An Analysis of the Production of Cassava as a Food Security Option for Zimbabwe

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ABSTRACT

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Access to food is a basic human right and therefore the insurance of food security to its people is a fundamental objective of every Government. However, as we approach the next millennium the food security situation of most developing countries is projected to decline. This is mainly attributed to civil strife, disasters and a rapidly increasing population.

Over the past three seasons the production of the main staple, maize, in Zimbabwe has consistently been below normal. Zimbabwe which was once dubbed the "Bread Basket of SADC" is now struggling to produce adequate food for national consumption. Secondly, the price of maize (Zimbabwe's staple) has risen significantly over this period making it beyond the rich of most households. This has jeopardised food security. A concerted effort is required at the national level in order to avert the disastrous consequences associated with food insecurity which may arise from the recent

trends.

Several mitigation measures which include food aid, regional food security and national food security programmes have been put in place. In this vein and within the SADC Region, Zimbabwe has been tasked to spearhead the development of the agricultural and natural resources sector. In Zimbabwe, food security is such a serious issue that a Strategic Grain Reserve has been put in place specifically to address this problem. Furthermore the policy of agricultural diversification has been adopted, inter alia, as a food security strategy and in response to the trends of the past three seasons.

Zimbabwe is an agro-based economy with over 70 per cent of her population residing in rural areas and thriving on agriculture. In this context and within the purview of the diversification process, the production of cassava is viewed as a strategic option for achieving food security in terms of direct human consumption and as a cheap stockfeed. The production of cassava for these purposes is not new and peculiar to Zimbabwe. Cassava is widely produced worldwide for human and animal consumption.

This study attempts to analyse the feasibility of producing cassava in Zimbabwe for food security purposes. A two pronged approach is employed in pursuing this goal. The primary thrust is to produce cassava for human consumption. The secondary thrust involves the production of cassava for use in stockfeeds. This assumes that this will result in the provision of cheaper stockfeeds hence cheaper meat. The project will initially be confined to Mashonaland Central and West Provinces. It is planned along the logical framework approach. The purpose of this project is to increase cassava

production in Zimbabwe so as to meet the overall goal of food security. The total cost of the project is US$499 200 (Z$19,24 million).

The feasibility analysis of the project looks at issues such as social aspects, technical aspects, economic and financial aspects. The cost-benefit analysis was used to assess economic and financial viability. The project passed all these tests and in addition has a host of other social and economic benefits to justify its implementation.

The main conclusions arising from this study are that it is feasible to produce cassava in Zimbabwe. Secondly, owing to its multiplicity of uses cassava offers great potential as a food and industrial crop. However, cassava should produced as a side crop in order to be fully compatible with the current socio-economic aspects related to smallholder farming in Zimbabwe.

CHAPTER ONE.

INTRODUCTION

1.1 Background

Zimbabwe is a landlocked country with a total surface area of 39,09 million hectares of which a small proportion is covered by water bodies. Land use is divided into categories which comprise agricultural land, wildlife and strategic areas, urban, and mining areas. Agricultural land constitute the largest category and accounts for about 33 million hectares of which about 12 million hectares are in the large scale commercial sector and the remainder in the smallholder sector, resettlement sector and stateland.

For agricultural purposes the country is divided into five regions in accordance with the agricultural potential of the area. Region 1 has the highest potential in terms of agricultural diversity and ideal climate while Region 5 has the least potential. Consequently most of the agricultural activities in Region 1 are rainfed whilst the affinity for irrigated agriculture increases from Region 1 to 5.

Zimbabwe has an estimated population of 11.5 million of which more than half dwell in rural areas. The majority of the rural population depend on agriculture for their livelihood. Current estimates put the number of rural households to 800 000. It is further estimated that 75 per cent of this number live in Regions 4 and 5. In line with the thrust of promoting growth in the smallholder sector which was adopted by Government in 1980 it has been realised that irrigation development features prominently in

developing a sustainable agriculture in these areas. Government has therefore made a deliberate effort to construct dams and irrigation schemes in these areas.

Within the formal sector 350 000 people are employed in agriculture. The informal or smallholder sector provides a livelihood to well over 800 000 households. With increasing unemployment within the formal sector it is envisaged that the agricultural sector will continue to play a dominant role in providing food to both the rural and urban population, employment to the rural population and curbing rural-urban migration.

Within the macro context agriculture plays a central role by way of generating foreign currency, providing food to the urban sector, providing raw materials to the industrial sector, capital formation and creation of employment. The sector accounts for about 14 per cent of the GDP and over 40 per cent of foreign currency earnings. A wide range of crops which include maize, tobacco, wheat, soyabeans, horticulture, sugar cane, tea and coffee are grown under irrigation and/or dryland farming. Currently maize is the main staple.

1.2 The Concept of Food Security

Food security is generally taken to mean access by people at all times to a sufficient supply of quality food for a healthy and productive life (Centre for International Economics, 1996). The main elements of this definition include access, sufficient supply, quality, all times, and healthy and productive life. It follows therefore that in terms of access; supply, affordability and proximity are important parameters in the food security equation. Abundant supplies which are not available to households owing to a

weak demand or logistical problems do not enhance food security. Similarly the nutritional balance and adequate quantities are important facets of food security. In that respect a balanced diet should primarily comprise adequate quantities of minerals, vitamins, proteins, energy and other essential ingredients.

The European Union defines food security as " a combination of circumstances of supply and demand (involving both availability of food and ability to obtain access to it) which represents a threshold above which households can start to accumulate reserves (in the form of stocks, livestock or savings), develop more powerful means of production or ways of increasing income and organise their social relations to provide more reliable solidarity networks; all of these actions make them less vulnerable in the case of a food crisis." It will be realised that this definition highlights all the elements given in the first definition. However, it goes further to bring in other dimensions such as poverty, coping strategies in the event of a crisis and the hierarchy of needs. It considers food security as a threshold for breaking out of poverty and developing more powerful means of production or increasing income. In other words it is seen as a basis of moving from physiological needs to higher needs. Thus, above this threshold people are seen as part of the development process or as it were actively participate in the development process.

The Bundesministerium fur wirtschaftliche Zusammenarbeit und Entwicklung define food security as "All people have access at all times to sufficient food to enable them to lead an active and healthy life." From a glance one would realise that this definition is very much in line with the first definition. Furthermore, it also nicely fits into the second definition.

Following an overview of the definition of food security it is now pertinent to review the mechanics of achieving food security. At a regional or global level food security can be achieved through promoting trade (Centre for International Economics,1996). Through the theory of comparative advantage it is believed that promotion of trade results in welfare gains. In this context trade enables access to higher quality and cheaper food owing to competition and relative comparative advantages. Alternatively countries can pursue policies of food self-sufficiency through promoting national production.

