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

by

N. DEAN FRANK

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ABSTRACT

This study has examined small-holder and large-scale mechanised wheat production in northern Tanzania using cost-benefit analysis. Small-holder production data were collected through a primary survey done 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. 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.

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. 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 for serving this market.

Small-holder wheat production is a more efficient generator of foreign exchange savings than large-scale mechanised production, as measured by a lower domestic resource cost 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 parameter values. This stability allows increased confidence in both the representativeness of the data and its use as a base for future analyses.

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Chapter I

INTRODUCTION

1.1 OVERVIEW

Tanzania, like most developing countries, has an economy dominated by agriculture with 57 percent of gross domestic product (GDP) and 86 percent of the labour force[1] being accounted for by this sector. The country has a long established policy of food self-sufficiency but has failed to eliminate the ongoing need for food imports and food aid (see Table 2.2). In seeking to increase the pace of economic development the emphasis of the Tanzanian government has fluctuated from single-minded support for industrial development to a policy of rapid development of the agricultural sector,[2] the logic of this latter approach being that in an economy dominated by the agricultural sector real and sustainable economic growth must begin with that sector.

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

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[1]The labour force comprises economically active persons aged 10 years and over, including the armed forces and the unemployed, but excluding housewives, students and other economically inactive persons.

[2]World Bank, Tanzania Country Economic Memorandum, (Washington, D.C.: Report no. 5019-TA, 1984), pp. 17 and 72.

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.[3] 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 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 10 and 5 percent were cultivated by animal traction

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[3]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.

and tractors respectively.[4] The total number of trained oxen in use in Tanzania is estimated to be only 300,000 head compared to approximately 5,000 tractors.[5]

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 utilised. Large-scale[6] 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.

Wheat has been an area of emphasis for Tanzanian agricultural policy for a number of years. 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

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[4]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.

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

[6]The term scale as used in this thesis 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.

technical assistance of the Canadian government.

As Table 2.2 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.

This thesis looks at wheat in the agricultural sector in Tanzania and examines the relative financial and economic profitability and contribution to foreign exchange savings of two different scales of wheat production technology in the country.

1.2 PROBLEM STATEMENT

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.[7] This scarcity of a resource so necessary for economic development indicates the need for well-focussed planning on the part of the

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

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.[8] This lack of a singular and cohesive government policy, and gap between 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.[9] 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.

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[8]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.

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

Recent theories of agricultural development, most notably the high-payoff input model,[10] maintain that production techniques developed in and for the industrialised economies are not necessarily transferrable 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 industrialised agricultural technology in contrast to contemporary development theory.[11] A more recent study of the Hanang farms, however, contradicts these results by concluding that the farms, while financially profitable, are uneconomic in their use of domestic and foreign resources for large-scale mechanised wheat production.[12] These studies have been conducted on a specific aid project and leave unanswered the broader question of the appropriate scale of technology for

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

[11]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.

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

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.[13] 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. Therefore, the problem addressed by this study is to determine the relative economic costs and foreign exchange saving capacity of small-holder and large-scale mechanised wheat production in Tanzania.

1.3 OBJECTIVES OF THE STUDY

Development economists would argue that the first question that should be addressed in a study of the type proposed here is whether or not a country such as Tanzania should even include wheat in its nutritional plans. However, if one accepts that a demand for wheat does exist in Tanzania, the question then becomes one of how best to satisfy that demand; domestic production or imports. In comparing these two options the different possible scales of domestic production should be assessed as well.

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[13]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.

The general objectives of this study are, therefore, to compare the efficiency (in economic terms) of wheat production in Tanzania on small-holder and large-scale mechanised farms and to compare these two scales of production with direct importation of wheat for both the inland and coastal markets in the country. Specific objectives include:

i) determination of the financial and economic viability of small-scale wheat production in Tanzania using ox-drawn technology;

ii) determination of the financial and economic viability of large-scale mechanised wheat production in Tanzania as represented by the Hanang farms operated by the National Agricultural Food Corporation (NAFCO).

iii) comparison of the economic costs of small-holder and large-scale wheat mechanised production with each other and with direct importation of wheat to satisfy (a) the inland market as represented by the Arusha region and (b) the coastal market in Dar-es-Salaam.

iv) comparison of the domestic resource costs of any foreign exchange savings as a result of producing wheat locally (versus direct importation) for both scales of technology and for both markets.

The following hypotheses are stated to provide the basis for evaluation of these objectives:

i) both scales of technology are hypothesized to be financially profitable given current physical and

economic conditions in Tanzania;

ii) small-holder wheat production (as represented by those farmers growing wheat using ox-drawn technology) is hypothesized to be economically viable if used to satisfy the inland market for wheat in the country but not economically viable if used to satisfy the coastal market;

iii) large-scale mechanised production (as represented by the Hanang farms) is hypothesized to be not economically viable in satisfying either the inland or coastal domestic market;

iv) small-holder wheat production is hypothesized to be more efficient in saving foreign exchange (as measured by domestic resource cost ratio) compared to large-scale mechanised production.

1.4 SCOPE AND ORGANIZATION OF THE STUDY

As noted earlier, wheat production in Tanzania occurs on a variety of scales using a wide range of technology. At one end of the spectrum small-holders in some districts grow wheat for home consumption using hand-hoe technology on small plots while on the other end wheat is grown as a monoculture crop on highly mechanised farms of several thousand acres. This study focusses on a comparison of wheat production using ox-drawn technology on the one hand and mechanised tractor cultivation on the other because these technologies appear to be the most

realistic options for satisfying the domestic demand for wheat and wheat products.

The financial analysis of the chosen scales of technology 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, 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..."[14]. The results of an 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 techniques relative to direct importation of the commodity. The difference between the financial and economic analyses also gives an indication of the subsidies (positive or negative)

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

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.

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 will be 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.

The approach of this thesis is to use traditional cost-benefit analysis adapted to cross-sectional data for the 1987/88 crop year. Cross-sectional data were used because the 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.

The study is divided into six chapters. Chapter 2 outlines the Tanzanian physical and economic setting especially as it relates to wheat production. Chapter 3 provides a literature review and theoretical considerations of cost-benefit analysis as it applies to cross-sectional studies. Chapter 4 presents

the information on the chosen small-holder and large-scale wheat production categories in Tanzania. Chapter 5 contains an analysis and sensitivity tests of the results based on the information in the previous chapter. The final chapter contains a summary, conclusions and implications both for government policy and for further research.

Chapter II

BACKGROUND: THE PHYSICAL AND ECONOMIC SETTING

This chapter presents a background to the analysis which follows in subsequent chapters. The first section of the chapter presents the physical environment of Tanzania as it relates to wheat production. The second section details the economic setting within which wheat production occurs in Tanzania.

2.1 THE PHYSICAL SETTING

Tanzania is a tropical country located on the east coast of Africa between 2 degrees and 11 degrees south of the equator. The country has a total land area of 945,087 square kilometres, 45 percent of which is suitable for agriculture. At present only 13.5 percent of arable land is under cultivation. With a population of 24 million and a population density of 25.4 persons per square kilometre there is less population pressure on the land than in most developing countries. A nominal population growth rate of 3.3 percent, however, necessitates a more rapid economic development to sustain or improve living conditions in the country.

The country is dominated by a hot, arid central plateau,the Nyika. This plateau is bordered to the east by the coastal plains, to the west by the lake region and to the north and

south by temperate highlands. 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 production requires at least 500 millimetres of precipitation.[15] These constraints of altitude and precipitation, in combination with suitable soils are the main determinants of feasible areas for rainfed wheat production in Tanzania.

