidised domestic costs	9,675.40	8,742.29	11,025.40	10,092.29
Economic forex costs	15,455.83	9,649.87	19,708.33	13,902.37
Profit (NEP)	7,768.68	14,507.75	(3,436.32)[c]	3,302.75
Benefit/cost ratio	1.31	1.79	0.89	1.14
DRC ratio	0.55	0.38	1.45	0.75

Source: Authors' calculation from Tables 3.1 and 3.2 using DRC formula from p. 25.

Notes: [a]All figures in shillings unless otherwise indicated

[b]In conducting the economic analysis of domestic wheat production for serving the inland market (basis Arusha), the price of wheat was adjusted upward to allow for the cost of transportation of imported wheat from Dar-es-Salaam to Arusha. Similarly, the cost of production was adjusted upward to allow for the cost of transportation from the location of production to Arusha. This procedure placed large-scale mechanised production, small-holder production and imports at the same point in space, thus enabling direct comparison of the alternatives. A similar adjustment was made for the coastal market (basis Dar-es-Salaam); the cost of imported wheat was taken as the economic cost of wheat landed in Dar-es-Salaam (see Appendix Table A4) while the economic cost of domestic wheat production was adjusted to allow for transportation from the location of production to Dar-es-Salaam.

[c]( ) denotes negative value

[d]To convert results to a per acre basis multiply the relevant value in the table by 1/(yield/1000).

Comparing the results for the inland and coastal markets also produces significant differences in costs because of the high transportation costs in Tanzania. If domestic production is used to serve the inland market (basis Arusha), per tonne production and distribution costs rise to 25,131.23 shillings for large-scale production and to 18,392.16 shillings for small-holder production. If domestic production is used to serve the coastal market (basis Dar-es-Salaam), per tonne production and distribution costs rise still further to 30,733.73 shillings for large-scale production and to 23,994.66 shillings for small-holder production. This increase in costs is due to the high cost of transportation from the location of production (Hanang) to Arusha for the inland market or to Dar-es-Salaam for the coastal market.

Net Economic Profitability

Just as NFP measures the profitability of wheat production from the perspective of the farmer so NEP measures the profitability of wheat production from the perspective of the national economy. The results of the economic analysis are shown in Table 4.2. Under the economic analysis the price of wheat was adjusted to reflect the opportunity cost of wheat in terms of direct importation into the country. The impact of location on the economic value of wheat in Tanzania was discussed earlier and is presented graphically in Figure 4.1. Two observations are apparent from Figure 4.1. First, the current producer price is far below the economic value (opportunity cost) of wheat in Tanzania. Second, the economic value of wheat increases in direct proportion to the distance from Dar-es-Salaam to the location of production.

Inland market (basis Arusha). In comparing domestic production and imports for the inland market, the price of wheat was determined by calculating the economic cost of

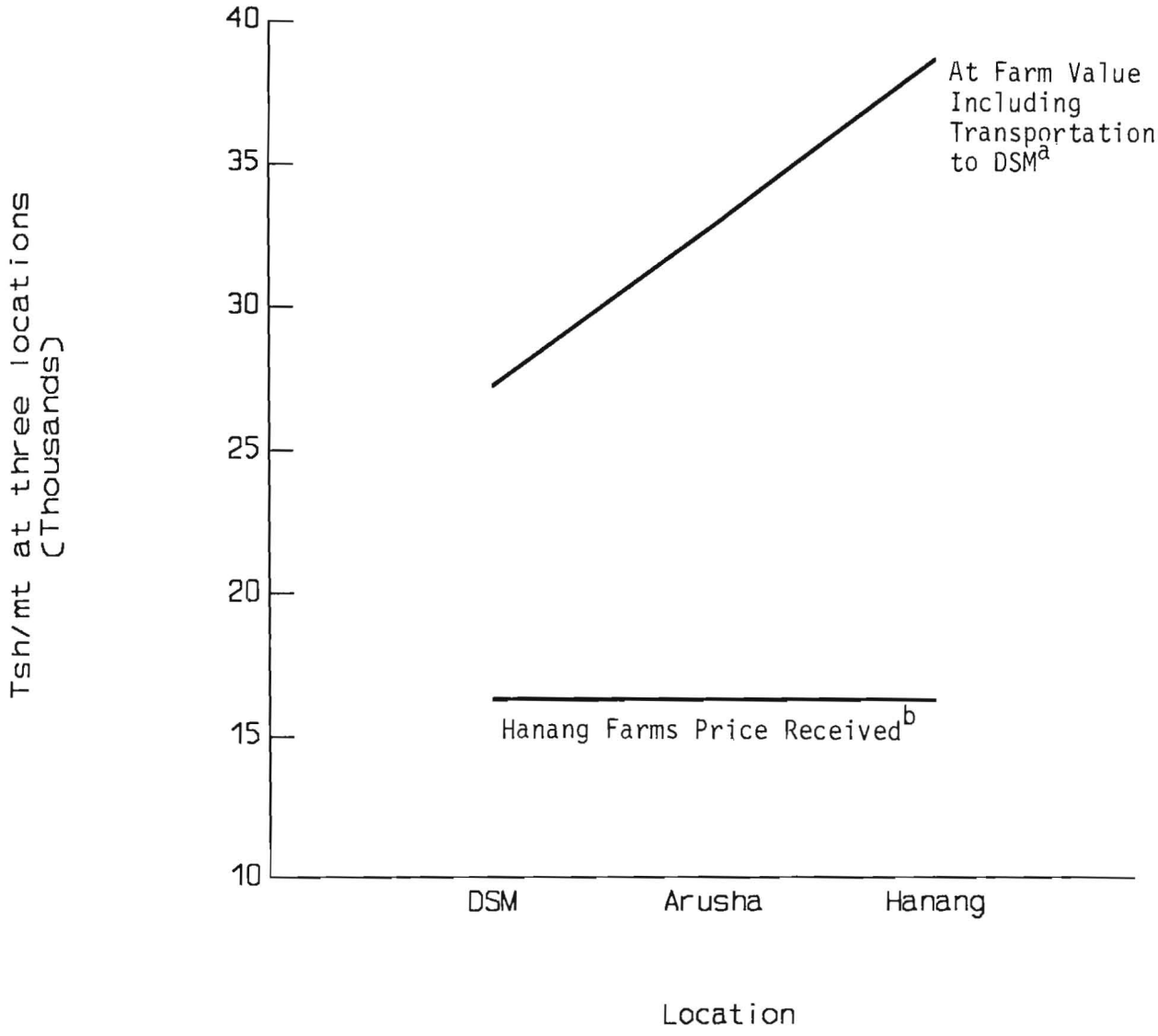
wheat landed in Dar-es-Salaam and adding to this the economic cost of transportation from Dar-es-Salaam to Arusha. This adjustment placed both domestic production and imports at the same point in space. As noted in Section 2, recent increases in the world price of wheat combined with a large devaluation of the Tanzanian shilling have caused the cost of imported wheat to rise substantially in 1988 (see Table 2.1). These factors plus the high cost of transportation within Tanzania caused the price of wheat to rise from 16.3 shillings per kilogram in the financial accounts to 32.9 shillings per kilogram in the economic accounts. This increase in price is more than enough to offset higher values for the costs of production and distribution in the inland market in the economic accounts causing large-scale mechanised production to become economically profitable and small-holder production to become even more profitable in the economic accounts.

Large-scale mechanised production has a NEP of 7,768.68 shillings per tonne compared to 14,507.75 shillings per tonne for small-holders. These results indicate that both small-holder and large-scale mechanised wheat production are economically viable for satisfying demand in the inland market of Tanzania. Small-holder production does, however, generate greater economic profitability both on a per tonne (Table 4.2) and a per acre (Appendix Table A6) basis thus indicating that Tanzania could make better use of its domestic resources by growing wheat on small-holder farms than it could by growing wheat using imported large-scale mechanised production technology.

Coastal market (basis Dar-es-Salaam). When the two domestic production alternatives are compared in serving the coastal market the results for both vary substantially from those observed under the inland market scenario. Costs for both scales of technology increase by 5,602.5 shillings per tonne while revenues decrease by the same amount. This occurs because domestically produced wheat must be transported the extra

Figure 4.1

TANZANIAN WHEAT PRICE STRUCTURE
(Basis CIF Dar-es-Salaam, 1987/88 crop year)



[a]Import price (at DSM) plus freight (at Hanang).
[b]price at Hanang, farms pay the freight.

Source: Tables 4.1 and 4.2

distance from Arusha to Dar-es-Salaam while imported wheat is landed directly at the port in Dar-es-Salaam.