At the household level food security can be achieved through own production, production of cash crops, wage employment and barter. Own production or subsistence production as it is popularly known involves production of various crops for household consumption. The extent to which this achieves food security depends on the quantities produced and the nutritional balance. Through the production of cash crops one is able to raise cash, part of which can be used for the procurement of food. In this way one can therefore achieve food security. Similarly through wage employment one is able to raise cash for food procurement. Barter trade involves trading certain goods and services for food. The most popular transactions involve the exchange of small livestock for cereals.

1.3 The Food Security Problem (Problem Statement)

In order to put Zimbabwe's food security problem into perspective it would be more ideal to give a global picture then proceed to present the national picture. About 840 million people suffer from malnutrition and poverty (FAO, 1996) worldwide. Furthermore, projections of food demand made by IFPRI (1992) show that

developing countries will experience an increasing production shortfall between 1992 and 2000. Detailed results of this projection are shown in the table below.

Table 1.1: Food Consumption/Demand Projections for 1992 - 2000

Region	Population %	Incomes %	Income Elasticity %	Food Demand %	Domestic Use %	Food Production %
Developing Countries	1.9	2.9	0.4	3.1	2.7	2.9
Sub-Saharan Africa	3.2	0.3	0.6	3.4	3.6	2.1
East Asia	1.5	5.7	0.2	2.6	-	-
South Asia	1.9	3.1	0.4	3.1	2.3	2.9
Latin America	1.8	2.2	0.3	2.5	-	-
MENA	2.0	1.6	0.3	2.5	3.2	3.0
High Income Countries	0.6	2.1	0.1	0.8	3.8	2.9

Source: IFPRI, 1992

Despite the decline in food production in LDCs the importance of livestock will be expected to increase over the next decade (Cees de Haan, *et al*, 1997). Demand for livestock products is expected to rise from the current level of 206 million metric tonnes to 275 - 310 million tons or more per year by 2020. Furthermore, current levels of meat and milk consumption are estimated to be one-fifth of consumption levels in developed countries (Cees de Haan, *et al*, 1997). Table 1.2 below shows the gap in consumption of livestock between developing and developed countries.

Table 1.2: Regional Consumption Levels of Meat and milk (kg capita/year, 1990)

REGION	PER CAPITA CONSUMPTION/YEAR (1990) KGS	
	MEAT	MILK
Global	30	70
Developed Countries	80	200
Developing Countries	12	30
Africa	10	25
Latin America	40	90
Middle East	20	68
Rest of Asia	10	23

Source: Haan, 1997 (adapted)

Future changes in food consumption within Developing Countries will greatly hinge on population growth, income growth, food prices and changes in preferences driven by changing lifestyles (IFPRI, 1992). Furthermore, demand for livestock products will accelerate in developing countries with high rates of per capita income. Population growth and urbanisation will be the major driving force in Africa. Table 1.3 below shows the relationship between income growth and growth in consumption of livestock products and feeds.

Table 1.3: The Relationship Between Income Growth and Consumption of Livestock Products and Feeds

GROWTH RATE OF PER CAPITA INCOME FOR THE 1961-80 PERIOD	GROWTH RATE (PER CAPITA)	
	Livestock Products	Feeds
Less than 1%	1.72	2.73
1.0 - 2.9%	3.02	4.02
3.0 - 4.9%	3.42	4.56
5.0% or more	4.91	6.02

Source: IFPRI (1992)

There are two global challenges arising from Table 1.3. The first challenge is to produce enough meat to meet the increasing consumption. The second challenge is to produce that meat in a cost effective fashion so as to address the food insecurity problem.

The food security situation in Zimbabwe is no better than the global perspective portrayed above. A greater proportion (70 per cent) of the Zimbabwean population live in rural areas and 31 per cent of the rural population is said to be in absolute poverty (FAO, 1997). Furthermore, the average daily energy consumption has declined from 2233kc per capita in 1980 to 2000kc per capita in 1993 and the situation is expected to deteriorate up to 2010 (FAO,1997).

On the same score the 1998 publication on "Poverty in Zimbabwe" by the Central Statistical Office (Government of Zimbabwe) estimates the percentage of population below the poverty line at 63,3 per

cent. In addition 76,2 per cent of the poor and 89,5 per cent of the very poor are in rural areas. It further highlights that the main determinants of poverty in Zimbabwe are residential status as it implies to urban or rural, access to land and its quality, and the level of rainfall received in a particular area. Within the study area or in Mashonaland Central and West respectively 80,4 and 66,7 per cent of the population is below the poverty line.

The general observation to be made is that FAO and Central Statistical Office data have several implications to food security. From the definitions given in section 1.3 it is apparent that food security and poverty are one in the same thing. Secondly, they are serious problems in Zimbabwe.

Similarly Web and Moyo (1992) report wide spread poverty and food insecurity in Zimbabwe especially in the rural areas. In their study the problem of malnutrition is underlined. Their average national figures for chronic and acute malnutrition, and low birth weights for 1988/89 and 1989/90 are summarised in the Table 1.4 below.

Table 1.4 Manifestations of chronic and acute malnutrition in Zimbabwe

Weight for Age (%)	Weight for Age (%)	Weight for Height (%)	Low Birth Weight (%)
1988/89	1989/90		
11.44	15.89	28.89	6.89

Source: Web and Moyo, 1992 (adapted)

The data in the Table 1.4 shows that the malnutrition problem is critical in Zimbabwe. The worst hit provinces are Matabeleland North, Matabeleland South and Manicaland.

The main factors which influence food security in Zimbabwe are income and droughts. The link between food security and income has been adequately covered above. It now suffices to analyse the influence of drought on food security. Maize is the main staple of Zimbabwe and the average maize consumption is estimated at 1,8 million metric tonnes per annum (Ministry of Lands and Agriculture, Zimbabwe). Since 1990 Zimbabwe has only, on 4 occasions produced maize in excess of 1,8 million metric tonnes. The domestic production and imports over the last 9 years is given in Table 1.5 below.

Table 1.5 Domestic production and imports of maize

Year	Total Domestic Production (mt)	Imports (mt)
1990/91	1,585,800	nil
1991/92	361,000	83,171
1992/93	2,011,850	1,845,000
1993/94	2,326,200	204,970
1994/95	839,600	nil
1995/96	2,609,000	133,000
1996/97	2,192,170	101,237
1997/98	1,418,030	390,719
1998/99	1,519,560	500,000

Source: Ministry of Lands and Agriculture (1999)

The country experienced food shortages in the 1991/92, 1994/95 and

1997/98 and 1998/99 seasons. The shortages of the first 3 seasons were drought related whilst that of 1998/99 was caused by excessive rains which depressed production. The situation was particularly bad in 1991/92 where the country only produced 360 000mt of maize, imported over 1,8 million mt of maize and enrolled 5,6 million or about half of the entire population on the food relief register (SADC, 1992). The problem was compounded by chronic and severe malnutrition, low food supplies, lack of purchasing power at the household level and, disease epidemics and pandemics (SADC ,1992).