Conservative estimates indicate that there are approximately 180,000 hectares of land suitable for wheat production in northern Tanzania. This includes 100,000 hectares in the Hanang area, 30,000 hectares in the Arusha-Monduli-Makuyuni area and 20,000 hectares in the West Kilimanjaro area. Similar estimates for the southern highlands place the suitable area at approximately 100,000 hectares. With this amount of land area suitable for wheat production it is clear that Tanzania could potentially eliminate wheat imports and achieve self-sufficiency. The constraints to self-sufficiency are not environmental but rather economic, technical and political.

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

The main focus of this thesis is on the economic environment in Tanzania and its impact on the appropriate scale of technology for wheat production (or the appropriateness of wheat production) in the country.

2.2 THE ECONOMIC SETTING

Tanzania is a country that has developed a prominent political profile regionally and internationally over the past two decades. The country has enjoyed almost complete political stability since independence. Economically, however, the performance has been less favourable.

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.[16] The country was a net exporter of food and animal feed.[17] 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

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

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

increased oil prices, droughts, decreased terms of trade and a costly war with Uganda.[18] These shocks resulted in an increasing dependence on external sources of finance (aid and loans) in order to maintain development efforts. As Table 2.1 indicates, real per capita GDP showed years of impressive growth and substantial decline during the decade. 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. 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.[19]

Economic growth and development generally lead to a reduction in the share of GDP accounted for by agriculture as growth occurs in other sectors and resources are shifted out of the agricultural sector. This trend (Table 2.1) is seen in Tanzania in the first half of the 1970's but had begun a

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

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

reversal by 1975. Agriculture's share of GDP has shown a substantial increase over the period covered by Table 2.1. This trend does not indicate growth in the agricultural sector, but, rather, drastic declines in other sectors of the economy as stagnation and recession set in. This is evidenced in poor rates of real GDP growth and overall decline in per capita real GDP as shown in Table 2.1.

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 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.

Beginning in 1967 with the Arusha Declaration Tanzania sought to achieve a more equitable distribution of the benefits of development. One of the operational mechanisms used to achieve this goal was an increase in government involvement in the economy. A number of industries and some large private farms were nationalized after 1967. Cooperative unions were banned in 1976 and their output distribution functions taken over by parastatal marketing authorities. This increasing involvement of the government in the everyday managing of the

Table 2.1

TANZANIA ECONOMIC INDICATORS

Year	Real GDP (M.Tsh)	Real GDP/Cap (Tsh)	Percent Change in Real GDP/Cap	Agric. as % of Total GDP
1970	7680	577	N/A	37
1971	8001	582	0.9	36
1972	8539	600	3.1	36
1973	8800	598	-0.3	35
1974	9020	592	-1.0	34
1975	9553	607	2.5	37
1976	10,165	624	2.8	41
1977	10,828	642	2.9	46
1978	10,925	627	-2.3	48
1979	11,291	629	0.3	47
1980	11,561	624	-0.8	46
1981	11,149	583	-6.6	41
1982	11,293	571	-1.4	45
1983	11,244	551	-3.5	48
1984	11,522	547	-0.7	49
1985	11,496	529	-3.3	53
1986	11,944*	532*	0.6*	59
1987	12,410*	535*	0.6*	N/A

Source: International Financial Statistics, various issues.
Tanzanian Government Proposals, 1987/88.
* Author's estimate from Tanzanian government figures presented in 1988/89 Government Budget Proposals, Daily News, 24 June, 1988.
Note: N/A = Not Available

economy stretched the financial and managerial resources of the government beyond their effective capacity. It was one of the factors contributing to the economic deterioration of the economy in the 1970's and early 1980's.[20]

The desperate situation of the early 1980's demanded that significant steps be taken to reorient the Tanzanian economy in ways that were more compatible with national resources and capabilities. The response of the government was to develop a Structural Adjustment Program (SAP) in 1982. This program called for a freeing up and restructuring of the economy. The main objectives were:

> ...(i) crisis management: to get inflation under control and to achieve a quick restoration of productive activities...cutbacks to restore balance in the fiscal and external accounts and policies related to the budget, prices, credit, parastatal deficits, etc...(ii) structural adjustment: to restore economic activity through altering incentive systems and setting priorities in government spending;...to increase capacity utilization and labour productivity...to improve planning and control systems...[21]

The SAP of 1982 was never successfully implemented with the result that there was a continued economic decline in the years after 1982. This decline eventually led to the introduction of an Economic Recovery Program (ERP) in 1986. The ERP followed the general policies of the earlier SAP. The most important difference was that most of the policies were implemented by

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[20]FAO, Tanzanian Agricultural Review Mission, (Rome: FAO, Report no. 96/87 CP-URT 27, 1987), p. 8.

[21]World Bank, op.cit., p. 72.

the government. The result of the ERP has been a freeing of the economy, including a loosening of foreign exchange controls and a redirection of development efforts with greater emphasis on agriculturally led development. The amount of government resources devoted to the agricultural sector has been limited due to fiscal and monetary measures implemented to reduce inflation but the emphasis is now being placed on development of the country's agricultural potential both in food and export crop production.

The emphasis on agricultural development is appropriate given the structure of the Tanzanian economy. What is now required is a development of policies for the agricultural sector. These policies must address a number of key issues one of which is the appropriate scale of technology the country should adopt in its wheat production strategy.

2.3 WHEAT IN THE TANZANIAN ECONOMY

Tanzanian farmers have been involved in wheat production for nearly 100 years. As noted in Chapter 1, initial production was centred around small-holders in the southern highlands. Large-scale mechanised production began on private farms in the northern highlands between World War I and World War II. A substantial proportion of wheat production in northern Tanzania at this time was shipped across the border into Kenya.

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 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.[22] 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"[23] Despite this objective, in the early years of independence emphasis was placed on export crop production at the expense of food

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

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

crops.[24]

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.[25]

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, 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.[26]

Table 2.3 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

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

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

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

imports over the past 20 years (Table 2.2).

Table 2.2 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[27] 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. 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 an increase in the CIF value of wheat imports 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

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

Table 2.2

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

Year	Wheat Prod'n (000MT)	Pref'd Staples Prod'n (000MT)	Wheat Imports (000MT)	Pref'd Staples Imports (000MT)	Wheat Prod'n as % of Pref'd Staples	Wheat Imports as % of Pref'd Staples	CIF Value of Wheat Imports (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	N/A	N/A	N/A	N/A	N/A	17.8

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

Notes: Preferred staples include maize, rice and wheat.
N/A = Not available

6.3 to 9.0 shillings per kilogram (see Table 2.3). 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 1988/89.

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. 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.[28] The open market operates throughout the country but is particularly active in surplus areas that are adjacent to areas of deficit.[29]

Table 2.3 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

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

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

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.

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

Table 2.3

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

Year	Off. Wheat Price (Tsh/kg) Nominal	Real	Off. Maize Price (Tsh/kg) Nominal	Real	O/M Wheat Price (Tsh/kg) Nominal	Real
1969/70	.57	14.86	N/A	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

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

Notes: Tanzanian Consumer Price Index used as deflator.
Off. = Official
O/M = Open market
N/A = Not available

importance to the Tanzanian government, they are also of interest to bilateral aid donors such as Canada and multilateral institutions such as CIMMYT,[30] 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 aid recipients.

The next chapter deals with the theoretical issues involved in a financial and economic analysis of this problem within the cost-benefit framework.

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[30]International Centre for Maize and Wheat Research

Chapter III

LITERATURE REVIEW AND THEORETICAL CONSIDERATIONS

Traditional financial and economic analysis as applied in developing countries draws heavily on cost-benefit analysis. This chapter reviews the literature on cost-benefit analysis and discusses the theoretical issues relevant to such an analysis of wheat production in Tanzania. Cost-benefit analysis was chosen as the analytical technique for two reasons. First, the more rigid data requirements of other techniques, such as econometrics, prevented their use because of the limited data availability in Tanzania. Second, cost-benefit analysis is a common technique of economic analysis in studies in developing countries and is more generally understood by the users of such analyses than are the more elaborate analytical techniques.