This increase in costs and reduction in revenues causes the NEP for large-scale production to turn negative, the economic loss per tonne being 3,436.32 shillings. The NEP for small-holder production is reduced but still positive at 3,302.75 shillings per tonne. These results indicate that it is not economically viable for the country to use large-scale mechanised wheat production to satisfy the domestic demand for wheat in the coastal market. Small-holders can produce wheat efficiently enough for them to serve the coastal market at a lower real resource cost than either large-scale producers or direct commercial imports of wheat.

Benefit-Cost (B/C) Ratio

Inland market (basis Arusha). The factors that cause the financial loss under large-scale mechanised production to be turned into a profit in the economic analysis also cause the B/C ratio to become greater than unity. The B/C ratio of 1.31 indicates that costs (revenues) would have to rise (fall) by more than 31 (23.7) percent for the ratio to become less than one. The B/C ratio for small-holder production increases from 1.53 in the financial accounts to 1.79 in the economic accounts. Calculation of the switching values for small-holder production indicates that costs (revenues) must rise (fall) by more than 79 (44.1) percent for the ratio to become less than one.

Coastal market (basis Dar-es-Salaam). Just as shifting the analysis from the inland to the coastal market reduces economic profitability, so it reduces the B/C ratios for the two production alternatives. The B/C ratio for large-scale mechanised production falls to 0.89 indicating that costs exceed benefits from the economy's point of view. This ratio

also indicates that costs must fall by more than 11 percent (or revenues rise by more than 12.4 percent) for the B/C ratio to become greater than one.

Shifting the analysis to the coastal market lowers the B/C ratio for small-holder production to 1.14 indicating that although costs are increased and revenues reduced, small-holder production still makes effective use of resources in satisfying demand in the coastal market.

Domestic Resource Cost (DRC) Ratio

The DRC ratio enables the analyst to compare the relative effectiveness (in terms of domestic resource use) of two or more alternatives in the saving (or earning) of foreign exchange. The DRC ratio is calculated by dividing unsubsidised domestic costs of production by the difference between revenues and economic foreign exchange costs of production, all being measured in domestic currency.

Inland market (basis Arusha). The DRC ratio is 0.55 for large-scale mechanised production and 0.38 for small-holder production (see Table 4.2). This ratio indicates that both scales of technology are effective in saving foreign exchange. The lower DRC ratio for small-holder production indicates that this scale of technology generates the greater savings. The reason for the greater effectiveness of small-holder production is the substantially lower foreign exchange costs compared to large-scale mechanised production, the difference in domestic costs per tonne being much less.

Coastal market (basis Dar-es-Salaam). The DRC ratio of 1.45 for large-scale mechanised production indicates that this scale of technology makes inefficient use of domestic resources in saving foreign exchange. It would be cheaper to import wheat directly and divert domestic resources to other uses than to attempt to satisfy the coastal

market for wheat using large-scale mechanised production technology, a result consistent with the Loyns study. The DRC ratio of 0.75 for small-holder production shows that this scale of technology makes effective use of domestic resources in saving foreign exchange. It is cheaper for the economy as a whole to serve the coastal market for wheat using small-holder farmers compared to direct importation or large-scale mechanised production.

SENSITIVITY TESTS OF RESULTS

In any analysis of a real world problem there is always some uncertainty about the accuracy of parameters and, hence, results as it is impossible to estimate parameters with 100 percent accuracy. Sensitivity tests attempt to deal with this uncertainty by changing the values of parameters and observing the effects on the results. The purpose of sensitivity testing is to determine the important parameter assumptions upon which the analysis is based.[58]

Sensitivity tests will be done on the parameters for yield, the world price of wheat, the shadow exchange rate (in the form of the foreign exchange premium) the real interest rate and the shadow price for family labour used in small-holder wheat production Changes in these parameters will be analyzed in terms of their effects on NFP's, NEP's, B/C ratios and DRC ratios.

Sensitivity testing is also useful for testing the stability of the results of cross-sectional data thus making it relevant to other time periods. This characteristic is useful in this analysis because time series data for small-holder wheat production were not available.

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[58]Concepts in this paragraph are taken from: D.W. Pearce, ed., The MIT Dictionary of Modern Economics, 3rd ed. (Cambridge: The Macmillan Press, 1986), p. 384. and S.M. Lee, L.J. Moore and B.W. Taylor III, Management Science, 2nd ed. (Dubuque, Iowa: Wm. C. Brown, 1985), p. 160.

Using sensitivity testing to determine the "bounds" of the results can also overcome potential problems of representativeness arising through use of a small sample size.

Yield

The sensitivity tests of the results to changes in yield for small-holders and large-scale mechanised production are presented in Tables 4.3 and 4.4 respectively. Although the current yield levels are respectable for dryland, nonfertilized, continuous wheat production, staff at Selian Agricultural Research Institute indicated that it should be possible to achieve yields of wheat approaching 1,200 kilograms per acre under rainfed conditions in northern Tanzania.[59] Such a yield level would represent nearly a doubling of current yields at the Hanang complex. On the other hand, reductions in yield due to changes in environmental, economic or political factors are also possible Sensitivity tests were done to determine the effects of varying yields from 350 to 1,200 kilograms per acre.

Financial analysis. The financial results of small-holder production are sensitive to changes in yield. A 15 percent decrease in yield from the base level causes a 32 percent decrease in NFP. The results of the small-holder financial analysis do not turn negative, however, until yields drop below 350 kilograms per acre, indicating that small-holder production can remain financially profitable at yields obtained most years in Tanzania given 1987/88 prices and costs. It takes a drop of more than 33 percent to turn the financial results unfavourable.

The results of the financial analysis on large-scale mechanised production are also sensitive to variations in yield. It takes an increase in yield of approximately 10 percent to turn the financial results positive while decreases in yield cause a rapid increase in

[59]Personal conversation with Selian ARI staff.

Table 4.3

SENSITIVITY OF RESULTS TO CHANGES IN YIELD --SMALL-HOLDER PRODUCTION--

Yield (Kg/Acre)	Financial Analysis NFP[a] (Tsh/MT)	B/C[b] Ratio	--------Basis Arusha-------- NEP[c] (Tsh/MT)	DRC[d] Ratio	B/C Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
350	292.00	1.02	8,224.20	0.60	1.33	(2,980.90)[e]	1.28	0.90
400	2,280.50	1.16	10,571.60	0.51	1.47	(633.40)	1.05	0.98
450	3,827.10	1.31	12,397.30	0.45	1.60	1,192.30	0.90	1.05
500	5,064.40	1.45	13,858.00	0.40	1.73	1,653.00	0.80	1.11
526	**5,614.80**	**1.53**	**14,507.80**	**0.38**	**1.79**	**3,302.80**	**0.75**	**1.14**
550	6,076.70	1.60	15,053.00	0.36	1.84	3,848.00	0.72	1.16
600	6,920.30	1.75	16,048.90	0.33	1.95	4,843.90	0.65	1.22
650	7,634.20	1.89	16,891.60	0.30	2.06	5,686.60	0.60	1.26
700	8,246.00	2.04	17,613.90	0.28	2.15	6,408.90	0.56	1.31
750	8,776.30	2.18	18,239.80	0.26	2.24	7,034.80	0.53	1.35
800	9,240.20	2.33	18,787.60	0.25	2.33	7,582.60	0.50	1.38
850	9,649.60	2.47	19,270.90	0.24	2.41	8,065.90	0.48	1.42
900	10,013.60	2.62	19,700.50	0.22	2.49	8,495.50	0.45	1.45
950	10,339.20	2.76	20,084.80	0.21	2.64	9,225.80	0.42	1.51
1,000	10,632.20	2.91	20,430.80	0.21	2.64	9,225.80	0.42	1.51
1,100	11,138.40	3.20	21,028.30	0.19	2.77	9,823.30	0.39	1.56
1,200	11,560.20	3.49	21,526.30	0.18	2.89	10,321.30	0.37	1.61

Source: Authors' calculation from Tables 4.1 and 4.2

Notes: [a]NFP = Net financial profitability
[b]B/C= Benefit/cost
[c]NEP = Net economic profitability
[d]DRC = Domestic resource cost
[e]( ) denotes negative value
Base results indicated in bold type