Web and Moyo(1992) portray a similar picture in the eighties. Their data on food relief indicates that in 1988 more than 9 million people received food relief. The number declined to 1,8 million in 1990 only to rise again to 5,6 million in 1992. Their data highlights the degree of instability in the food security situation in Zimbabwe.

The food security problem as it is related to drought is also interlinked to low productivity, geographic location and access to means of production (Web and Moyo, 1992). Communities who live in high potential areas tend to have higher incomes and yields hence are relatively more food secure compared to those who live in marginal areas where incomes and yields are much lower. In marginal areas food shortages and malnutrition are rampant.

With regards to access to means of production it is reported that the success story of smallholder farmers in Zimbabwe is only attributed to 30 per cent of the farmers who account for 75 per cent of production in the smallholder farming sector (Web and Moyo, 1992). The other 75 per cent is languishing in poverty. Furthermore, the wide disparities in welfare are attributed to access to means of production.

The food security situation at the global and national level is not so bright. In Zimbabwe the situation is equally bad. The rural areas are particularly hard hit with more than three quarters of the population being below the poverty line. The correlation between poverty and food insecurity implies that the majority of the rural population is food insecure. This problem needs urgent attention. Furthermore, it is also apparent that agriculture plays a pivotal role in poverty eradication in Zimbabwe.

1.4 Overview of World Cassava Production

Cassava is popularly known as mandioca in Portuguese and manioc in French. Local production is still insignificant and estimated at 18,000 metric tonnes per annum. However, within the global context cassava is a very important crop as a staple food, in livestock production and industrial use.

World cassava production is in excess of 150 million tonnes wet mass. The major producers by continent are South America, Asia and Africa. In terms of area under production, Africa is in the lead with over 5,5 million hectares under cassava. However, it should be noted that yields for cassava in Africa are still very low hence production in Asia and America which have significantly lower hectarages are very high. It is also noteworthy that whilst cassava is of little commercial significance in Africa it is a major commercial crop in Asia and Brazil. The major producers include Thailand, Nigeria, Brazil, Indonesia, Malaysia, India, Central America, Democratic Republic of Congo, Angola, Malawi, Mozambique and Tanzania. Table 1.4 below gives a summary of the global production of cassava.

Table 1.6: The Global Production of Cassava

Region	Production (MT) x 1000	Area (Ha) x 1000	Yield in MT/Ha
World	164,400	10,532	9
Africa	85,000	5,567	7
South America	31,700	2,413	13
Asia	47,600	2,378	9
Other Countries	32,000	104	6
Brazil	23,900	2,004	14
Indonesia	15,100	1,466	7
D. Rep. of Congo	16,800	843	12
Nigeria	32,100	928	10
India	6,000	328	15
Thailand	18,100	206	15

Sources: FAO (1998) and Onwueme (1989)

As indicated in the table the largest producers of cassava are Brazil, Thailand, Indonesia, Nigeria and the Democratic Republic of Congo. Each of these countries produce in excess of 10 million tonnes per annum. Despite being still a minor crop in Zimbabwe cassava is undoubtably one of the major crops produced for human and animal consumption world wide.

1.5 The Current Food Security Options for Zimbabwe

Food security options are underpinned by three main pillars which include trade in food, promotion of production and promotion of consumption (Lipton, 1988). The strategy to enhance food security through the promotion of trade has been debated widely in the Southern Africa Development Community (SADC). Rukuni and Bernstern (1988) in their analysis of food security options underscore the

role of trade in food security. It has several weaknesses most of which relate to reliability of supply (Nziramasanga, *et al*, 1989). Its main weakness is that it does not guarantee effective demand or access at the household level. The general criticism levelled against it is that owing to the bulkiness of food and poor infrastructure which result in high transport costs imported food often ends up being unfordable (Lipton, 1988).

Production options seek to empower the household to produce enough food for own consumption or sale. This is very popular in Zimbabwe. The main strategies have been used include provision of research and extension services, development of production such as irrigation systems, development of marketing infrastructure, adoption of appropriate technologies, development of input supply systems and resettlement of farmers(Rukuni and Bernstern, 1988). The main problem associated with most of these strategies is high cost. These high costs are factored in food prices thereby making it unaffordable. Secondly, high production costs discourage technological adoption hence perpetuate poverty or food insecurity. In order to put the former into percepective the price of inputs (irrigation water, agro-chemicals, electricty, fertiliser, fuel, transport, etc) have risen by over 300 per cent over the past 3 years, roller meal (mealie meal) prices have risen by more than 250 per cent over the same period and minimum wages have risen by about 75 per cent (Commercial Farmers Union, 1999). Consequently the food security situation has deteriorated significantly. To add fuel to a burning fire, population pressures are pushing rural folk into marginal areas. The challenge on the production option on food security is therefore to identify cost effective production strategies and crop varieties that grow well in marginal areas. In the face of recurrent droughts irrigation development provides an ideal production strategy. However, the inhibitive costs of

developing such infrastructure renders it no longer attractive.

Consumption strategies involve putting in place programmes which enhance access to food at the household level. These include food relief, food aid, food subsidies, price controls, strategic grain reserves, food for work programmes and minimum wage policies. Provision of food relief has been a common practice in Zimbabwe and this is well documented in Section 1.3 above. The Food-for-Work programme was introduced in 1993 following the devastating drought of 1992. This strategy entails employing rural people to participate in community development programmes and paying them in cash or kind. Payment in cash enables the households to buy food and payment in kind (food) directly provides food to the household. This option is well documented by Web and Moyo(1992). The programme has since been abandoned mainly because the Government does not have adequate financial resources to sustain it.

Tagwireyi, *et al*,(1989) propose the provision of a descent minimum wage as a strategy for enhancing food security at the household level. Their argument is that the provision of a descent wage stimulates effective demand for food hence improve household food security. In the eighties Government was actively envolved in determining wages. However, this function was relegated to Labour Unions following the introduction of the Economic Structural Adjustment Programme. It was deemed that economic controls were not sustainable (Government of Zimbabwe,1991). This strategy and price controls compliment each other. Price controls on food have been in place since 1980. They were temporarily lifted in 1994 only to be imposed again in 1998. Price controls are under heavy criticism from Rukuni, *et al*, whose views are that they are a tax to production.