Section 3.1 compares the concepts and theory of financial and economic analysis. Section 3.2 reviews the theory and literature of cost-benefit analysis, including the valuation of costs and benefits and evaluation criteria. Section 3.3 presents a brief summary of the chapter.

3.1 FINANCIAL AND ECONOMIC ANALYSIS: NECESSARY AND SUFFICIENT CONDITIONS

The basic cost-benefit analysis framework differs from

straightforward financial analysis in that the latter deals with costs and returns as faced by the individual while the former considers the economic costs and returns to society as a whole. In other words, what may be considered a gain or loss to one individual or sector in the economy may not be considered a gain or loss to the economy as a whole.[31] This difference in approach is reflected in the choice of the numeraire.[32] Financial analysis has private costs and returns as the numeraire while economic analysis typically uses national income.

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 project.[33]

Economic analysis, by contrast, indicates the profitability

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[31]E.J. Mishan, Cost-Benefit Analysis, 2nd ed. (London: George Allan and Unwin Ltd., 1975), p. x.

[32]Numeraire is defined by Gittinger (op.cit., p. 488) as "The common measurement used as a unit of account."

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

of the initiative from the point of view of society as a whole and as such is also a necessary condition for success (at least 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 project is uneconomic from society's point of view. Taken together the two conditions provide the sufficient condition.[34] 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.

Economic analysis is one decision-making tool available to the public sector. It does not indicate the path that will be chosen by the government as political or social considerations may be overriding. Even in such a situation, however, economic analysis is useful as an indicator of the costs of those policy alternatives. For example, economic analysis can indicate the costs of achieving national self-sufficiency in areas where comparative advantage would favour direct importation.

3.2 COST-BENEFIT ANALYSIS: THEORY AND CONCEPTS

Cost-benefit analysis is widely used in development economics particularly in the appraisal of existing or contemplated projects. Cost-benefit analysis is considered to be applied welfare economics in that it entails "the

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

application of the principles of welfare economics to specific and actual activities, programs, or projects".[35] Welfare economics seeks to achieve that allocation of resources that will maximize social welfare. Cost-benefit analysis is based on a criterion of welfare economics which holds that there is an increase in the general welfare level if those who are made better off by some change could compensate those made worse off and still achieve some improvement in their overall welfare.[36]

All countries must make choices in an environment where national wants (that is, demand) are greater than available resources. Decision-makers must choose those projects that contribute greatest to the national welfare. One of the techniques available for the making of these choices is cost-benefit analysis.

In determining the optimal allocation of resources, cost-benefit analysis compares the present value of all benefits less the present value of all costs. This rather straightforward objective presents some intriguing problems including the determination of benefits and costs, their valuation by some chosen numeraire, comparison of those costs and benefits in a manner meaningful to the decision-maker and the recognition that there are nonquantifiable costs and benefits in any project.

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[35]L.G. Anderson and R.F. Settle, Benefit-Cost Analysis: A Practical Guide, (Toronto: D.C. Heath and Co., 1977), p. 11.

[36]This is the well-known Hicks-Kaldor criterion or Potential Pareto Optimality.

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

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:[37]

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

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

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[37]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.

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 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.

3.2.1 IDENTIFICATION AND VALUATION OF COSTS AND BENEFITS

In conducting a cost-benefit analysis, two issues of immediate concern are the identification of actual or potential costs and benefits and their valuation.

The objectives of the project being analyzed are typically defined in monetary terms and provide a means of identifying costs and benefits. A cost is considered to be anything that reduces an objective and a benefit anything that increases an objective.[38] In financial analysis a benefit or cost is most

[38]J.P. Gittinger, op.cit., p. 43.

frequently described via a change in private profitability while in economic analysis the relevant criterion is usually a change in national income.

Following identification of costs and benefits against the objectives of the project these costs and benefits must be valued. This valuation follows directly from the process of identification. In financial analysis, costs and benefits are valued on the basis of their direct impact on the private individual (or firm) involved. Economic analysis values costs and benefits on the basis of their impact on national income. As noted earlier, these two measures, and consequently results, will not necessarily be the same.

The first step in developing the economic accounts is to remove transfer payments from the financial accounts. A transfer payment is "a payment made without receiving any good or service in return".[39] A transfer payment simply shifts the claim on the good or service from one sector of the economy to another with no change in national income. As economic analysis is concerned with changes in real resources only these transfers must be removed from the accounts in converting from financial to economic values. The most common transfers are taxes, subsidies and bank (not opportunity cost) interest.

Adjustments are also required for two other categories of goods normally found in any project, namely traded and nontraded goods. A good is considered to be traded if its

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[39]J.P. Gittinger, op.cit., p. 502.

production or consumption will affect imports or exports at the margin regardless of whether or not it is actually traded. Both traded and nontraded goods can be valued using either national income or foreign exchange as the numeraire. The use of national income is the approach chosen by UNIDO.[40] In contrast, Little and Mirrlees[41] and subsequently Squire and van der Tak[42] recommend the use of foreign exchange as the numeraire. These two approaches are essentially the same and given equivalent assumptions will yield equivalent results.[43]

Little and Mirrlees argue for the valuation of exports and imports at their unadjusted world market prices. Their consequent adjustment would be to reduce the value of nontraded goods and convert these into pure foreign exchange values. This approach has two justifications according to Layard.[44] The first is a matter of convenience in that because there are more traded than nontraded goods in most industrial projects, for which their manual is written, it is easier to use pure

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[40]United Nations Industrial Development Organization, Guidelines for Project Evaluation, (New York: United Nations, 1972)

[41]I.M.D. Little and J.A. Mirrlees, Project Appraisal and Planning for Developing Countries, (London: Heinemann Educational Books, 1974)

[42]L. Squire and H. van der Tak, Economic Analysis of Projects, (Baltimore: Johns Hopkins University Press, 1975)

[43]D. Lal, Methods of Project Analysis: A Review, World Bank Staff Occasional Papers no. 16, (Baltimore: Johns Hopkins University Press, 1974), p. 18.

[44]R. Layard, Cost-Benefit Analysis, (Markham, Ontario: Penguin Books, 1972), p. 21-22.

foreign exchange as the numeraire. Their second justification is more moralistic in that they maintain that all goods which would be tradeable under optimum conditions ought to be valued at world prices to encourage countries to adopt more liberal trading regimes.

The Little-Mirrlees approach does have the theoretical appeal of advocating use of multiple shadow exchange rates (SER's) discussed as conversion factors in their manual. The UNIDO approach on the other hand uses a single shadow exchange rate. To the extent that trade distortions vary across sectors or commodities the Little-Mirrlees approach will give more representative results. The problem lies in the computational difficulties involved in the estimation of a number of SER's. The result of this is a reliance on a single SER in most studies in developing countries. The approach is to use a SER (standard conversion factor) if national income (foreign exchange) is the chosen numeraire.

3.2.1.1 SHADOW PRICING GOODS AND FOREIGN EXCHANGE

Cost-benefit analysis usually begins with a financial analysis of the project from the perspective of the individual. These values must then be adjusted to reflect any market distortions that may exist. This forces 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.[45]

Squire and van der Tak go on 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.[46]

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".[47] If one assumes that an overvalued exchange rate is maintained through import duties, quotas and export subsidies and that existing tariff policies will continue, the SER can be determined numerically as:[48]

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[45]L. Squire and H. van der Tak, op.cit., p. 26.

[46]L. Squire and H. van der Tak, op.cit., p. 26.

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

[48]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.

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

where: 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:[49]

$$SER = OER \times FXP$$

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 FXP in Tanzania at 1.35 which results in a SER of 101.25 Tanzanian

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

shillings to the Canadian dollar (at an OER of 75:1).[50]

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 costs 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 chapter. 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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[50]Personal conversation with World Bank personnel, September, 1988.