Table 4.4

SENSITIVITY OF RESULTS TO CHANGES IN YIELD --LARGE-SCALE PRODUCTION--

Yield (Kg/Acre)	Financial Analysis NFP[a] (Tsh/MT)	B/C[b] Ratio	--------Basis Arusha-------- NEP[c] (Tsh/MT)	DRC[d] Ratio	B/C Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
350	(17,806.30)[e]	0.48	(10,806.70)	2.58	0.75	(22,011.70)	(6.30)	0.55
400	(13,543.00)	0.55	(6,080.50)	1.64	0.84	(17,285.50)	(53.57)	0.61
450	(10,227.10)	0.61	(2,404.50)	1.21	0.93	(13,609.50)	8.64	0.67
500	(7,574.40)	0.68	536.40	0.96	1.02	(10,668.80)	4.08	0.72
550	(5,404.00)	0.75	2,942.50	0.80	1.10	(8,262.50)	2.71	0.77
600	(3,595.40)	0.82	4,947.60	0.69	1.18	(6,257.40)	2.05	0.81
650	(2,064.90)	0.89	6,644.20	0.60	1.25	(4,560.80)	1.66	0.86
688	**(1,050.60)**	**0.94**	**7,768.70**	**0.55**	**1.31**	**(3,436.30)**	**1.45**	**0.89**
700	(753.20)	0.96	8,098.40	0.54	1.33	(3,106.60)	1.40	0.90
750	383.70	1.02	9,358.80	0.49	1.40	(1,846.20)	1.22	0.94
800	1,378.50	1.09	10,461.60	0.45	1.47	(743.40)	1.08	0.97
850	2,256.20	1.16	11,434.60	0.41	1.53	229.60	0.98	1.01
900	3,036.40	1.23	12,299.60	0.39	1.60	1,094.60	0.89	1.04
950	3,734.50	1.30	13,073.50	0.36	1.66	1,868.50	0.82	1.07
1,000	4,362.80	1.37	13,770.00	0.34	1.72	2,565.00	0.77	1.10
1,100	5,448.00	1.50	14,973.00	0.31	1.84	3,768.00	0.68	1.16
1,200	6,352.30	1.64	15,975.60	0.28	1.94	4,770.60	0.61	1.21

Source: Authors' calculation From Tables 4.1 and 4.2

Notes: [a]NFP = Net financial profitability
[b]B/C= Benefit/cost
[c]NEP = Net economic profitability
[d]DRC = Domestic resource cost
[e]( ) denotes negative value
Base results indicated in bold type

financial losses and significant deterioration in the B/C ratio. A 10 percent decrease in yield increases financial losses from a baseline of 1,050.60 shillings per tonne to approximately 3,000 shillings per tonne.

Economic analysis

Inland market (basis Arusha). The results of the economic analysis of small-holder production vary significantly with changes in yield, however, results remain positive at all yield levels. NEP drops to a low of 8,224.20 shillings per tonne at yields of 350 kilograms per acre but remains positive because of the high costs of (1) importing wheat into the country and (2) transporting these imports from Dar-es-Salaam to Arusha. Large-scale mechanised production produces less stable results as NEP turns negative if yields drop much below 500 kilograms per acre. Large-scale mechanised production requires higher yields to achieve the same level of NEP as small-holder production because of the higher foreign exchange component in costs of production in the former (see Tables 3.2 and 4.2).

The B/C ratio for small-holder production remains favourable at all yield levels. Even at yields of 350 kilograms per acre it requires a 33 percent increase in costs to reduce the ratio to one. The B/C ratio for large-scale mechanised production turns unfavourable at yield levels below 500 kilograms per acre, reinforcing the fact that this scale of technology requires significantly higher yields than small-holder production to remain profitable.

The DRC ratios indicate that small-holder production is more efficient in saving foreign exchange at all yield levels than either large-scale mechanised wheat production or direct imports. At yield levels below 500 kilograms per acre the DRC ratio for large-scale

mechanised wheat production exceeds unity, indicating that at yields below this level it is more effective to use domestic resources in some other productive activity (in terms of foreign exchange savings) and to import wheat directly, even for the inland market.

In all of these yield tests small-holder production outperforms large-scale mechanised production. It requires yield reductions to approximately one-half current levels to turn small-holder results unfavourable.

Coastal market (basis Dar-es-Salaam). Shifting the market focus from Arusha to Dar-es-Salaam has an unfavourable impact on the results of the economic analysis for both small-holder and large-scale mechanised producers because of the increased costs and decreased revenues involved. At yield levels of 400 kilograms per acre small-holder production is uneconomic as shown by a negative NEP. At yield levels between 400 and 450 kilograms per acre it becomes economically feasible to serve the coastal market using small-holder production. As yield levels improve NEP increases rapidly pointing out that yield improvements on small-holder farms is one area that should receive attention if domestic wheat production is to be stimulated. The responsiveness of NEP to yield improvements highlights the fact that successful implementation of yield improving technologies or practices will produce favourable results both for the individual farmer and for the nation as a whole.

There is less scope for using large-scale mechanised wheat production to serve the coastal market because of the higher foreign exchange costs involved. Yields must approach 850 kilograms per acre (an increase of 23.5 percent from the base) before positive NEP's result. These are yield levels that have been approached, but never achieved, in the best years on the Hanang farms, although researchers indicate they are

within the feasible range. It may thus be possible to serve the coastal market using large-scale mechanised production technology in good years in the future, however, the prospects for doing so consistently with this technology are less favourable given the variations in yield in Tanzanian wheat production.

The B/C ratio for small-holder production exceeds unity at yield levels between 400 and 450 kilograms per acre and rises steadily with yield increases. The B/C ratio for large-scale mechanised production does not exceed unity until yield levels of 850 kilograms per acre are approached, again indicating that yields on large-scale farms must be increased if this technology is to be used to serve the coastal market in Tanzania.

Shifting the market focus from the inland to the coastal market has an unfavourable impact on the DRC ratios for both scales of technology. The DRC ratio for small-holder production remains below unity for yield levels above 400 to 450 kilograms per acre. The DRC ratio for large-scale mechanised production remains above unity until yield approaches 850 kilograms per acre indicating that at yields below this level large-scale mechanised wheat production makes inefficient use of domestic resources in saving foreign exchange compared to small-holder wheat production or imports.

World Wheat Prices

The economic analysis required using the world price of wheat as the economic value of domestic wheat production because domestic production is a substitute for imported wheat. The world price of wheat thus becomes an important parameter in the economic accounts and as such requires sensitivity testing to determine if changes in its value have a significant impact on the results of the economic analysis. In 1988 the price of wheat landed in Dar-es-Salaam was 27,297 shillings per tonne (Cdn$364 per tonne at

official exchange rates). In the sensitivity analysis the price of wheat landed in Dar-es-Salaam was varied from 18,500 to 36,000 shillings per tonne (Cdn$247 to Cdn$480 at official exchange rates) and the impact on the results assessed.

The results of testing for the effects of changes in the world price of wheat in the economic accounts for small-holder and large-scale mechanised production are shown in Tables 4.5 and 4.6 respectively.

Inland market (basis Arusha). Changes in the world price of wheat (adjusted to reflect the cost of landing the wheat in Dar-es-Salaam) affect the NEP of both scales of technology in the direction expected. The NEP of large-scale mechanised production becomes negative when the landed price of wheat falls much below 20,000 shillings per tonne (Cdn$267 at official exchange rates). A drop in world prices of this magnitude is unlikely as it would place the price below those levels seen in 1987, a year of very low world wheat prices.

The B/C ratio for small-holder production remains substantially above one for all world prices tested. At a landed price of 18,500 shillings per tonne the B/C ratio is 1.31, a ratio high enough so that costs would have to rise by more than 31 percent before it would turn unfavourable. The B/C ratio for large-scale mechanised production exceeds unity at all prices above 20,000 shillings per tonne but the ratio is always less than for small-holder production.

The DRC ratio for small-holder production likewise remains below one (and below that for large-scale mechanised production) indicating that at all world wheat prices tested small-holder production makes more effective use of domestic resources in saving foreign exchange than either large-scale production or imports.