Zimbabwe's Strategic Grain Reserve was established in 1995. The Reserve is two faceted and comprises a financial and physical stocks component (Government of Zimbabwe, 1996). At its inception Z$842,4 million was set aside for the programme and this would convert to 936 000mt of maize at prices of that time. The producer price of maize at the inception of the programme was Z$900/mt and now has more than quadrupled to Z$4200/mt in 1999. Part of the fund has been used to subsidise maize meal. Consequently, the fund has dwindled. Thus, the main problem with this option is once again that of sustainability.

Strategies which promote production are very effective in improving food security at the national level although such improvements do not trickle down to the household owing to price related lack of effective demand. Similarly production strategies greatly enhance national food security and to a certain extent household food security. This notwithstading, the rapidly increasing cost of production is compromising potential gains to be made at the household level. Consumption strategies are very effective in improving access to food. However, they are not sustainable.

1.6 Rationale for the Production of Cassava in Zimbabwe

Cassava is of major economic importance. The main uses of cassava include human consumption, manufacturing of stockfeeds and flour for industrial use, beer brewing, fuel production (butanol) and forage for animals. In terms of its importance with regards to food security Onwueme(1989) makes this observation:

> "...Ease of production. A factor which has promoted the rapid spread of cassava to various parts of the world is the ease

with which it can be produced. Reasonably good yields can be obtained even if the crop suffers considerable neglect by the farmer. Even in modern cassava production, the crop requires very little care beyond the stage of canopy closure. Because of this ease of production, cassava is used in many traditional communities as a famine reserve. It is planted and left relatively untended, while most of the attention is devoted to the preferred crop such as yams, sweet potatoes, maize or guinea corn. If the main crop is good, the cassava may be left unharvested: but if the main crop should fail, the farmer is rest assured that he can supplement his diet from what the neglected cassava has produced."

Similarly the African Farming Magazine makes the following observations on the importance of cassava in food security:

"..Traditionally thought of as a food of the poor, cassava is an important staple for around 200 million African people"

"...It can grow in poor soil and survive erratic rains and drought conditions when other crops fail." and,

"..Cassava tubers can be stored in the ground as a food reserve for up to a year, hence the saying "where there is cassava, there is no hunger." "

Hahn(1989) and Jones(1991) also highlight the importance of cassava as a food crop and its role in food security.

From these observations it can be concluded that cassava plays a significant role in food security although downplayed. This role is dualistic in nature. It involves direct and indirect consumption.

In direct consumption it is a major source of energy. The chemical composition of its tuber as given below vouches for this observation.

Table 1.7: The chemical composition of cassava.

Nutrient	Content
Water	62%
Carbohydrate	35%
Protein	<2%
Fat	0.3%
Fibre	<2%
Minerals	1%

Source: Onwueme (1989)

It is rich in vitamin C, phosphorous and iron. Its main weakness in terms of food security is the low calcium and protein content. It therefore needs protein supplements. Table 1.6 below gives a comparison of various sources of energy under a subsistence production system. From the table it is very apparent that cassava supersedes most popular crops such as maize, rice, wheat, sorghum and Irish potato.

Table 1.8: The energy yield of various crops at a subsistence level of production.

Crop	Yield in MT/Ha	Million Calories/Ha
Cassava	9	12
Yam	8	7
Sweet Potato	7	7
Taro	6	6
Rice	2	5
Maize	2	8
Sorghum	1	3
Irish Potato	10	6
Wheat	1	4

Source: Onwueme(1989)

The main foods derived from cassava include fresh tubers which are normally eaten row, meal which is used for preparation of porridge and roasts, chips, cassava flakes, flour for blending with wheat, and noodles. In Brazil cassava is mainly produced for human consumption and fuel production. In Philippines its use is restricted to production of noodles and livestock feeds. In addition it is produced as a secondary crop. In Africa the production of meal for porridge is a common practice.

Secondly, it is a cheaper stockfeed ingredient. Fresh cassava tuber finds considerable use as a feed for livestock. Sheep, goats, cattle and particularly pigs are often fed on fresh cassava tubers which they find palatable (Onwueme,1989). In this regard cassava exports are estimated at 14,5 million tonnes of which Thailand accounts for over 13 million tonnes. The main export destination is the European Union which accounts for more than 12 million tonnes. Cassava exports are mainly used in livestock production. The implications to food security are that with increasing competition in meat production cassava offers cost cutting opportunities which

in turn provide scope for making the price of meat affordable. This in turn increases access to meat (protein) from the demand perspective.

It has been amply demonstrated in this section that cassava is of strategic importance. It is drought tolerant, easy to produce, it can adapt to wide range of environmental conditions, it can store easily for long periods and it has a multiplicity of uses. It therefore offers great scope for addressing the food security problem especially in the rural and marginal areas where the majority of the poor or the food insecure reside.

1.7 Objectives

In Zimbabwe the improvement of food security is given high priority. Traditionally research and extension has put more emphasis on food crops. Of late this emphasis has been extended by incorporating the crop diversification aspect. In this respect cassava has been identified as a promising crop.

The purpose of this study is to appraise the feasibility of producing cassava primarily for food security purposes. The specific objectives are to:

1. Assess the suitability of cassava as a strategic crop for the enhancement of food security;
2. Assess the compatibility of cassava production with sectoral and macro-policy;
3. Carry out a technical, social, financial and economic analysis of cassava production in Zimbabwe;
4. Identify appropriate strategies for cassava production in Zimbabwe; and,

5. Assess the suitability of the study area for cassava production.

This study therefore seeks to introduce the production of cassava in Zimbabwe as cheaper complement of maize for food and livestock feeds. Primarily it seeks to enhance food security through:

- directly providing a cheaper and drought tolerant food crop;

- indirectly through providing a cheaper stockfeed thereby reducing meat production costs and hence reduce meat prices; and,

- raising the incomes of communal farmers

1.8 Methodology

The viability of cassava production in Zimbabwe is underpinned by four hypotheses. The success of cassava production like the success of any other project greatly depends on the availability of a sound technical base, its financial and economic soundness, and comparative advantage over enterprises which compete for the same resources. In order to make the feasibility study more meaningful and practical a project proposal to pilot the production of cassava in two selected provinces is used as a case for technical, financial and economic analysis.

The main technical elements which come into the viability assessment of cassava production include agronomic and botanic aspects, human and physical resources, commercial aspects and

appropriate technology. The financial analysis determines the attractiveness of the production of cassava in terms of cost-benefit analysis. The economic analysis assesses the overall impact of the project to the nation. It determines whether it is worthwhile to commit the nations scarce resources to the project. The comparative advantage analysis evaluates the attractiveness of the proposed investment vis-a-vis other projects which could compete with this project for resources such as land and finance.