3.2.2 COMPARING COSTS AND BENEFITS

Successful identification and valuation of a project's costs and benefits leads the analyst to the next stage of the evaluation, a comparison of those costs and benefits. The methods of comparison chosen must provide information that is readily comprehensible and facilitates the decision-making process. The method of comparison should also lead to the selection of those projects that make the most effective use of scarce resources.

One of the first measures of project worth to be widely used in developed countries was the benefit-cost ratio. In multi-period analyses 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:[51]

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

where: BCR = Benefit-cost ratio
B_t = Benefits in year t
C_t = Costs in year t

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

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

The benefit-cost ratio should not be used as the sole measure of project worth as it may give an incorrect ranking among projects. The project with the highest net economic profitability (NEP) may have a lower benefit-cost ratio even though it makes the largest contribution to national income. This characteristic of the benefit-cost ratio prevents its use as the sole indicator of project worth for mutually exclusive projects. Consider the case of two projects, A and B, with benefit cost ratios of 1.33 and 1.50 respectively. Project A involves benefits of 20 and costs of 15 while project B involves benefits of 9 and costs of 6. Use of the benefit-cost ratio alone would favour project B while project A has a (NEP) of 5 (20 minus 15) compared to a (NEP) of 3 (9 minus 6) for project B. Project A contributes the most to national income even though project B has a higher benefit-cost ratio.

Use of the benefit-cost ratio does provide a convenient indicator for the calculation of two switching values[52] 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

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[52]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".

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 to reduce the benefit-cost ratio to less than one.

The most useful and most commonly used measure of project worth in cost-benefit analysis is net present value (NPV). In multi-period analysis this measure takes the benefits and costs in all years and discounts each by an appropriate discount rate to arrive at a net value of the project at a given point in time. In single-period analysis, however, there is no need for discounting which simplifies the formula considerably. The net benefits of small-holder and large-scale mechanised wheat production have been defined in this study in a manner equivalent to NPV. Net benefits in the financial analysis were defined as net financial profitability (NFP) while net benefits in the economic analysis were defined as net economic profitability (NEP). These concepts were explained and shown mathematically in section 3.2 above.

This approach can be used in financial analysis to determine the net income value (as shown by NFP) to an individual of a given investment decision and in economic analysis to determine the incremental change in national income (as shown by NEP) as

a result of an investment.

A third criterion for project evaluation is the domestic resource cost (DRC). The DRC simply measures the cost in domestic resources required to produce a unit of foreign exchange.[53] 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 the unit of foreign exchange in terms of its domestic currency.

In comparing two export promotion projects, for example, the first may generate greater overall savings of foreign exchange. This would lead planners to favour the first project. A comparison of the DRC's of the two projects may reveal that the first generates savings of foreign exchange only at a very high domestic 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

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[53]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.

imported inputs, the domestic cost of local inputs and the opportunity cost of capital. Expressing this as a pure ratio leads to the formula:[54]

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

where: DRC = Domestic resource cost
N_j = Nontraded domestic inputs in domestic currency
E_i = Exported (or exportable) outputs in foreign currency
M_i = Imported inputs in foreign currency
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.

3.3 SUMMARY

This chapter has examined the literature and theory pertaining to financial and economic analysis within the cost-benefit framework. This framework will be applied to small-holder and large-scale wheat production technologies in northern Tanzania. A financial analysis will be done first.

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[54]Adapted from A. Ray, op.cit., pp. 68-69. For use of this formula in the case of import substitutes see footnote 34.

The results of this analysis will then be adjusted according to the theory presented in this chapter. The costs and benefits occurring under both financial and economic analysis will then be compared on the basis of net present value, benefit-cost ratio and domestic resource cost, where applicable. This will allow the evaluation of both scales of technology for wheat production in Tanzania in relation to the necessary and sufficient conditions discussed in this chapter.

Chapter IV

FINANCIAL AND ECONOMIC VALUES OF WHEAT PRODUCTION IN TANZANIA

The basic purpose of this thesis is to compare the economic and foreign exchange costs and benefits of small-holder and large-scale mechanised wheat production in Tanzania with each other and with direct importation of wheat. The previous chapter outlined the theory and usefulness of financial and economic analyses for this purpose and within the benefit-cost framework.

This chapter presents the financial and economic data for small-holder and large-scale wheat production in Tanzania. Section 4.1 describes the nature of the sample and the sampling and data collection procedures used. Section 4.2 presents the financial values for the two scales of technology including a description of each category of cost in the analysis. Section 4.3 follows a similar procedure for the economic values used in the analysis including the adjustments required in converting from financial to economic values.

4.1 SAMPLING FRAMEWORK AND DATA COLLECTION

All wheat production in Tanzania occurs under rainfed conditions. The two major producing areas are the northern and southern highlands. Production in the southern highlands is dominated by small-holders using either hand-hoe, tractor hire

or ox cultivation. In the northern highlands production is split between large-scale commercial farms, parastatal farms and small-holders. Most of the wheat production in northern Tanzania occurs in the Arusha region with small-holder production in a number of districts. Large-scale mechanised parastatal farms are found in the Hanang district of Arusha region.

Analysis of small-holder and large-scale mechanised wheat production on the basis of the framework and criteria outlined in the previous chapter 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.[55]

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 RRA consisted of interviews and discussions with agro-mechanisation officers, district agricultural development officers, bwana shambas,[56] mwenyekitis[57] 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, a parastatal operated by NAFCO with assistance from CIDA. The complex comprises seven farms, each operating as a semi-autonomous subsidiary of NAFCO, plus a central maintenance and service centre.

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[55]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.

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

[57]Village chairmen.

The technical coefficients are, as far as possible, representative of average practices under small-holder and large-scale mechanised wheat production in northern Tanzania. 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 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.

4.2 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. 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, for example, are 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.

4.2.1 VARIABLE COSTS

The variable costs of wheat production for small-holder and large-scale farms are shown in column III of Tables 4.1 and 4.2 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 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

Table 4.1

SMALL-HOLDER WHEAT PRODUCTION COSTS PER ACRE (Tsh)

I Capital Investment	II Forex (%)	III Total Cost/Acre	IV Unsubsidised Cost/Acre	V Unsubsidised Domestic Cost/Acre	VI Unsubsidised Forex Cost/Acre	VII Economic Forex Cost/Acre	VIII 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 of 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 (5%)	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: 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 4.2

LARGE-SCALE WHEAT PRODUCTION COSTS PER ACRE (Tsh)

I Capital Investment	II Forex (%)	III Total Cost/Acre	IV Unsubsidised Cost/Acre	V Unsubsidised Domestic Cost/Acre	VI Unsubsidised Forex Cost/Acre	VII Economic Forex Cost/Acre	VIII 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 (5%)	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: 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

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 practiced 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.

4.2.2 FIXED COSTS

Fixed costs for small and large-scale wheat production are shown in column III of Tables 4.1 and 4.2 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 farmers tillage practices.[58]

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[58]Acre-ploughings equals number of acres times number of ploughings. This was done 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.

The interest charged to fixed assets represents an opportunity cost of capital for those assets. It is the rate of return that could have been realized by the owner of the asset if he had chosen to invest that capital in its next best use. The interest rate chosen to discount the return to fixed assets is the real (pre-inflation) rate of interest.[59] This is different from revolving assets where the opportunity cost is calculated at the nominal rate of interest. The real rate of interest is used for fixed assets in order to remove pecuniary effects from the analysis. An analyst is interested only in real resource flows and must therefore subtract any purely monetary effects. A nominal rate of return is used for revolving assets because the return to these assets is assumed to be inflation compensated. To offset this inflationary component of revenues, a compensatory adjustment is required to costs, hence the use of nominal interest rates. 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 for large-scale mechanised wheat production are shown in Appendix Table A1.