Table 4.5

SENSITIVITY OF RESULTS TO WORLD WHEAT PRICES --SMALL-HOLDER PRODUCTION--

CIF Price (DSM)[a] (Tsh/Mt)	-------Basis Arusha------- NEP[b] (Tsh/MT)	DRC[c] Ratio	B/C[d] Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
18,500.00	5,710.30	0.60	1.31	(5,494.70)[e]	2.20	0.77
20,000.00	7,210.30	0.55	1.39	(3,994.70)	1.66	0.83
21,500.00	8,710.30	0.50	1.47	(2,494.70)	1.33	0.90
23,000.00	10,210.30	0.46	1.56	(994.70)	1.11	0.96
24,500.00	11,710.30	0.43	1.64	505.30	0.95	1.02
26,000.00	13,210.30	0.40	1.72	2,005.30	0.83	1.08
27,297.00	**14,507.80**	**0.38**	**1.79**	**3,302.80**	**0.75**	**1.14**
28,500.00	15,710.30	0.36	1.85	4,505.30	0.69	1.19
30,000.00	17,210.30	0.34	1.94	6,005.30	0.63	1.25
31,500.00	18,710.30	0.32	2.02	7,505.30	0.57	1.31
33,000.00	20,210.30	0.30	2.10	9,005.30	0.53	1.38
34,500.00	21,710.30	0.29	2.18	10,505.30	0.49	1.44
36,000.00	23,210.30	0.27	2.26	12,005.30	0.46	1.50

Source: Authors' calculation from Table 4.2

Notes: [a]DSM = Dar-es-Salaam
[b]NEP = Net economic profitability
[c]DRC = Domestic resource cost
[d]B/C= Benefit/cost
[e]( ) denotes negative value
Base results indicated in bold type

Table 4.6

SENSITIVITY OF RESULTS TO WORLD WHEAT PRICES --LARGE-SCALE PRODUCTION--

CIF Price DSM[a] (Tsh/MT)	-------Basis Arusha------- NEP[b] (Tsh/MT)	DRC[c] Ratio	B/C[d] Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
18,500.00	(1,028.70)[e]	1.12	0.96	(12,233.70)	(9.12)	0.60
20,000.00	471.30	0.95	1.02	(10,733.70)	37.80	0.65
21,500.00	1,971.30	0.83	1.08	(9,233.70)	6.15	0.70
23,000.00	3,471.30	0.74	1.14	(7,733.70)	3.35	0.75
24,500.00	4,971.30	0.66	1.20	(6,233.70)	2.30	0.80
26,000.00	6,471.30	0.60	1.26	(4,733.70)	1.75	0.85
27,297.00	**7,768.30**	**0.55**	**1.31**	**(3,436.70)**	**1.45**	**0.89**
28,500.00	8,971.30	0.52	1.36	(2,233.70)	1.25	0.93
30,000.00	10,471.30	0.48	1.42	(733.70)	1.07	0.98
31,500.00	11,971.30	0.45	1.48	766.30	0.94	1.02
33,000.00	13,471.30	0.42	1.54	2,266.30	0.83	1.07
34,500.00	14,971.30	0.39	1.60	3,766.30	0.75	1.12
36,000.00	16,471.30	0.37	1.66	5,266.30	0.68	1.17

Source: Authors' calculation from Table 4.2

Notes: [a]DSM = Dar-es-Salaam
[b]NEP = Net economic profitability
[c]DRC = Domestic resource cost
[d]B/C= Benefit/cost
[e]( ) denotes negative value
Base results indicated in bold type

Coastal market (basis Dar-es-Salaam). Shifting the focus to the coastal market has an adverse impact on all results in the economic analysis. For small-holder production, NEP turns negative when the landed price of wheat falls below approximately 24,000 shillings per tonne (Cdn$320 at official exchange rates). This does indicate that the world price could fall 11 percent from its present level and small-holder production just would remain economically profitable in serving the coastal market. Large-scale mechanised production by contrast does not become economically profitable until the landed price of wheat rises somewhat above 30,000 shillings per tonne (Cdn$400 at official exchange rates).

The B/C ratio for small-holder production exceeds unity at all price levels above approximately 24,000 shillings per tonne while the same ratio for large-scale mechanised production does not do so until the landed price exceeds 30,000 shillings per tonne.

The DRC ratios follow a similar pattern to those observed in the inland market except the ratios do not become favourable until somewhat higher price levels. Results continue to indicate that small-holder production makes more effective use of domestic resources in the saving of foreign exchange than does large-scale mechanised production at all price levels and more effective use of domestic resources than direct importation at price levels above 24,000 shillings per tonne.

Shadow Exchange Rate

The FXP used in the economic analysis was estimated (not derived) by the World Bank and as such requires sensitivity testing to determine if the results of the analysis are sensitive to changes in the FXP. Tables 4.7 and 4.8 present the results of changes to the FXP for small-holder and large-scale mechanised production respectively.

Table 4.7

SENSITIVITY OF RESULTS TO CHANGES IN FOREIGN EXCHANGE PREMIUM--SMALL-HOLDER PRODUCTION

	-------Basis Arusha-------			---Basis Dar-es-Salaam---		
FXP[a]	NEP[b] (Tsh/MT)	DRC[c] Ratio	B/C[d] Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio
1.00	9,132.60	0.49	1.54	(2,072.40)[e]	1.26	0.91
1.10	10,668.40	0.45	1.61	(536.60)	1.06	0.98
1.20	12,204.10	0.42	1.68	999.10	0.91	1.04
1.30	13,739.90	0.39	1.75	2,534.90	0.80	1.11
1.35	**14,507.80**	**0.38**	**1.79**	**3,302.80**	**0.75**	**1.14**
1.40	15,275.60	0.36	1.82	4,070.60	0.71	1.17
1.50	16,811.40	0.34	1.89	5,606.40	0.64	1.23
1.60	18,347.10	0.32	1.95	7,142.10	0.59	1.29
1.70	19,882.90	0.31	2.01	8,677.90	0.54	1.34

Source: Authors' calculation from Table 4.2

Notes: [a]FXP = Foreign exchange premium
[b]NEP = Net economic profitability
[c]DRC = Domestic resource cost
[d]B/C= Benefit/cost
[e]( ) denotes negative value
Base results indicated in bold type

Table 4.8

SENSITIVITY OF RESULTS TO CHANGES IN FOREIGN EXCHANGE PREMIUM--LARGE-SCALE PRODUCTION

	-------Basis Arusha-------			---Basis Dar-es-Salaam---		
FXP[a]	NEP[b] (Tsh/MT)	DRC[c] Ratio	B/C[d] Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio
1.00	3,898.80	0.71	1.17	(7,306.20)[e]	2.96	0.74
1.10	5,004.50	0.66	1.22	(6,200.50)	2.29	0.78
1.20	6,110.20	0.61	1.26	(5,094.80)	1.86	0.83
1.30	7,215.80	0.57	1.29	(3,989.20)	1.57	0.87
1.35	**7,768.70**	**0.55**	**1.31**	**(3,436.30)**	**1.45**	**0.89**
1.40	8,321.50	0.54	1.33	(2,833.50)	1.35	0.91
1.50	9,427.20	0.51	1.36	(1,777.80)	1.19	0.94
1.60	10,532.90	0.48	1.39	(672.10)	1.06	0.98
1.70	11,638.60	0.45	1.42	433.60	0.96	1.01

Source: Authors' calculation from Table 4.2

Notes: [a]FXP = Foreign exchange premium
[b]NEP = Net economic profitability
[c]DRC = Domestic resource cost
[d]B/C= Benefit/cost
[e]( ) denotes negative value
Base results indicated in bold type

Inland market (basis Arusha). In all cases, increases in the FXP have a favourable impact on the results in the economic analysis. NEP's and B/C ratios increase and DRC ratios decrease, indicating that as the SER increases it becomes more economically profitable to produce wheat in Tanzania. None of the SER's tested caused a change in the ordering of the results; small-holder production remains more economically profitable and more effective in saving foreign exchange than large-scale mechanised production.
None of the SER's tested caused a change to unfavourable results for any of the evaluation criteria.

Coastal market (basis Dar-es-Salaam). The direction of changes in the economic results in response to changes in the FXP is the same for the coastal market as for the inland market. For small-holder production a FXP between 1.1 and 1.2 causes the results to turn unfavourable. This occurs because there is a large foreign exchange component in imported wheat while economic foreign exchange costs of domestic production are relatively small (both components appearing in the denominator of the formula for the DRC ratio). A decrease in the FXP thus tends to reduce the net foreign exchange savings of small-holder production. Large-scale mechanised production remains economically unprofitable until the FXP increases to above 1.6, a very high level. This is because the high foreign exchange component of large-scale mechanised wheat production reduces the per tonne foreign exchange saving compared to direct importation.

Real Interest Rate

The real interest rate was used to calculate the opportunity cost of capital used in wheat production. The interest rate chosen must be estimated as an interest rate

reflecting the true opportunity cost of capital can never be known with absolute certainty. Sensitivity tests determine the effect of changes in the real interest rate on results of both the financial and economic analyses. Table 4.9 presents the results of changes in the real rate of interest for both scales of technology.

Financial analysis. Reductions in the real rate of interest cause minor improvements in the results of the financial analysis. The same reductions applied to large-scale production yield greater improvements in results compared to small-holder production because of the more capital intensive nature of the former. A reduction in the real interest rate from 12 percent to 8 percent is enough to turn the results favourable for large-scale production.

Economic analysis. Changes in the real interest rate have little impact on results of the economic analysis. Although a reduction in the real interest rate to 8 percent was enough to turn the financial results for large-scale production favourable, this was not the case in the economic analysis for either the inland or coastal market.