The main analytical tool to be used in the study to test the viability of cassava production in Zimbabwe is the cost-benefit analysis. The analysis also looks at technical and socio-economic aspects. The study is based on both primary and secondary data. However, it is heavily biased on secondary data which was collected through desk research. The data on the production and utilisation of cassava was collected from various texts, publications and workshop proceedings.

Primary data collection was based on purposive sampling techniques. Data was collected through interviews with key informants, stakeholder workshops and meetings. Cassava enthusiasts were identified within the Department of Research and Specialist Services; University of Zimbabwe; Agricultural and Rural Development Authority; Farming Community; and, the Agricultural,Technical and Extension Services Department. These were interviewed through open discussions. Such discussions were meant to probe into issues associated with cassava production, utilisation and processing. The workshops were used to identify and follow up on issues raised in key informant discussions.

Most of the information on production and utilisation of cassava in Africa was gathered through meetings of the Steering Committee on

Cassava Production in Zimbabwe and the Southern Africa Root Crops Research Network (SARRNET) organised workshop which was held in Harare in January 1999. A course on Trade Policy which was organised by the Centre for International Economics and held in Australia in February gave the author an opportunity to interview participants from Asia (Thailand, Indonesia, Sri Lanka and Philippines) where there is large scale commercial production of cassava. A trip to Uganda in mid February 1999, to a meeting on bio-fertilisers provided further insight into the production and utilisation of cassava. A few field trips to assess the situation on the ground capped up the information gathering process.

The mathematical analysis hinges on the financial and economic analysis of the viability of producing cassava in Zimbabwe. Through the "with and without" project scenario the issue of comparative advantage was naturally taken on board. The main appraisal parameters are return per dollar(Z$) variable cost, net present value (NPV), the internal rate of return(IRR) and economic rate of return(ERR). The return per dollar(Z$) variable cost is the ratio of the gross income to total variable costs. The internal rate of return is the discount rate which causes the present value of net future cash flows to equal the cost of the investment (Correia, 1993). Similarly the economic rate of return is the social discount rate which causes the present value of net future cashflows to equal the cost of investment. The net present value is the sum of the discounted net cashflow minus the initial capital outlay.

The decision criteria is based on a selected threshold of the return per dollar variable cost, the required rate of return and the selected threshold of the net present value. The threshold for return per dollar variable costs is 150 per cent. Any value equal to or above this level is accepted. With regards to the internal

rate of return the opportunity cost of capital which is based on lending rates is normally used as the selection criteria. This is commonly called the required rate of return or the investor's required return on investment. In this context 43 per cent is the minimum return for financial analysis and 8 per cent is the minimum return for economic analysis adopted in this study.

1.9 Outline

This report comprises 6 Chapters. The first Chapter presents the food security concept, problem, current options and methodology. The Second Chapter gives an overview of the macro and sectoral policies and evaluates the fit between policy and the project. The Third Chapter gives an overview of the study area. The Fourth Chapter describes the proposed project. The Fifth Chapter provides a descriptive and mathematical analysis of the feasibility of the project. Finally the Chapter Six draws conclusions on the analysis of the option to produce cassava in Zimbabwe for purposes of improving food security.

CHAPTER TWO

THE ECONOMIC AND AGRICULTURAL POLICY ENVIRONMENT

2.1 Introduction

Sustainable development can only be achieved under a co-ordinated and focused policy environment. Thus, the success of any project is largely influenced by national and sectoral policies. The consistency of a project with policy is very important in terms of drawing support from Government, Donors and the civic society. Furthermore, policy has an influence on the legal environment and as such a project which is not consistent with policy may face legal problems on implementation.

This Chapter gives an overview of the national policy, the Zimbabwe Programme for Economic and Social Transformation (ZIMPREST), and the sectoral policy, the Zimbabwe Agricultural Policy Framework (ZAPF). It then attempts to evaluate consistency between Government policy and the project concept.

2.2 The Zimbabwe Programme for Economic and Social Transformation (ZIMPREST)

The ZIMPREST is the framework for national policy for Zimbabwe. The document identifies poverty and unemployment as the main problems which have to be addressed in order to achieve sustainable growth. It highlights Poverty as the last and greatest enemy of the people and a threat to far too many Zimbabweans. This is qualified by the fact that over 63,3 per cent of the total population is below the poverty line and in rural areas 72 per cent of the rural population

is below the poverty line. In addition Zimbabwe's demographic structure is such that growth in labour force which is estimated at 4,2 per cent is projected to be considerably higher than growth in population of about 3,1 per cent. This implies that in absolute terms there is a net addition of over 183 800 to the labour market each year over the period 1996-2000. This exacerbates the food insecurity and poverty problems.

In confrontation with these challenges the fundamental objective of the macro policy is to:

> "achieve a sustained high rate of economic growth and speedy development in order to raise the incomes and standards of living of all our people, and expand productive employment of rural peasants and urban workers, especially the former." (ZIMPREST,1997)

The underlying strategic framework for achieving this objective involves mobilising investment and savings which should be used efficiently to generate economic growth and employment, cultivate entrepreneurship, enhance economic empowerment, and sustainably alleviate poverty. Within this framework each of the sectors has specific strategies which are expected to fit in the overall policy matrix.

Under the purview of agricultural development the national policy puts emphasis on the development of the smallholder farming sector. It underscores the need to transform this sector from subsistence to commercial production. This is to be achieved through technological innovation, land and agrarian reform, strengthening of institutions, promotion of agro-processing, improvement of market access and the adoption of an integrated agricultural sector

investment.

2.3 Zimbabwe Agricultural Policy Framework (ZAPF)

The ZAPF provides a development vision for the agricultural sector for the next 25 years. The focus of the document is on the modalities for generating more comprehensive and orderly agricultural growth. It is designed to be indicative of what needs to be done at the national and household level in order to get agriculture back on the path of sustained growth and development.

In the document, four pillars (goals) or fundamentals are highlighted as key to the building of the future structure of agriculture. These include the following :

1. The transformation of smallholder agriculture into a fully commercial farming system;

2. An average increase in total agricultural output each year that is significantly larger than the increase in population;

3. The full development of physical and social infrastructure in all rural areas throughout the country; and,

4. The development of fully sustainable farming systems throughout the country which reverses current environmental degradation and soil erosion.