There is no charge for land rent under fixed costs. This is based on Tanzanian government policy whereby land has no value

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[59]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.

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[60] 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.[61] 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.

4.3 ECONOMIC ANALYSIS

Economic analysis differs from financial analysis in that

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[60]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.

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

the latter uses the change in individual income as the numeraire while the former uses the change in national income. 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:[62]

(i) adjustment for direct transfer payment,

(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.

4.3.1 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 kilogramme. Large-scale farms tend to pay

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

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 by the amount of the levy.

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.[63] 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.

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

4.3.2 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.[64]

Wheat produced in Tanzania is an import substitute. The relevant price used in the analysis is the CIF price for imported wheat. 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 to the extent that the local manufacturer of plows 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.[65] The small-holder economic accounts for machinery depreciation, repairs

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

[65]Personal conversation with Ubangi Farm Implements personnel.

and maintenance and interest have been adjusted to reflect the true resource cost of this domestically produced equipment.

The unsubsidised values of tradeable goods 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 4.1 and 4.2) 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).

4.3.3 ADJUSTMENTS FOR PRICE DISTORTIONS IN NONTRADED GOODS

Nontraded goods are those for which the CIF price is greater than the domestic cost of production which is greater than the FOB price or which are not traded because of government policies.[66] 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

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

previously unutilized.[67] Tanzania is a country with abundant resources of unused land that is suitable for agricultural production (see Chapter II). 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 method adopted here is consistent with the Loyns study[68] 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 in section 4.3.2 above.

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[67]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.

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

Chapter V

ANALYSIS OF RESULTS AND SENSITIVITY TESTS

This chapter presents the results of the financial and economic analyses. Sensitivity tests are done 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.

Section 5.1 presents the criteria to be used in the analysis. Section 5.2 presents the results of the financial analysis and the calculation of two switching values for the two scales of technology. Section 5.3 contains the results of the economic analyses for the two scales of technology using the stated evaluation criteria. Section 5.4 presents the results of sensitivity tests conducted on the financial and economic analyses. The results were tested for changes in yield, world wheat prices, the shadow exchange rate, and the real rate of interest. Additionally, the opportunity cost of family labour used in small-holder wheat production was set at the same rate as skilled labour in large-scale mechanised production in one test to determine the effect of changes in this parameter assumption. Section 5.5 contains a brief

summary of the chapter.

5.1 EVALUATION CRITERIA

Chapter 3 outlined the general evaluation criteria to be used in this analysis: net financial profitability (NFP) and benefit-cost (B/C) ratio in the financial analysis; net economic profitability (NEP), B/C ratio and domestic resource cost (DRC) ratio in the economic analysis. NFP is the difference between annual undiscounted average costs and returns from the perspective of the individual farmer. All inputs and outputs are valued at current market prices and the result measures the profitability of the operation under the present economic conditions faced by the farmer. NEP measures the difference between annual undiscounted average costs and returns for the economy as a whole, on the basis of economic criteria. NEP is measured net of all transfer payments and with inputs and outputs shadow priced whenever market prices are not true indicators of the opportunity cost of real resource use. NEP prices wheat production on the basis of imported wheat costs which gives an indication of the economic profitability of domestic wheat production compared to imports.

The B/C ratio gives a measure of the relationship between benefits and costs. It provides a measure of the relative amount by which benefits exceed costs or vice versa. The B/C ratio can be used to calculate two switching values, the percentage by which costs must rise before they exceed benefits

and the percentage by which benefits must fall before costs exceed benefits.

The DRC ratio provides a measure of the effectiveness of the two scales of technology in saving foreign exchange. A DRC ratio of less than (greater than) one indicates that the production method makes effective (ineffective) use of domestic resources in saving foreign exchange compared to direct importation of wheat. The DRC ratios for the two scales of technology can also be compared to each other to determine which one is the most effective (as measured by a lower ratio) in saving foreign exchange.

Many studies in developing countries focus on the foreign exchange component of domestic production and compare this cost to direct importation of a given commodity. Such a comparison gives only a partial picture of the usage of a scarce resource (foreign exchange) as it ignores the efficiency of domestic resource use in the saving (or earning) of that foreign exchange. Domestic production may be shown to save foreign exchange compared to direct importation but without knowing the costs of that saving in terms of domestic resources (which have an opportunity cost in terms of their ability to generate savings of foreign exchange in other uses) it is impossible to know if domestic production makes economic sense. The domestic resource cost (DRC) ratio is one means of determining the relative effectiveness of using domestic resources in a given activity for the purpose of saving (or earning) foreign

exchange. The fact that the DRC ratio considers the effectiveness of domestic resources used for saving (or earning) foreign exchange makes it a more complete and, hence, preferable indicator than a simple comparison of the direct foreign exchange cost components of domestic production versus imports.

5.2 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 5.1 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.

5.2.1 COSTS OF PRODUCTION AND YIELDS

The results of the financial analysis indicate that capital investment and cost of production per acre are 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 the lower yields under small-holder production raise the cost per tonne by a greater percentage than occurs

Table 5.1

RESULTS OF FINANCIAL ANALYSIS FOR 1987/88 CROP YEAR
(per tonne)

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

Source: Authors calculation from Tables 4.1 and 4.2.

Notes: 1) All figures in shillings unless otherwise indicated
2) 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.
3) ( ) denotes negative value
4) To convert results to a per acre basis multiply the relevant value in the table by 1/(yield/1000).

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.

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.

5.2.2 NET FINANCIAL PROFITABILITIES

The NFP of small-holder wheat production is positive, generating profits of 2953.40 shillings per acre and 5614.82 shillings per tonne in the 1987/88 crop year. Large-scale mechanised wheat production has a negative NFP of -722.81 shillings per acre and -1050.60 shillings per tonne for the same crop year.[69] These results are due to the substantially

[69]These results appear to be in contrast to those obtained in the Loyns study with the discrepancy being partly due to the difference in the approach of the two studies. Loyns et al concluded that the Hanang farms were financially profitable for the period 1969-85 which seems to provide a contradictory conclusion, however, the Loyns 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

lower costs of production for small-holders, the lower costs being more than enough to offset the 24 percent lower yields realised under this scale of technology.

5.2.3 BENEFIT-COST (B/C) RATIOS

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[70] 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.

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includes such things as all equipment purchases and interest on revolving and fixed assets in the cost of production whereas the Loyns 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 study in light of these factors reveals the similarity of the results with those presented here.

[70]This switching value is calculated as follows: 1-(1/.94). For an explanation of switching values, see page 41.

5.3 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 5.2. Economic results on a per acre basis are shown in Appendix Table A6.

5.3.1 COSTS OF PRODUCTION

Eliminating transfer payments and shadow pricing inputs and outputs raises the costs 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.

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

Table 5.2

RESULTS OF ECONOMIC ANALYSIS FOR 1987/88 CROP YEAR (per tonne)

Item	-------Basis Arusha------		---Basis Dar-es-Salaam---	
	Large-scale	Small-holder	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	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 costs	10,346.85	7,998.10	10,346.85	7,998.10
Fixed 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)	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)	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: Author's calculation from Tables 4.1 and 4.2

Notes: 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.

( ) denotes negative value

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.

5.3.2 NET ECONOMIC PROFITABILITIES

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 5.2. 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.

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 Chapter 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 2.2). 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 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 5.3) and a per acre (Appendix Table 6) 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 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.

5.3.3 BENEFIT-COST (B/C) RATIOS

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, the latter still exceed the former and small-holder production makes effective use of resources in satisfying demand in the coastal market.

5.3.4 DOMESTIC RESOURCE COST (DRC) RATIOS

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 by the difference between revenues and economic foreign exchange costs, 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 5.2). This ratio indicates that both scales of technology are effective in saving foreign exchange. The lower DRC ratio for small-holder production indicated 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.