Shadow Price of Family Labour

Ideally, the opportunity cost of family labour would be accounted for in the economic analysis when the potential net income foregone (because the next best alternative crop was not produced) was deducted from the income earned as a result of wheat production. As noted in Section 3, however, this approach was not feasible because of time, financial and data constraints. As an alternative, family labour used in small-holder wheat production was shadow priced at the same rate as skilled labour used in large-scale wheat production as explained in Section 3. This is believed to be a high rate for the opportunity cost of family labour but is useful for testing the stability of the results.

Table 4.9

SENSITIVITY OF RESULTS TO CHANGES IN REAL INTEREST RATES

Interest Rate (%)	Financial Analysis NFP[a] (Tsh/MT)	B/C[b] Ratio	Economic Analysis ------Basis Arusha------ NEP[c] (Tsh/MT)	DRC[d] Ratio	B/C Ratio	-Basis Dar-es-Salaam- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
			-----LARGE-SCALE PRODUCTION-----					
3.00	1,990.50	1.14	9,098.80	0.48	1.38	(2,114.20)[e]	1.28	0.93
8.00	301.00	1.02	8,356.30	0.52	1.34	(2,848.70)	1.38	0.91
12.00	**(1,050.60)**	**0.94**	**7,768.70**	**0.55**	**1.31**	**(3,436.30)**	**1.45**	**0.89**
			-----SMALL-HOLDER PRODUCTION-----					
3.00	7,158.60	1.79	16,088.00	0.31	1.96	4,883.00	0.64	1.22
8.00	6,300.90	1.64	15,291.30	0.34	1.87	4,086.30	0.69	1.18
12.00	**5,614.80**	**1.53**	**14,507.80**	**0.38**	**1.79**	**3,302.80**	**0.75**	**1.14**

Source: Authors' calculation from Tables 4.1 and 4.2

Notes:
[a]NFP = Net financial profitability
[b]B/C = Benefit/cost
[c]NEP = Net economic profitability
[d]DRC = Domestic resource cost
[e]( ) denotes negative value
Base results indicated in bold type

Setting the shadow price of family labour used in small-holder wheat production at the same rate as for skilled labour used in large-scale mechanised wheat production has the expected impact on the results of the economic analysis. Table 4.10 presents the results of this change. NEP is reduced by approximately 3,000 shillings per tonne in both markets, although it remains positive in both markets. The B/C ratios are likewise reduced from 1.79 to 1.56 in the inland market and from 1.14 to 1.02 in the coastal market. The DRC ratios are increased from 0.38 to 0.48 in the inland market and from 0.75 to 0.95 in the coastal market.

The major impact of changing the shadow price of family labour is thus to reduce economic profitability and the efficiency of domestic resource use in the saving of foreign exchange to marginally favourable levels if small-holder wheat production is used to serve the coastal market in Tanzania.

SUMMARY AND CONCLUSIONS FROM THE ANALYSIS

Financial Profitability

The analysis presented in this section shows that small-holder wheat production is financially profitable while large-scale mechanised wheat production is marginally financially unprofitable under current conditions in Tanzania. This difference is due mainly to the lower foreign exchange costs of small-holder wheat production; these reduced costs being more than enough to offset the lower yields under this scale of technology.

Economic Profitability

The economic analysis indicates that small-holder wheat production is more economically profitable than large-scale mechanised wheat production for the same reason

Table 4.10

SENSITIVITY OF RESULTS TO CHANGES IN THE SHADOW PRICE OF FAMILY LABOUR--SMALL-HOLDER PRODUCTION

Shadow Rate	--------NEP[a]------- Basis Arusha	Basis DSM[d]	----B/C Ratio[b]----- Basis Arusha	Basis DSM	---DRC Ratio[c]--- Basis Arusha	Basis DSM
Base	14,507.8	3,302.8	1.79	1.14	0.38	0.75
Skilled Labour	11,843.2	638.2	1.56	1.02	0.48	0.95

Source: Base data compiled from Table 4.2. Skilled labour wage rates taken from Hanang farm data.

Notes: [a]NEP = Net economic profitability
[b]B/C = Benefit-cost
[c]DRC = Domestic resource cost
[d]DSM = Dar-es-Salaam

as in the financial analysis, namely the foreign exchange component in overall production costs is much lower under small-holder production.

Foreign Exchange

Small-holder production is also more effective in saving foreign exchange as shown by a lower DRC ratio compared to large-scale mechanised production. This is mainly because the difference between the cost of imported wheat and the foreign exchange component of production is greater under small-holder production than under large-scale mechanised production. This difference translates into a greater foreign exchange saving per tonne under small-holder production and a lower DRC ratio when measured against the domestic resources used up in saving that foreign exchange.

Inland Market

The economic analysis shows that large-scale mechanised wheat production can be used to serve the inland market for wheat in Tanzania because of the high cost of transporting imported wheat from the coast to those markets. It is, however, cheaper in terms of overall resource use efficiency for the country to import wheat to serve the coastal market rather than promote large-scale mechanised production. The reduced profit margin under this scale of technology causes it to be unable to bear the high cost of transporting wheat from the location of production to the coast.

Coastal Market

Small-holder wheat production can be used to serve either the inland or coastal market at less real resource cost compared to imported wheat. This comes about because of the lower cost of production (especially foreign exchange cost of production) under this scale of technology. These lower costs result in a substantial profit margin on wheat

production used to serve the inland market and even allow this scale of technology to bear the high cost of transporting wheat all the way from Arusha to the coast.

Sensitivity Tests

Sensitivity tests indicate that small-holder production is better able to sustain financial and economic profitability in the face of adverse environmental or economic conditions compared to large-scale mechanised production. In none of the tests did large-scale mechanised production outperform small-holder production. Large-scale mechanised production was also more sensitive to changes in any of the parameters compared to small-holder production. Results of small-holder production are most sensitive to changes in yield (alters the relative profitability but does not cause financial or economic losses, except in extreme cases) and world wheat prices (for production used to serve the coastal market). Results of large-scale mechanised production are sensitive to changes in yield, world wheat prices (for production used to serve the coastal market) and the real interest rate (financial analysis).

Sensitivity testing causes some variation in the results, however, the conclusions drawn from these results, especially those concerning small-holder production, are stable across a relatively wide range of parameter values. This stability increases confidence in (1) the representativeness of the data in terms of the physical and economic conditions in northern Tanzania and, (2) the applicability of these results to other time periods and, hence, their use as a base for future projections.

Wheat Pricing

As noted earlier, the current wheat producer price in Tanzania is significantly below the CIF value of wheat imports into the country (see Figure 4.1). The results of this price

discrepancy are a transfer of income from producers to consumers of wheat and a disincentive to local production compared that which would occur if prices were set on an economic basis. While increases in the world price of wheat in early 1988 were partly responsible for the the decline in the ratio of the domestic price to the world price, and as such may reflect a temporary phenomenon, the main reason for the decrease in this ratio has been the devaluations of the shilling in recent years. These devaluations are not temporary and failing to adjust domestic wheat prices to reflect this change in relative prices, at least insofar as devaluations impact on net returns to producers, will act as a deterrent to future domestic wheat production under any scale of technology. In order to prevent any benefits of currency devaluation from being lost through offsetting increases in domestic inflation, increases in wheat producer prices could be phased in over a period of several years. This is a question of timing however, and as such is a matter of policy formulation which must be dealt with by the Tanzanian government. The basic economic arguments in favour of setting prices in relation to real resource costs are not changed by any question of implementation.

The Tanzanian government also maintains a two-price policy for wheat deliveries into the official marketing channel with the result that small-holder wheat producers receive less for their production than do large-scale producers who can deliver directly to NMC. Cooperatives receive the difference between the producer price and the price paid by NMC as a marketing margin. There is no sound economic argument in favour of this policy and its cost in terms of a disincentive to small-holder production is clear.

V. FUTURE PRODUCTION, EMPLOYMENT AND INCOME EFFECTS AND INFRASTRUCTURE REQUIREMENTS

INTRODUCTION

Successful completion of this study required going beyond a financial and economic analysis of the two scales of wheat production technology in northern Tanzania. As outlined at the beginning of Section 3, analysis was required to determine (i) future production levels that can be expected in Tanzania, (ii) the relative employment and income effects of wheat production under the two scales of technology and (iii) the relative infrastructure requirements of the two scales of technology.

FUTURE PRODUCTION

Conservative estimates place the amount of land in Tanzania that is suitable for wheat production at 280,000 hectares while Marketing Development Bureau estimates place the annual disappearance of wheat (domestic production plus imports) at 100,000 to 125,000 metric tonnes. It is, therefore, entirely feasible for the country to produce enough wheat to satisfy present domestic demand using small-holder wheat production technology. Future growth in domestic demand for wheat can also be satisfied using small-holder production (assuming realistic growth rates in demand).