2.3.1 The Agricultural Sector Investment Programme

The agricultural sector investment Programme (ASIP) will provide mechanisms for collaborative financing of agricultural activities by the Government of Zimbabwe (GOZ), donors and various stakeholders. The aim of the ASIP is to support the goals outlined in the Zimbabwe Agricultural Policy Framework and the Programme for Economic and Social Transformation (ZIMPREST) and provide an investment map. Within this framework short to medium term objectives for agriculture include:

1. Accelerating agricultural and agro-industrial growth, thereby creating additional rural income earnings and employment opportunities, especially within the medium-to-high potential areas;

2. Reduce rural poverty and improve household food security and the sustainability of agricultural production systems and natural resource management within semi-arid areas;

3. Double grain yields for smallholder farmers;

4. Diversify production in order to move smallholder farmers into high value crops such as horticulture;

5. Improve women's participation at all levels of agriculture;

6. Reform public sector agricultural institutions to improve efficiency, cost effectiveness and ensure demand driven responses;

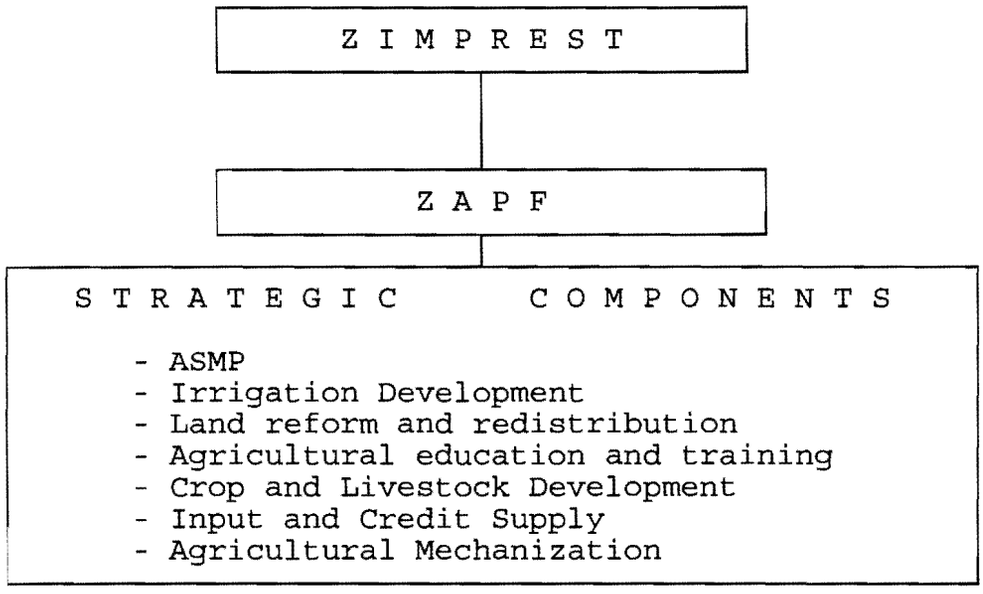
7. Increase area of smallholder irrigation from 10 000Ha to 50 000Ha and improve the overall water use efficiency; and,

8. Facilitate the land resettlement programme and settle households on the basis of reformed tenure system.

Achieving these objectives requires improved and sustainable delivery of technical support services to smallholder and commercial farming/agri-business sectors, and building the institutional and legal foundations for sustainable natural resource management in the country. Thus, the broad strategic components of the ASIP include the following;

- The agricultural services and management project(ASMP);
- Irrigation Development;
- Agricultural Education and Farmer Training;
- Crop and Livestock Development;
- Land reform and redistribution;
- Input and credit supply; and,
- Agricultural mechanization.

These strategies will be operationalised within the following policy and conceptual framework;



Within the crop and livestock development subhead the major thrust is to sustain crop and livestock production. It will be recalled that in section 1.3 a gloomy picture of national and international food situation was painted. The rationale of this project is to reverse this situation particularly at a national level. Within the policy strategies food security is set to be enhanced through diversification and increase in productivity. The production of cassava is conceived within the context of diversification. It is specifically meant to hedge against drought risk. It contributes to agricultural and national development through risk reduction from crop diversification, enhanced food security, increased employment and higher farm incomes.

2.4 Analysis of the Fit Between the Project Concept and Policy

The general policy thrust in agriculture as enunciated in ZIMPREST and ZAPF is to address poverty and unemployment. The fundamental goal being one of meeting the basic needs. In this context the specific strategies include diversifying production in order to minimise risk and enhance food security, and to commercialise the smallholder sector.

In chapter one and previous sections of this chapter the causality between poverty and food insecurity was highlighted. In this context the ZIMPREST and ZAPF underscore the need to alleviate poverty which implies the need to address the food insecurity problem. Secondly, the macro and sectoral policies are coherent, and both have a primary objective of transforming the smallholder sector into a commercial sector and to reduce unemployment. They also have similar strategies for addressing these problems.

Within the national and sectoral framework the proposed project fits under the diversification policy. It seeks to redress the poverty and food insecurity problem. Cassava being suited to marginal areas where the majority of the smallholder farmers and poor live, would be the ideal crop for the target beneficiaries. Its low input requirements also augers in well with resource limitations experienced in these areas. The extent of food insecurity in Zimbabwe has been well covered and the potential impact of this project in addressing this problem cannot be over-emphasised. In addition, by complementing maize production the proposed project does not compromise the objective of doubling grain yields.

CHAPTER THREE

THE STUDY AREA

3.1 Introduction

The previous chapters dwelled a lot on poverty in Zimbabwe and the demographics associated with it. From these chapters it came out clearly that the poor and most food insecure groups of the population are in rural areas. It suffices to add that the poorest are mostly found in the marginal areas. Marginal means that the areas receive very low rainfalls, the soils are generally less fertile and in some instances infrastructure is poorly developed.

This chapter gives a description of the study area part of which falls in marginal areas. The chapter comprises five sections. The second and third sections describe the location of the study area and its physical features respectively. The last three sections look at the area's demographic aspects, climate and agricultural activities. These aspects are of major significancee in the feasibility analysis which comes in Chapter 5.

3.2 Location

The proposed cassava project will be confined to Mashonaland West and Central. These two provinces comprise about one quarter of the country starting from the north east to the north west. The map in Annex 1 gives the location of the study area on the Map of Zimbabwe. Mashonaland West has a total area of 57 441 square kilometres and Mashonaland Central has an area of 28 347 square

kilometres. Mashonaland West comprises 6 districts which are Kariba, Hurungwe, Makonde, Zvimba, Chegutu and Kadoma. In Mashonaland Central there are 7 districts and these are Guruve, Centenary, Mt Darwin, Rushinga, Mazoe, Shamva and Bindura. These areas are suitable for cassava production.

3.3 Physical features

The area is largely composed of flat and undulating terrain. However, some of the districts such as Mt Darwin, Kariba and Makonde are mountainous. In addition part of the Kariba District falls in the Zambezi valley. The soils in the area vary from sandy loams to clays. Similarly soil fertility varies from place to place. Lower lying areas such as the Zambezi valley tend to have deep clay soils whilst high areas such as Makonde usually have shallow sandy loams. In terms of cassava production the soils are not much of a limiting factor since the crop grows well both in heavy and light soils. However, heavy soils tend to present harvesting problems and encourage vegetative growth.