5.4 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.[71]

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 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

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[71]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.

analysis where time series data for small-holder wheat production were not available. 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.

5.4.1 YIELD

The sensitivity tests of the results to changes in yield for small-holders and large-scale mechanised production are presented in Tables 5.3 and 5.4 respectively. Staff at Selian Agricultural Research Institute felt that it was possible to achieve yields of wheat approaching 1,200 kilograms per acre under rainfed conditions in northern Tanzania.[72] Such a yield level would represent nearly a doubling of current yields at the Hanang complex. Sensitivity tests were done to determine the effects of varying yields from 350 to 1,200 kilograms per acre.

5.4.1.1 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

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[72]Personal conversation with Selian ARI staff.

Table 5.3

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

Yield (Kg/Acre)	Financial Analysis		Basis Arusha			Basis Dar-es-Salaam		
	NFP (Tsh/MT)	B/C Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio
350.00	292.00	1.02	8,224.20	0.60	1.33	(2,980.90)	1.28	0.90
400.00	2,280.50	1.16	10,571.60	0.51	1.47	(633.40)	1.05	0.98
450.00	3,827.10	1.31	12,397.30	0.45	1.60	1,192.30	0.90	1.05
500.00	5,064.40	1.45	13,858.00	0.40	1.73	2,653.00	0.80	1.11
526.00	**5,614.80**	**1.53**	**14,507.80**	**0.38**	**1.79**	**3,302.80**	**0.75**	**1.14**
550.00	6,076.70	1.60	15,053.00	0.36	1.84	3,848.00	0.72	1.16
600.00	6,920.30	1.75	16,048.90	0.33	1.95	4,843.90	0.65	1.22
650.00	7,634.20	1.89	16,891.60	0.30	2.06	5,686.60	0.60	1.26
700.00	8,246.00	2.04	17,613.90	0.28	2.15	6,408.90	0.56	1.31
750.00	8,776.30	2.18	18,239.80	0.26	2.24	7,034.80	0.53	1.35
800.00	9,240.20	2.33	18,787.60	0.25	2.33	7,582.60	0.50	1.38
850.00	9,649.60	2.47	19,270.90	0.24	2.41	8,065.90	0.48	1.42
900.00	10,013.60	2.62	19,700.50	0.22	2.49	8,495.50	0.45	1.45
950.00	10,339.20	2.76	20,084.80	0.21	2.57	8,879.80	0.43	1.48
1,000.00	10,632.20	2.91	20,430.80	0.21	2.64	9,225.80	0.42	1.51
1,100.00	11,138.40	3.20	21,028.30	0.19	2.77	9,823.30	0.39	1.56
1,200.00	11,560.20	3.49	21,526.30	0.18	2.89	10,321.30	0.37	1.61

Source: Author's calculation from Tables 5.1 and 5.2

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

Table 5.4

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

Yield (Kg/Acre)	Financial Analysis		Basis Arusha			Basis Dar-es-Salaam		
	NFP (Tsh/MT)	B/C Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio
350.00	(17,806.30)	0.48	(10,806.70)	2.58	0.75	(22,011.70)	(6.30)	0.55
400.00	(13,543.00)	0.55	(6,080.50)	1.64	0.84	(17,285.50)	(53.57)	0.61
450.00	(10,227.10)	0.61	(2,404.50)	1.21	0.93	(13,609.50)	8.64	0.67
500.00	(7,574.40)	0.68	536.40	0.96	1.02	(10,668.80)	4.08	0.72
550.00	(5,404.00)	0.75	2,942.50	0.80	1.10	(8,262.50)	2.71	0.77
600.00	(3,595.40)	0.82	4,947.60	0.69	1.18	(6,257.40)	2.05	0.81
650.00	(2,064.90)	0.89	6,644.20	0.60	1.25	(4,560.80)	1.66	0.86
688.00	**(1,050.60)**	**0.94**	**7,768.70**	**0.55**	**1.31**	**(3,436.30)**	**1.45**	**0.89**
700.00	(753.20)	0.96	8,098.40	0.54	1.33	(3,106.60)	1.40	0.90
750.00	383.70	1.02	9,358.80	0.49	1.40	(1,846.20)	1.22	0.94
800.00	1,378.50	1.09	10,461.60	0.45	1.47	(743.40)	1.08	0.97
850.00	2,256.20	1.16	11,434.60	0.41	1.53	229.60	0.98	1.01
900.00	3,036.40	1.23	12,299.60	0.39	1.60	1,094.60	0.89	1.04
950.00	3,734.50	1.30	13,073.50	0.36	1.66	1,868.50	0.82	1.07
1,000.00	4,362.80	1.37	13,770.00	0.34	1.72	2,565.00	0.77	1.10
1,100.00	5,448.00	1.50	14,973.00	0.31	1.84	3,768.00	0.68	1.16
1,200.00	6,352.30	1.64	15,975.60	0.28	1.94	4,770.60	0.61	1.21

Source: Author's calculation From Tables 5.1 and 5.2

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

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 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.

5.4.1.2 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 8224.20 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 Table 5.2).

The B/C ratio for small-holder production remains positive 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 requires 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.

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.

5.4.2 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). 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 5.5 and 5.6 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

Table 5.5

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

CIF Price (DSM) (Tsh/Mt)	-------Basis Arusha------- NEP (Tsh/MT)	DRC Ratio	B/C 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)	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: Author's calculation from Table 5.3

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

Table 5.6

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

DSM Price (Tsh/MT)	-------Basis Arusha------- NEP (Tsh/MT)	DRC Ratio	B/C Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
18,500.00	(1,028.70)	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: Author's calculation from Table 5.3

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

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.

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 would just 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.

5.4.3 SHADOW EXCHANGE RATE

The shadow exchange rate (SER) was used in the economic analysis to account for any distortions impinging on foreign trade at the margin. The approach was to calculate a foreign exchange premium (FXP) and to multiply the foreign exchange component of production, measured in domestic currency, by the FXP. 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.

5.4.3.1 ECONOMIC ANALYSIS

Tables 5.7 and 5.8 present the results of changes to the FXP

for small-holder and large-scale mechanised production respectively.

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 caused 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 DRC). A decrease in the FXP thus tends to reduce the net foreign exchange savings of small-holder production.

Table 5.7

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

FXP	-------Basis Arusha------- NEP (Tsh/MT)	DRC Ratio	B/C Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
1.00	9,132.60	0.49	1.54	(2,072.40)	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: Author's calculation from Table 5.3

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

Table 5.8

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

FXP	-------Basis Arusha------- NEP (Tsh/MT)	DRC Ratio	B/C Ratio	---Basis Dar-es-Salaam--- NEP (Tsh/MT)	DRC Ratio	B/C Ratio
1.00	3,898.80	0.71	1.17	(7,306.20)	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: Author's calculation from Table 5.3

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

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.

5.4.4 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 will determine the effect of changes in the real interest rate on results of both the financial and economic analyses. Table 5.9 presents the results of changes in the real rate of interest for both scales of technology.

5.4.4.1 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. Large-scale mechanised production is more

Table 5.9

SENSITIVITY OF RESULTS TO CHANGES IN REAL INTEREST RATES

Interest Rate (%)	Financial Analysis		Economic Analysis					
			Basis Arusha			Basis Dar-es-Salaam		
	NFP (Tsh/MT)	B/C Ratio	NEP (Tsh/MT)	DRC Ratio	B/C Ratio	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)	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: Author's calculation from Tables 5.1 and 5.2

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

sensitive to changes in the real rate of interest because of the more capital intensive nature of this technology.

5.4.4.2 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.

5.4.5 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 Chapter 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 Chapter 4. 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.

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 5.10 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.

Table 5.10

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

Shadow	-------NEP------		--B/C Ratio--		---DRC Ratio---	
Rate	Basis Arusha	Basis DSM	Basis Arusha	Basis DSM	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 5.2. Skilled labour wage rates taken from Hanang farm data.
Notes: NEP = Net economic profitability
B/C = Benefit-cost
DRC = Domestic resource cost

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.