Whether or not domestic self-sufficiency is achieved in future is a more difficult question, the answer being dependent upon the availability of appropriate technologies, inputs, adequate price incentives, and the state of the domestic marketing and distribution systems. All of these factors are, directly or indirectly, influenced by Tanzanian government policy making them both subject to greater control and more difficult to predict.

Those small-holder wheat producers surveyed demonstrated the ability and desire to grow more wheat but were constrained to a greater or lesser degree by each of the factors noted above. As a result of these constraints it is felt that small-holder production will be unable to meet domestic demand in the short term. Comments of those involved in provision of support services to farmers and the observed resilience of small-holder production in the past few years, however, point to the ability of this group of producers to achieve significant increases in production over a relatively short period of time. Therefore, given the proper incentives it is felt that small-holder producers could easily satisfy domestic demand for wheat within the next decade.

EMPLOYMENT AND INCOME EFFECTS

Time, data and financial constraints prevented direct measurement of domestic employment and income effects of the two scales of technology in this study. A review of the development literature on technology, employment and income, however, clearly indicates that the adoption of a more capital intensive scale of technology generates less employment and income amongst the poorest sectors of the population relative to that generated by a more labour intensive technology. Promotion of small-holder wheat production with its more labour intensive approach generates more direct rural employment through a combination of increased owner-operator labour and hired labour.

Additionally, this scale of production technology has been proven to generate greater spin-off employment in small-scale local industry because the type of technology used lends itself to increased local production. It appears, therefore, difficult to justify large-scale mechanised agricultural development on equity grounds, an observation which supports the basic conclusion of this study, namely, that, on grounds of economic efficiency alone, the

Tanzanian government should promote small-holder wheat production if it wishes to achieve domestic self-sufficiency at the lowest possible cost. The fact that greater small-holder production also would increase rural employment in agriculture and small industry and raise the incomes of people in the countryside compared to large-scale mechanised agricultural production is one more reason to promote this scale of technology in Tanzania.

INFRASTRUCTURE REQUIREMENTS

The measurement of the relative infrastructure requirements of the two scales of technology proved to be one of the most difficult undertakings in the analysis. In spite of the problems involved, some general conclusions regarding storage and collection, transportation and production infrastructures are possible based on field observations and the comments of knowledgeable Tanzanians and expatriates.

Storage and Collection

The collection and distribution of any bulky commodity requires sufficient storage capacity at points of interface in the system, i.e., farmer delivery locations, processing centres, wholesale distribution centres, etc. Small-holder wheat production requires a greater number and wider dispersal of farmer delivery points compared to large-scale production because of the pattern of production and because the type of transportation used for farmer deliveries varies from animal power to custom hauling with trucks. The recent revival of the cooperative marketing system may provide a solution to this problem. Cooperative storage facilities are fairly widely spread in crop producing regions of the country and so are usually available within a short distance of the farm. These facilities can be used by the farmer if he chooses to market his grain through the official marketing channel.

A farmer who sells his wheat on the open market must generally store his grain on the farm until it is picked up by the purchaser or delivered by himself to the market. This does not present a significant storage problem in a country where there is a prolonged dry season after harvest as the grain is stored in bags either in the farmers house or in some other simple shelter. The collection of the crop is a more difficult problem under the open market system if farmers using this system are not able to store their produce at primary cooperatives as alternative arrangements must then be made between purchaser and seller. This problem could be overcome through some type of fee-for-storage arrangement between either the producer or purchaser and the primary cooperative allowing the storage of the grain at the primary cooperative until it is picked up by the purchaser. A variation of this type of system is currently in place in western Canada and operates with few difficulties.

Transportation

Regardless of the scale of technology practised, the road network beyond the point of first collection will be quite similar. Grain is hauled by truck directly from large farms and primary cooperatives to wholesale processing and distribution centres such as NMC. The main difference in the transportation requirements of the two scales of technology occurs on the farm and between the farm and the point of primary delivery.

Large-scale mechanised production requires a (relatively) well developed system of feeder roads in order to transport equipment, inputs and produce between the field and the market. In its present location (Hanang), the transportation requirements are one of the major constraints to economic feasibility in serving other than local markets. By contrast, small-holder production requires a less well developed (due to less use of mechanised equipment and purchased inputs) but perhaps slightly more dense road network because of

the size distribution of holdings. The potential for more economical production in the location context appears to favour small-holder production. The relative costs of the two systems act in offsetting directions and as a consequence it is believed they will not have a significant impact on the results of this analysis. Small-holder production will remain significantly more financially and economically profitable in all markets in Tanzania.

Production

The production of wheat in Tanzania under either scale of technology requires a particular production infrastructure in addition to the storage and transportation infrastructures discussed above. The particular production infrastructure applicable to each scale of technology is embedded in the financial and economic analyses and will not be reiterated here. There is, however, one particular component of small-holder production which deserves further clarification because of its importance to future increases in wheat production under this scale of technology. This component is the type of harvest technology currently available in Tanzania and the particular nature of the harvest system used.

It was noted earlier in this report that the only mechanised harvest technology available in Tanzania is that using large combine harvesters. A small-holder wheat producer has two options available in harvesting his crop. He can hire a combine from a large-scale farmer, cooperative or parastatal or he can harvest the crop manually. The first option is somewhat uncertain in most areas as neither the availability of the combine nor its hiring rate is known with any degree of certainty at planting. The second option requires substantial family and or hired labour at a time when such labour may be in short supply. Small-holder wheat producers in all parts of the country stated that a major

constraint to increased wheat production on their farms was the scarcity of harvesting equipment. In many areas combines were either unavailable or expensive. The hand harvesting of large areas of wheat was felt to be too labour intensive in a period of already high labour demand due to the maize harvest occurring at this time as well.

Harvesting of wheat on small-holder farms in northern Tanzania is currently accomplished using combine harvesters. Any significant increase in small-holder wheat production will in all likelihood require introduction of a more appropriate harvest technology as an expansion of small-holder relative to large-scale production will decrease the availability of combines to small-holders. Combines are not seen as a solution to the harvest problem in Tanzania because the physical and economic characteristics of the technology favour its use on large farms. The size of the investment involved means that effective control of the asset also tends to be more centralized and out of the hands of the small-holder producer.

There is a definite need for research to identify appropriate cereal harvesting technologies for Tanzania. Investigation of current practices in India, Pakistan, China and other regions in Africa may yield potential techniques and equipment that can be used in, or adapted to, Tanzanian conditions. It bears repeating that increased small-holder wheat production in Tanzania will require adoption of some form of harvesting technology and the design of appropriate harvest systems which are technically and economically suited to this scale of production. Removal of this constraint appears to be a necessary condition for further development of wheat production in Tanzania.

REORGANIZATION OF THE LARGE FARMS

One reviewer of this study suggested it might be useful to provide a benefit-cost measure of "converting large farms into small farms." Although this was not part of the scope of this study, it is a relevant question, particularly in light of at least two studies conducted on the appropriate organization of the Hanang Farms. We cannot provide a benefit-cost estimate but these results suggest economic benefits might be greater under smaller, less mechanized production. Reorganization into smaller units implies a number of other questions (labour supply, assembly of product, storage and security) but these results suggest reorganization payoff that would reduce the impact of these factors. The results also suggest, from an economic standpoint, the location is also an important component of the organization question. Obviously, there are many interesting questions yet to be pursued related to technology, scale and location of wheat production in northern Tanzania.