3.4 Demographic Aspects

According to the 1992 census Mashonaland West and Central have populations of 1 112 955 and 856 736 people respectively. In both provinces females slightly outnumber males. The population density is about 20 and 30 persons per square kilometre for Mashonaland West and Mashonaland Central provinces respectively. The sparse population offers opportunities for agriculture. In Mashonaland West about 76 per cent of the population is rural and in Mashonaland Central 92 per cent of the population is rural. The average household size is 5 persons with total number of households being 408 351. In Mashonaland West about 63 per cent of the

population above 15 years of age is economically active and in the other province 49 per cent of the total population is economically active. It is therefore envisaged that the project will not experience any labour problems.

In terms of wellbeing the "Poverty in Zimbabwe" study classifies about 80,4 per cent of the population of Mashonaland Central as poor and 46,1 as extremely poor. Similarly 66,7 per cent of the population of Mashonaland West is classified as poor with 40,4 being extremely poor. However, over 50 per cent of the population in each of the two provinces live in high potential areas. The main factor which accounts for the widespread poverty is therefore rurality rather than rainfall and land quality. Owing to lack of formal employment incomes are very low in these rural areas and as such the use of technical inputs is very low due to the fact that most farmers cannot afford them. This results in low yields hence poverty or high food insecurity. In addition, most households experience food stockouts before December. Cassava being less input intensive offers opportunities for redressing the food insecurity problem.

3.5 Climate

More than two thirds of the area falls in Region 2 and the other third falls in Regions 3, 4 and 5 in almost equal proportions. Box 1 below gives a brief overview of the five natural regions of Zimbabwe in order to provide a greater insight into what will be discussed in this section.

Box 1

Region 1: (Specialised and diversified farming areas) This constitutes less than 2 per cent of the total area of Zimbabwe. Rainfall is in excess of 1000mm per annum. The main farming activities include fruit, forest and intensive livestock farming.

Region 2: (Intensive farming) The region constitutes less than 15 per cent of total area. It receives between 750 and 1000mm of rainfall per annum. It specialises in crop production and intensive livestock farming.

Region 3: (Semi-intensive farming) The region constitutes about 19 per cent of total land area. The rainfall ranges from 650-800mm per annum. The main agricultural activities include livestock, fodder and cash crops - there is marginal production of maize, tobacco and cotton.

Region 4: (Semi-extensive farming) The region constitutes about 38 per cent of the total area. The annual rainfall ranges from 450-650mm. The region specialises in the extensive production of livestock and drought tolerant crops.

Region 5: (Extensive farming) This region constitutes about 27 per cent of total area. The average annual rainfalls are below 300mm. The main activities are cattle and game ranching, and production of very drought tolerant crops.

Generally annual rainfall declines as one moves from the South to the North East and West. The total annual rainfall for the area varies from slightly more than 800mm per annum in Region 2 to less

than 300mm per annum in Region 5. Most of the rains fall in summer i.e. from October to end of April. Annual rainfalls tend to decrease as one moves to the North-East and North-West. Droughts and dry spells are a common feature of the climate in Regions 3 to 5 and are less pronounced in Region 2. Temperatures vary according to area and in relation with the region. Generally average annual temperatures tend to rise with latitude and summer temperatures can rise to a high of 37 degrees celsius in the Zambezi valley. Winters are generally cool to warm and dry.

3.6 Agricultural Activities

The main economic activity in the study area is farming. The major crop is maize. Other crops of importance include millet, cotton, sorghum, and pulses. Grain production is the dominant activity in areas falling under Region 2 although market gardening is rife in higher rainfall areas. Part of the area falls within the maize belt of Zimbabwe so in terms of food security the majority of households in Region 2 are able to produce enough cereals for their requirements. Most of the cassava produced in the maize belt will therefore mostly be used for stockfeeds. Food production is generally inadequate to meet the annual requirements of the majority of households. However, for the marginal areas which fall in Regions 3 to 5 there is a high degree of food insecurity. Most households in these marginal areas depend on remittances, grain loans extended by government and food relief provided by NGOs to meet shortfalls. This group will benefit most from the proposed cassava option.

Livestock production is a major activity in the area. The main livestock enterprises include cattle, poultry, pigs and goats. The livestock industry has suffered major setbacks following a series

of droughts over the current decade. Generally cattle production is extensive although in most cases supported by supplementary feeding. Pen fattening is also a common practice. However, this is constrained by high feed costs. Poultry and pigs are produced under intensive systems. Production of cassava is expected to boost production of livestock and consumption of meat. This is further elaborated below.

Zimbabwean stockfeeds are mostly maize based. With the rapidly increasing costs of maize which are coupled with the depreciation of the local currency the prices of stockfeeds have skyrocketed. This has rendered dairy and livestock production less viable while milk and meat have become unaffordable to consumers. Cassava will therefore provide a cheaper substitute for maize in stockfeed production.

3.7 Conclusions

This Chapter gives an overview of the study area. It highlights that the two provinces of Mashonaland Central and Masholand West have 7 and 6 districts respectively. It goes on to describe the physical features of the two provinces and how they affect cassava production. From this analysis it emerges that physical features do not constrain cassava production. In order to evaluate the availabilty and adequacy of critical resources such as land and labour a demographic analysis is carried. Figures on population density and numbers of economically active persons in the two provinces indicate that there is adequate land and human resources. In view of the importance of climate to agricultural production an effort is made to assess the suitability of the study area to cassava production. Finally a review of the current agricultural

activities is presented. The purpose is to try and integrate cassava production into the current structures and systems.

CHAPTER FOUR

A DESCRIPTION OF THE PROPOSED PILOT PROJECT ON CASSAVA

4.1 Introduction

This Chapter provides a detailed description of the proposed cassava project. The Chapter is composed of 7 sections and discusses the details of the project, developments which will take place under the project and issues such as organisation, activities falling under the project, project costs and financing. Most of the facts and figures presented in this Chapter are based on my own reasearch. It should be underscored that the incorporation of a pilot cassava project in the study area is as highlighted in Section 1.7 meant to facilitate the technical, financial and economic analysis.

4.2 The Planning Framework

This project is planned along the logical planning framework (Log-Frame). This is given in Annex 4. The logical framework is an analytical tool for project planning, monitoring and evaluation, and implementation guide. Planning involves defining goals, setting objectives, defining targets and putting up a programme of activities. In logical framework analysis these aspects are co-ordinated through logical linkages.