5.5 SUMMARY

This chapter has presented the results of the financial and economic analyses for small-holder and large-scale mechanised wheat production in northern Tanzania. The analyses show that small-holder production is both more financially and more economically profitable than large-scale mechanised wheat production. Small-holder production is also more effective in saving foreign exchange as shown by a lower DRC compared to large-scale production. Large-scale mechanised production can be used to serve the inland market for wheat in Tanzania but it is cheaper for the country to import wheat to serve the coastal market. Small-holder wheat production can be used to serve either the inland or coastal market at less resource cost compared to imported wheat under most of the scenarios examined. 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.

Sensitivity testing causes some variation in the results, however, the conclusions drawn from these results, especially those of small-holder production, are stable. This stability indicates (1) the representativeness of the data, and, (2) the

applicability of these results to other time periods and, hence, their use as a base for future projections.

Chapter VI

SUMMARY, CONCLUSIONS AND IMPLICATIONS

This thesis has examined small-holder and large-scale mechanised wheat production in Tanzania using the cost-benefit analysis format. Small-holder production data were based on those farmers growing wheat using ox-drawn technology drawn from a survey as part of this study in 1988. Data on large-scale mechanised production were taken from the Hanang farms, a large parastatal farm operating as a subsidiary of the National Agricultural Food Corporation (NAFCO). These two scales of technology were compared to each other in terms of net financial profitability (NFP); and benefit-cost (B/C) ratio and to each other and direct imports of wheat in terms of net economic profitability (NEP); benefit-cost (B/C) ratio; and efficiency of domestic resource use in the saving of foreign exchange as measured by the domestic resource cost (DRC) ratio.

The domestic market in Tanzania was divided into an inland market and a coastal market in the economic analysis in order to reflect high domestic transportation costs which effectively create a series of isolated geographical markets in the country. Finally, sensitivity tests were done to determine the effects on the results of changes in yield, the world wheat price, the shadow exchange rate, the real rate of interest and the shadow price of family labour used in small-holder wheat

production.

6.1 CONCLUSIONS

The conclusions of this thesis are presented in two sections. Those of the base results for the 1987/88 crop year are discussed in the next section with the conclusions of the sensitivity tests in the following section.

The base results for the 1987/88 crop year are discussed in two sub-sections. The results pertaining to small-holder production are presented first and are followed by those for large-scale mechanised production.

6.1.1 BASE RESULTS

Small-holder production. Small-holder wheat production in northern Tanzania is financially profitable under current market conditions as shown by a NFP of 5,614.82 shillings per tonne and a B/C ratio of 1.53.

Small-holder wheat production is economically profitable in serving the inland market for wheat as shown by a NEP of 14,507.75 shillings per tonne and a B/C ratio of 1.79. This scale of technology also makes efficient use of domestic resources in saving foreign exchange (DRC ratio of 0.38) compared to direct importation of wheat in serving this market.

Shifting the focus of the analysis to the coastal market makes all indicators of performance less favourable, although results remain positive. NEP decreases to 3,302.75 shillings

per tonne, the B/C ratio decreases to 1.14 and the DRC ratio increases to 0.75. This change in results occurs because the burden of Dar-es-Salaam to Arusha (or Arusha to Dar-es-Salaam) transportation charges shifts from imported wheat when the aim is to serve the inland market to domestic production when the aim is to serve the coastal market. Overall, small-holder production is proven to be profitable by each evaluation criteria and in both markets.

Large-scale mechanised production. A negative NFP (-1,050.6 shillings per tonne) and a B/C ratio of 0.94 indicate that large-scale mechanised wheat production in northern Tanzania is marginally financially unprofitable under 1987/88 price and cost conditions, although small a yield increase, a small reduction in costs or a small increase in the producer price would cause the results to turn positive.

In the economic analysis for the inland market the NEP of 7,768.68 shillings per tonne and B/C ratio of 1.31 show that from an economic perspective it is viable for Tanzania to use large-scale mechanised wheat production for serving this market for wheat in the country. The DRC ratio of 0.55 indicates that this scale of technology makes effective use of domestic resources in saving foreign exchange compared to the direct importation of wheat for serving the inland market. All indicators are, however, less favourable than those obtained under small-holder production.

These results are more favourable than those seen in the

financial analysis of large-scale production because of the substantial increase in the price of wheat in the economic analysis. This price increase occurs because the opportunity cost of imported wheat at Arusha must be used in the economic accounts. This causes not only the use of a higher world price for wheat than is currently seen in Tanzania but also the inclusion of transportation costs from Dar-es-Salaam to Arusha. In effect, high transportation costs provide a regional advantage in the north for locally produced wheat.

When the evaluation criteria are applied to the economic analysis of large-scale mechanised wheat production for the purpose of serving the coastal market the results become unfavourable because of the high cost of transportation to Dar-es-Salaam. NEP turns negative (-3,436.32 shillings per tonne), the B/C ratio declines to 0.89 and the DRC ratio increases to 1.45. The country can make better use of its resources by importing wheat directly for the coastal market (or, preferably, increasing small-holder production) rather than promoting large-scale mechanised wheat production.

The physical proximity of the location of production to the expected market is so important to these results because of the high cost of transportation in the country, a result partially anticipated in the Loyns study when they tested for the effect of shifting the location of wheat production from Hanang to Arusha. The conclusions of this thesis regarding large-scale mechanised wheat production in Tanzania are consistent with

those reported in the Loyns study in pointing to the poor economic performance of this scale of technology in serving other than local markets because of an inability to bear the high costs of transportation in the country.

6.1.2 SENSITIVITY TESTS

Sensitivity tests were conducted on yields, the world wheat price, the shadow exchange rate, the real rate of interest and the shadow price of family labour used in small-holder wheat production. Sensitivity tests can give an indication of the representativeness of the data used in a study. If, as is the case in this study, the results are relatively stable over a range of parameter values, the data can be assumed to be generally representative of actual conditions.

Yield. In the financial analyses, results for both scales of technology are sensitive to changes in yield. Small-holder wheat production is, however, able to remain financially profitable in the face of declining yields (at all levels tested) while large-scale mechanised production requires a 10 percent increase in yield to achieve financial profitability.

Yield sensitivity tests on the economic results for small-holder production indicate that this scale of technology can serve the inland market at all levels tested. If Tanzania wishes to serve the coastal market using small-holder production under 1987/88 cost-price relations, yields must be maintained above 400 kilograms per acre. The base results of

this analysis are favourable because average yields on small-holder farms in northern Tanzania are 126 kilograms per acre above that level.

Yield sensitivity tests on the economic results for large-scale mechanised production produce a less favourable outcome than for small-holder production. While yields can fall below 500 kilograms per acre (a decrease of 188 kilograms from present levels) before it becomes economically unprofitable to serve the inland market, they must rise to nearly 850 kilograms per acre (an increase of over 20 percent from present levels) before it is economically viable to serve the coastal market using this scale of technology.

World wheat prices. Sensitivity tests on the world price of wheat indicate that small-holder production remains economically profitable in serving the inland market over a wide range of wheat prices. On the other hand, if the world price of wheat landed in Dar-es-Salaam drops from the present level of 27,297 shillings per tonne (Cdn$364) to much below 24,000 shillings per tonne (Cdn$320) it becomes economically unprofitable to serve the coastal market using this scale of technology.

Large-scale mechanised wheat production requires higher world wheat prices to achieve the same level of economic profitability as small-holder production. Landed wheat prices must drop below 20,000 shillings per tonne (Cdn$267), however, before it becomes economically unprofitable to serve the inland

market using large-scale mechanised production. If the aim is to serve the coastal market, the world price of wheat must increase 3,000 shillings per tonne from the current level of 27,297 shillings per tonne (Cdn$364) before it becomes economically profitable to do so.