APPENDIX A

Table A1

MACHINERY INVESTMENT, DEPRECIATION AND OPPORTUNITY COST --LARGE-SCALE FARM (Tanzanian shillings)

Machinery	Financial Farmgate Cost	Useful Life (Yrs)	Annual Dep'n	Annual Interest (12%)	Farmgate Cost net of Duty, Tax	Annual Dep'n	Annual Interest (12%)
Tractors (4WD) (3)	24,615,000.0	10.0	1,969,200.0	1,772,280.0	24,615,000.0	1,969,200.0	1,772,280.0
Tractors (2WD)(6)	31,999,500.0	10.0	2,559,960.0	2,303,964.0	31,999,500.0	2,559,960.0	2,303,964.0
Press drills (3)	19,593,000.0	7.0	2,239,200.0	1,410,696.0	17,230,500.0	1,969,200.0	1,240,596.0
Duplex discs (3)	9,236,700.0	7.0	1,055,622.9	665,042.4	8,122,950.0	928,337.1	584,852.4
Sprayers (3)	4,923,000.0	7.0	562,628.6	354,456.0	4,923,000.0	562,628.6	354,456.0
Harrows (2)	5,598,000.0	7.0	639,771.4	403,056.0	4,923,000.0	562,628.6	354,456.0
Disc	3,172,200.0	7.0	362,537.1	228,398.4	2,789,700.0	318,822.9	200,858.4
Frontend loader	492,300.0	5.0	78,768.0	35,445.6	492,300.0	78,768.0	35,445.6
Grain cleaner	1,394,850.0	6.0	185,980.0	100,429.2	1,394,850.0	185,980.0	100,429.2
Cultivators (3)	7,837,200.0	6.0	1,044,960.0	564,278.4	6,892,200.0	918,960.0	496,238.4
Cultivators (6)	10,076,400.0	6.0	1,343,520.0	725,500.8	8,861,400.0	1,181,520.0	638,020.8
Combines (6)	39,186,000.0	6.0	5,224,800.0	2,821,392.0	34,461,000.0	4,594,800.0	2,481,192.0
P.T. swathers (5)	8,397,000.0	7.0	959,657.1	604,584.0	7,384,500.0	843,942.9	531,684.0
S.P. swather	3,918,600.0	7.0	447,840.0	282,139.2	3,446,100.0	393,840.0	248,119.2
Grain wagons (3)	4,478,400.0	5.0	716,544.0	322,444.8	3,938,400.0	630,144.0	283,564.8
Tractors (2WD) (4)	16,410,000.0	10.0	1,312,800.0	1,181,520.0	16,410,000.0	1,312,800.0	1,181,520.0
Lorries (2)	11,505,000.0	6.0	1,534,000.0	828,360.0	8,205,000.0	1,094,000.0	590,760.0
Pickup	2,301,000.0	7.0	262,971.4	165,672.0	1,641,000.0	187,542.9	118,152.0
Landcruiser	3,451,500.0	5.0	552,240.0	248,508.0	2,461,500.0	393,840.0	177,228.0
Total	208,585,650.0		23,053,000.6	15,018,166.8	190,191,900.0	20,686,914.9	13,693,816.8

Sources: Selian Agricultural Research Institute
Malai Freight Forwarders Ltd.
Authors' calculation

Note: All figures in this table apply to a 10,000 acre farm.

Table A2

OXEN OWNERSHIP AND MAINTENANCE COSTS
(Ths/Acre/Year)

Purchase price (pair)		6,302.00
Depreciation		0.00
Interest (12%)		687.93
Maintenance		
Medical, refund of damages, etc.	403.30	
Deathloss (5%)	301.70	
Management (25 hrs @ 6/=)	150.00	
Sub-Total: Maintenance		855.00

Sources: Kilimo personnel
Marketing Development Bureau
Authors' estimate

Table A3

ESTIMATED CANADIAN AID TO WHEAT PROJECT, 1971-87
(Canadian $)

EXPENDITURE	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79
Administration								
Consultants				80,000	286,566	205,000	10,448	
RESEARCH								
Equip. Purchase								
Training and TA	35,988	78,572	76,071	103,578	114,647	315,754	403,679	336,959
Infrastructure								
FARMS								
Equip. Purchase							1,250,000	25,447
Training and TA					9,000	234,535	239,398	258,454
Dev. Costs								140,183
SUBTOTAL	35,988	78,572	76,071	103,578	203,647	836,855	2,098,077	771,491
CUM. TOTAL	35,988	114,560	190,631	294,209	497,856	1,334,711	3,432,788	4,204,279

Table A3 (concluded)

EXPENDITURE	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Administration	300,258	159,372	214,243	652,821	464,461	400,000	400,000	468,500
Consultants	20,000	55,000	607,742	602,068	485,819	100,000	100,000	
RESEARCH								
Equip. Purchase	634,294	246,013	278,299	246,013	252,241	300,000	200,000	170,800
Training and TA	102,084	678,372	820,778	1,127,614	1,113,103	1,250,000	1,100,000	910,500
Infrastructure		1,026,406	1,141,862	592,516	250,599	500,000	500,000	913,200
FARMS								
Equip. Purchase	476,056	3,762,620	2,615,706	1,660,090	1,009,252	1,000,000	800,000	1,549,200
Training and TA	387,788	605,219	928,257	1,338,990	1,432,801	1,450,000	1,100,000	1,668,300
Dev. Costs	128,867	1,295,691	810,259	885,989	636,030	600,000	1,100,000	
SUBTOTAL	2,049,347	7,828,693	7,417,146	7,106,101	5,644,306	5,600,000	5,300,000	5,680,500
CUM. TOTAL	6,253,626	14,082,319	21,499,465	28,605,566	34,249,872	39,849,872	45,149,872	50,830,372

Sources: Canadian International Development Agency
Prairie Horizons

Table A4

PER TONNE COST OF WHEAT LANDED IN DAR-ES-SALAAM
(Tanzanian shillings)
(Vessel size =10,000 tonnes; Exchange rate = Tsh 75:$Cdn 1)

Item	Forex (%)	Total Cost	Domestic Cost	Forex Cost	Economic Forex Cost	Economic Forex Cost Plus Domestic Cost
Purchase price	100.00	15,675.00	0.00	15,675.00	21,161.25	21,161.25
Ocean freight/insurance	100.00	2,090.00	0.00	2,090.00	2,821.50	2,821.50
CIF: Dar-es-Salaam	100.00	17,765.00	0.00	17,765.00	23,982.75	23,982.75
Variable Port Costs						
Wharfage (1.5% CIF)	50.00	266.47	133.24	133.24	179.87	313.11
Stevedoring	10.00	418.00	376.20	41.80	56.43	432.63
Trimming hold	50.00	9.50	4.75	4.75	6.41	11.16
Port agency fee	50.00	71.30	35.65	35.65	48.13	83.78
Communication fee	50.00	57.00	28.50	28.50	38.48	66.97
Shore handling	10.00	210.90	189.81	21.09	28.47	218.28
Bagging costs						
Machine	90.00	807.50	80.75	726.75	981.11	1,061.86
Grainbags	50.00	371.85	185.92	185.92	251.00	436.92
Agency fee	50.00	285.00	142.50	142.50	192.38	334.88
Sub-Total		2,497.52	1,177.32	1,320.20	1,782.27	2,959.60
Interest on variable costs (30%)	0.00	187.31	187.31	0.00	0.00	187.31
Total Variable Port Costs		2,684.84	1,364.64	1,320.20	1,782.27	3,146.91
Fixed Port Costs						
Depreciation on fixed assets	90.00	116.90	11.69	105.21	142.03	153.72
Interest on fixed assets (12%)	0.00	14.03	14.03	0.00	0.00	14.03
Total Fixed Port Costs		130.93	25.72	105.21	142.03	167.75
Total Port Costs		2,815.77	1,390.35	1,425.41	1,924.31	3,314.66
Total Cost of Wheat Landed in Dar		20,580.77	1,390.35	19,190.41	25,907.06	27,297.41

Sources: Marketing Development Bureau
Panalpina Freight Forwarders Ltd.
Canadian Wheat Board
Authors' calculation

Table A5

RESULTS OF FINANCIAL ANALYSIS FOR 1987/88 CROP YEAR[a] (per acre)

Item	Large-Scale	Small-Holder
Yield (Kg/Acre)	688.00	526.00
Producer price (Tsh/Kg)[b]	16.30	16.20
Revenue	11,214.40	8,521.20
Capital Investment	33,016.14	9,308.00
Variable Costs	6,153.13	3,334.54
Fixed Costs	5,215.64	1,968.13
Total Production Costs	11,937.21	5,567.80
Profit (NFP)	(722.81)[c]	2,953.40
Benefit-Cost Ratio	0.94	1.53

Source: Authors' calculation from Tables 3.1 and 3.2.

Notes: [a]All figures in shillings unless otherwise stated.
[b]Small-holder producer price is .10 shillings per kilogram less than large-scale producer price because of direct payment of local tax by the latter.
[c]( ) denotes negative value.