Shadow exchange rate. Changes in the shadow exchange rate, as reflected in the foreign exchange premium, have a significant impact on the results only when the rate tested diverges substantially from the base rate of 1.35. Since the import cost component in each scale of production technology is less than the import cost component of direct imports of wheat (in either market), increases in the FXP cause improvements in the results of both analyses and in both markets compared to the base.

Real interest rate. Changes in the real interest rate have only a minor impact on the results for small-holder production. A reduction in the real interest rate from the base level of 12 percent to 8 percent is enough to turn the financial results for large-scale mechanised production favourable, however.

Reductions in the real interest rate also have a favourable impact on all results in the economic analyses but the magnitude of the change is small and does not reverse any of the base results.

Shadow price of family labour. Shadow pricing the family labour used in small-holder wheat production at a rate equal to skilled labour employed on the Hanang farms lowers economic

profitability for this scale of technology by 2,664.6 shillings per tonne, reduces the benefit-cost ratio by approximately 12 percent and increases the domestic resource cost of saving foreign exchange by roughly 30 percent under this scale of technology. Results, however, continue to exceed large-scale mechanised production, and remain significantly favourable in the inland market and marginally favourable in the coastal market. This estimate is considered to be a high value of the opportunity cost of family labour used in small-holder wheat production. Consequently, valuing family labour does not alter the basic feasibility of small-holder wheat production in Tanzania.

6.2 IMPLICATIONS

The main implications of this study have relevance for a number of sectors in the Tanzanian economy as well as the aid community.

Domestic wheat production and foreign exchange. If the aims of the Tanzanian government are (1) to produce wheat domestically using the most efficient production technology and (2) to save the maximum amount of foreign exchange in the process then small-holder wheat production using ox-drawn technology should be encouraged ahead of either large-scale domestic production or imports.

Government attempts to satisfy demand for wheat in the coastal market using large-scale mechanised wheat production

technology are less efficient from an economic standpoint than is small-holder production. This study, as well as that of Loyns indicate that a policy built around large-scale mechanised wheat production results in substantial resource use inefficiency because of the combination of (1) high foreign exchange costs of production under this scale of technology and (2) high domestic transportation costs.

No matter which market is considered, both small-holder and large-scale mechanised wheat production require less pure foreign exchange than do direct imports of wheat. However, when one considers the amount of domestic resources used in saving this foreign exchange, it does not make economic sense to produce wheat on large-scale mechanised farms for the purpose of serving the coastal market. All other base results show domestic production, using either scale of technology, to be more effective in saving foreign exchange compared to imports.

Domestic self-sufficiency. 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 given current consumption levels. 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 will depend upon the availability of appropriate technologies, inputs, adequate price incentives, and the state of the domestic marketing and distribution systems. Small-holder wheat producers surveyed demonstrated the ability and desire to grow more wheat but were constrained by the factors noted above.

Research into small-holder wheat production. Any constraints to small-holder wheat production must be identified and alleviated in order to increase output under this scale of technology. For example, small-holders in surveyed areas of Tanzania stated that a lack of mechanised harvesting equipment was one of the main reasons they did not grow more wheat on their farms despite a desire to do so.

Research should be conducted to determine the reasons for reduced yields under small-holder production. Increases in small-holder yields through low-cost improvements such as more timely operations or better ox-drawn tillage equipment would improve the profitability of small-holder wheat production still further.

Technologies that are intermediate between the two analyzed here, i.e., small-tractor tillage, should also be investigated to determine their feasibility under Tanzanian conditions.

Government policy. The mix of current government policy in Tanzania includes both incentives and disincentives to domestic

wheat production. The world price of wheat, adjusted to reflect transportation costs to Arusha, for example, is over 50 percent higher than the current producer price, basis Arusha. The result is a significant transfer of income from wheat producers to consumers (or government) in the inland market if the alternative is to serve this market through imports. At the same time, the government provides wheat producers with indirect subsidies in the form of reduced taxes on diesel fuel, which encourages (inefficient) large-scale mechanised wheat production, and subsidised domestic production of small-scale machinery.

If the government removes any producer subsidies such as those on machinery and fuel and at the same allows the price of wheat to be determined by conditions in the domestic market, arbitrage will equilibrate prices and quantities across the different markets in the country and encourage greater resource use efficiency in wheat production. Wheat is a minor crop in Tanzania so a policy of freeing up wheat prices could be implemented with less disruption to the economy than for other crops, such as maize. This, in conjunction with the small-holder feasibility shown in this study, suggests that significant progress in expanding domestic wheat production can be achieved. Successful implementation of a more liberal pricing policy in the wheat market could be used as a springboard to similar changes in other agricultural markets in the country.

If the Tanzanian government intends to continue promoting large-scale mechanised wheat production, it should seek ways to reduce the import component of production in order to decrease the foreign exchange required to produce wheat using this scale of technology. Any serious attempt to reduce the foreign exchange component of production under this scale of technology must by definition address the question of the logic of this technology in a country with an economic structure such as Tanzania's.

6.3 LIMITATIONS OF THE STUDY

Tanzanian economic conditions, time and financial constraints prevented the use of a larger sample size which raises questions as to the representativeness of the data. These concerns were accommodated through the use of an information gathering technique known as rapid rural appraisal whereby data collected through farmer surveys was augmented by interviews with professionals in the government and agricultural service industry. The consistency of the results found here regarding large-scale mechanised wheat production with those of the Loyns study tends to support the representativeness of this data as well.

More elaborate modelling techniques, while theoretically appealing, were not used here because of the increased data requirements of these approaches. The data required for use of sophisticated econometric techniques, for example, are

generally not available in developing countries. Additionally, the approach taken in this study is one that is frequently used in studies in developing countries and is therefore more widely understood by those interested in the results of such studies.

In conjunction with other information on Tanzanian wheat production this study adds significant useful information. It is the first systematic comparison of two levels of technology and the results are reasonably conclusive. If further research were to be undertaken it likely should be in the area of constraints to small-holder production in Tanzania.

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Table A1

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

Machinery	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.
Author's 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
Author's 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
Development Costs								140,183
SUBTOTAL	35,988	78,572	76,071	103,578	203,647	836,855	2,098,077	771,491
CUMULATIVE TOTAL	35,988	114,560	190,631	294,209	497,856	1,334,711	3,432,788	4,204,279

Table A3 (concluded)

Estimated Canadian Aid to Wheat Project, 1971-87
(Canadian $)

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
Development 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
CUMULATIVE 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 (US#1, basis: Gulf)	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

Source: Marketing Development Bureau
Panalpina Freight Forwarders Ltd.
Canadian Wheat Board
Author's calculation

Table A5

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

ITEM	LARGE-SCALE	SMALL-HOLDER
Yield (Kg/Acre)	688.00	526.00
Producer price (Tsh/KG)	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)	2,953.40
Benefit-Cost Ratio	0.94	1.53

Source: Authors calculation from Tables 4.1 and 4.2.
Notes:
1. All figures (except Benefit/Cost Ratio) in Tanzanian shillings unless otherwise stated
2. 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.
3. ( ) denotes negative value

Table A6

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

Item	Basis Arusha		Basis Dar-es-Salaam	
	Large-Scale	Small-Holder	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	10,633.6	5,075.83	13,559.33	7,312.65
Profit (NEP)	5,344.85	7,631.08	(2,364.19)	1,737.25
Benefit/cost ratio	1.31	1.79	0.89	1.14
DRC ratio	0.55	0.38	1.45	0.75

Source: Author's calculation from Tables 4.1 and 4.2

Notes: 1. See notes 1 and 2 from Table 5.3
2. All figures (except Benefit/Cost and DRC Ratios) in Tanzanian shillings unless otherwise stated
3 ( ) denotes negative value