Table A6

RESULTS OF ECONOMIC ANALYSIS FOR 1987/88 CROP YEAR[a]
(per acre)

Item	---------Basis Arusha-------- Large-Scale	Small-Holder	----Basis Dar-es-Salaam---- Large-Scale	Small-Holder
Yield (Kg/Acre)	688.00	526.00	688.00	526.00
Producer price (Tsh/kg)	32.90	32.90	27.30	27.30
Revenue	22,635.14	17,305.35	18,780.62	14,358.44
Capital investment	40,772.34	10,451.61	40,772.34	10,451.61
Variable costs	7,118.64	4,207.00	7,118.64	4,207.00
Fixed costs	5,578.07	2,086.42	5,578.07	2,086.42
Total production costs	13,233.62	6,572.81	13,233.62	6,572.81
Total costs (prod + dist)	17,290.29	9,674.28	21,144.81	12,621.19
Unsubsidised domestic costs	6,656.68	4,598.45	7,585.48	5,308.55
Economic forex costs	10,633.61	5,075.83	13,559.33	7,312.65
Profit (NEP)[b]	5,344.85	7,631.08	(2,364.19)[c]	1,737.25
B/C[d] ratio	1.31	1.79	0.89	1.14
DRC[e] ratio	0.55	0.38	1.45	0.75

Source: Authors' calculation from Tables 3.1 and 3.2

Notes: [a]All figures in shillings unless otherwise stated
[b]NEP = Net economic profitability
[c]( ) denotes negative value
[d]B/C= Benefit-cost ratio
[e]DRC = Domestic resource cost

Table A7

PROFIT AND LOSS PERFORMANCE OF WHEAT PROJECT FARMS, 1969-1988
(000 Tanzanian shillings)

Year	Basotu	Setchet	Mulbadaw	Murjanda	Gawal	Gidagamowd	Waret
1969/70	(750)[a,b]						
1970/71	(780)						
1971/72	(418)						
1972/73	(1,853)						
1973/74	(1,415)						
1974/75	(1,129)						
1975/76	1,566	(1,646)					
1976/77	4,667	(1,065)					
1977/78	(931)	(2,712)					
1978/79	709	807	2,510				
1979/80	3,689	3,020	1,924	(532)			
1980/81	5,972	1,363	2,100	(617)			
1981/82	1,051	(281)	4,295	839	2,670		
1982/83	9,052	(1,902)	(2,023)	4,173	542	(6,879)	
1983/84	12,363	7,534	13,045	20,674	8,614	1,197	(2,319)
1984/85	8,244	23,363	18,320	18,984	18,524	(453)	(2,349)
1985/86	15,059	14,684	876	3,583	1,807	(5,224)	(615)
1986/87	9,969	37,152	48,938	56,526	23,439	21,521	20,557
1987/88[c]	13,548	67,343	79,135	57,160	49,835	48,367	32,514

Source: Hanang Farm Accounts

Notes: [a]Denotes negative value.
[b]All figures are before tax.
[c]Figures for 1987/88 are projections by farm managers.

Table A8

HANANG FARMS FINANCIAL DATA
(All farms combined, in Tsh)

CATEGORY	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79
INFLOWS										
Wheat Sales	1,613,095	1,211,152	2,299,148	590,451	580,526	400,916	5,449,277	10,973,315	11,819,334	24,052,768
Other Produce Sales	3,100	483,692	425,774	197,574	855,025	316,458	500,477	1,342,111	114,441	216,652
Other Income	94,458	39,531	45,864	35,704	68,018	119,075	140,075	114,903	163,822	210,724
Rental/Eq. Sales	168,080	262,142	69,359	127,130	44,612	870,988	798,895	2,143,354	963,250	851,400
Grants	3,528,381	0	0	0	0	0	0	0	0	0
NMC Rebate	0	0	0	0	0	0	0	3,391,106	4,187,814	8,097,527
TOTAL INFLOW	5,407,114	1,996,517	2,840,145	950,859	1,548,181	1,707,437	6,888,724	17,964,789	17,248,661	33,429,071
OUTFLOWS										
Farm Development Costs	3,000,000	385,588	168,204	20,394	190,809	230	1,470,950	1,140,647	5,180,487	3,876,828
Training and T/A	0	0	0	0	0	0	0	0	0	0
Machinery, Eq. and Spares	3,318,225	450,831	887,451	348,076	364,491	934,550	9,698,083	3,568,003	9,849,050	7,161,792
Cash Operating Expenses	487,595	434,024	848,698	815,660	1,120,829	606,978	2,741,317	3,237,131	4,372,667	5,805,925
Transportation of grain	261,602	171,611	281,935	84,120	96,752	16,743	685,769	3,291,218	3,680,219	7,051,795
Purchase of Gunny Bags	104,885	76,053	201,480	96,019	59,187	33,200	291,135	485,272	684,837	1,126,257
Salaries,Wages & Ass'd Costs	372,584	491,953	557,622	624,292	684,163	413,651	726,679	1,132,506	1,306,283	2,154,152
Services	28,281	38,323	34,954	45,259	18,026	69,494	110,722	142,056	142,213	200,817
NAFCO Service Fee	0	0	0	0	0	0	304,882	693,986	609,985	906,028
Land Rent	0	0	0	0	918	0	0	0	0	17,000
Preliminary Expenses W/O	14,844	0	0	0	0	0	317,067	0	0	0
Inc. (Dec.) in Inventory	750,000	22,303	8,488	11,812	-492,977	416,872	1,201,625	917,660	1,712,468	3,665,664
TOTAL OUTFLOW	8,338,016	2,070,686	2,988,832	2,045,632	2,042,198	2,491,718	17,548,229	14,608,479	27,538,209	31,966,258
NET BENEFIT (Nom)	-2,930,902	-74,169	-148,687	-1,094,773	-494,017	-784,281	-10,659,505	3,356,310	-10,289,548	1,462,813
(Real)	-34,562,524	-839,966	-150,199	-10,416,489	-3,939,530	-4,951,269	-62,850,855	17,739,482	-48,788,753	6,102,683

Table A8 (concluded)

HANANG FARMS FINANCIAL DATA
(All farms combined, in Tsh)

CATEGORY	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88
INFLOWS									
Wheat Sales	27,346,452	40,600,441	60,950,614	71,470,877	148,025,717	208,334,000	211,144,000	512,299,000	652,000,000
Other Produce Sales	1,264,992	1,708,194	2,321,343	19,740	54,860	0	0	0	0
Other Income	723,295	2,590,249	2,162,131	4,037,799	5,921,320	2,459,916	1,926,000	3,175,000	3,256,000
Rental/Eq. Sales	1,212,294	1,493,502	724,764	688,184	10,390,034	2,278,000	860,000	424,000	1,227,000
Grants	0	8,568,537	147,879	24,637,150	0	0	0	0	0
NMC Rebate	9,576,185	13,077,459	20,847,252	24,317,320	49,129,799	68,559,590	105,990,000	120,623,860	188,000,000
TOTAL INFLOW	40,123,218	68,038,382	87,153,983	125,171,070	213,521,730	281,631,506	319,920,000	636,521,860	844,483,000
OUTFLOWS									
Farm Development Costs	4,894,600	12,797,735	10,306,025	13,471,166	18,562,749	16,910,000	583,000	0	4,543,000
Training and T/A	0	0	0	0	0	0	545,000	808,000	3,308,000
Machinery, Eq. and Spares	4,702,759	31,641,111	14,411,449	35,225,712	24,393,164	28,283,190	30,345,000	48,475,000	73,048,000
Cash Operating Expenses	8,790,109	12,315,307	19,697,377	28,827,994	41,453,097	59,927,144	73,381,000	107,534,000	217,828,000
Transportation of Grain	8,586,042	11,406,224	18,941,014	21,243,400	44,158,968	60,375,737	95,337,310	115,598,000	155,000,000
Purchase of Gunny Bags	1,635,048	2,037,892	2,946,861	2,916,936	5,921,802	8,754,060	13,960,690	5,853,960	34,192,000
Salaries,Wages & Ass'd Costs	2,162,737	3,795,833	5,860,319	7,316,432	10,019,788	14,398,011	14,125,000	16,207,000	25,159,400
Services	368,514	488,996	895,798	672,136	1,207,211	2,517,306	15,844,000	27,738,000	31,227,000
NAFCO Service Fee	977,519	2,139,211	2,400,771	3,387,501	9,677,689	11,683,978	12,830,000	40,983,000	52,160,000
Land Rent	204,104	108,768	61,774	249,558	84,903	89,549	118,000	1,090,000	181,000
Preliminary Expenses W/O	0	0	0	0	2,436,728	0	0	0	0
Inc.(Dec.) in Inventory	5,972,226	10,281,419	4,520,247	4,714,270	14,560,138	12,901,719	43,538,974	53,581,127	65,000,000
TOTAL OUTFLOW	38,293,658	87,012,496	80,041,635	118,025,105	172,476,237	215,840,694	300,607,974	417,868,087	661,646,400
NET BENEFIT (Nom)	1,829,560	-18,974,114	7,112,348	7,145,965	41,045,493	65,790,812	19,312,026	218,653,773	182,836,600
(Real)	5,880,939	-48,514,738	14,095,022	11,156,854	55,257,799	76,332,303	43,538,974	72,334,521	118,300,000

Sources: Years 1969/70 to 1984/85 estimated by Prairie Horizons Ltd. from primary data.
Years 1985/86 to 1987/88 estimated by authors from primary data.