By description the logical framework is a 4 x 4 matrix comprising the narrative summary in the first column, objectively verifiable indicators in the second column, means of verification in the third column and assumptions in the fourth column. The first column has

four rows which comprise the goals to be realised through the intervention, the purpose of the project, the expected outputs and activities. Within the columns there is a vertical logic and correspondingly a horizontal logic across the rows.

The goals are broad achievements of the project. These are a measure of the contribution of the intervention to welfare. Examples include improvement in food security, balance of payments, standard of living, etc. For this specific project the goal is to increase/enhance food security. The purpose is the direct impact of the project and being what the project should realise. Thus, the purpose of the proposed project is to increase cassava production for human and livestock consumption. The outputs are the results from various activities carried out within the context of the project. These are stockfeeds and cassava. Finally, the activities are all those actions that have to be taken in order to realise the goals, purpose and get the outputs. These will be highlighted in Section 4.6. These include labour, seed, fertiliser, agrochemicals, etc.

There are three logical linkages up the column. The activities or actions are meant to organise inputs into production or outputs which is the first linkage. As per our example, all the activities highlighted in the above paragraph results in production of legumes and vegetables being the outputs. The second linkage is a continuity of the first linkage and connects the outputs to purpose. The horizontal logic links the various elements of each column. The goal, purpose, outputs and activities are linked to objectively verifiable indicators, means of verification and assumptions.

The major strengths of the log-frame are its simplicity,

comprehensiveness, flexibility and multiplicity of uses. One of the major elements in planning is the adoption of the SMART concept in objective formulation. This means that objectives should be specific, measurable, achievable, realistic and time bound. The logical framework is designed to do just that. By breaking the narrative summary into goals, purpose, outputs and inputs the main objective is to enhance focus thereby increasing specificity and realism in objective formulation. The second column of objectively verifiable indicators aims at enhancing timing, specificity, measurability, achievability. It also audits the realism of the objectives. The third column supports the second column. The column of assumption puts emphasis on achievability and realism. Without realistic assumptions chances are that the goal may not be achieved. From the foregoing the importance of the logical framework in comprehensive planning cannot be over-emphasised.

In this context the logical framework will be used for planning, monitoring and evaluation. It will also be used to assess the performance of project managers and, the accuracy and effectiveness of the cost benefit analysis.

4.3 Description of the Project

The project is oriented towards improving food security. Ideally its fundamental goal is to enhance food security. Its purpose is to increase production of cassava for human consumption and production of stockfeeds. A summary of the goals, purpose, inputs, outputs and major assumptions underlying the successful implementation of this project are given in Annex 4. It entails producing cassava for direct human consumption and stockfeed production. Under direct human consumption cassava will be consumed in various forms. Cassava meal or chips can be roasted and consumed directly. Ground

dry cassava will be blended with wheat flour and maize meal for baking of biscuits and cooking of "sadza", a traditional staple in Zimbabwe. In this respect current research findings indicate that flour or maize blends of less than 30 per cent cassava do not corrupt the taste of bread and "sadza" ,i.e. experiments have indicated that such blends are below the taste differential threshold of consumers. The other advantage of cassava is that it has a high starch and low gluten content hence improves the crumb in biscuits, and the cooking quality in bread and "sadza." With respect to "sadza" the implications are that the quantity of maize meal used in the cooking is reduced i.e mealie meal is saved. Thus, the overall cost of food is reduced whilst the usage period of a given quantity of mealie meal is extended. There is thus a double positive impact on food security. On another score, and in terms of adoption of cassava it is deemed that natural calamities such as droughts will accelerate the adoption of cassava.

In terms of meat supply (protein) the project will provide a cheap stockfeed which makes meat production, especially pork and poultry, very cheap. This provides scope for greater consumption of meat hence improved food security. The importance of cassava in stockfeed production was detailed in Chapter 1 where its use as a stockfeed was underscored.

The project has two main components which are field production of cassava and processing. The analysis in Chapter 5 indicates that it will be more viable from a socio-economic perspective to produce cassava as a secondary crop. This project therefore adopts the use of contour ridges, alleys and field edges for cassava production. A proposed farm plan for such a strategy is given in Annex 2. It should be born in mind that this strategy is semi-extensive and as such does not result in production of very large quantities of

cassava. However, it is very effective in promoting adoption and managing cassava diseases.

Furthermore, it should be emhasised that under the current situation which is charaterised by declining food security it would be more desirable to adopt a production strategy that increases overall food production as opposed to crop substitution. In this context the use of alleys/contour ridges is meant to minimise the displacement of maize by cassava or as it were optimise land utilisation. Thus, maize and cassava will complement each other in achieving the food security goal.

This project will concentrate on sweet varieties because they have a better taste, lower concentration of cyanogenic glucosides and shorter production cycle. The botany of cassava is given in Chapter 5 where a comparison of the two varieties is given. A match of the physical and relief features of the study area which are given in Chapter 4. This together with the botany of cassava gives sweet varieties as a better option for Zimbabwe.

The planting material will be drawn from the Research Stations under the Department of Research and Specialist Services (DR&SS), Ministry of Lands and Agriculture. There are on-going cassava multiplication and distribution activities being executed by the Department. This project will benefit from the current experience of the Department. In this context the staff of the Department which is currently working on cassava will be co-opted into this project.

The subject of planting orientation vis-a-vis yields and ease of harvesting is discussed in Chapter 6. In this discussion the advantages of horizontal orientation are highlighted. Thus, in this

pilot project a horizontal planting orientation will be adopted. This is meant to maximise yields and make it easier to harvest.

The production season will last about 7 months. The normal season of sweet varieties is about 12 months. However, in order to fit this project into the socio-economic environment of smallholder farming the 6 - 7 months period will be adopted. Planting starts just before the rain season or between August and November and harvesting starts in May. A reap and replant approach will be encouraged in order to optimise labour. Most of the field activities will be done manually.

The processing of cassava for stockfeed manufacturing involves washing of harvested cassava then cutting it into chips. These chips are then sun or machine dried. After drying the chips are ground into cassava meal. This meal is then mixed with other stockfeed ingredients in various proportions to produce various stockfeed rations or used for preparation of human feed.

The main capital items which fall under the processing sub-head include a mill, vehicles, offices, accommodation, factory building and office equipment. The mill comprises squeezers, driers, grinding mills, mixers , bulking silos, scales and packing machines. Squeezers are for squeezing out water from the tuber. Driers expedite the drying process. The mills grind the dry cassava into meal. It is important to note that most grinding meals can perform this function. The mixer is used in conjunction with stockfeed manufacturing. It mixes the various stockfeed ingredients in the prescribed ratios. The weighing and packing systems functions are by definition.

This project will procure two integrated feed manufacturing mills

each of which will service one of the two provinces. The stockfeed processing flow diagram is given in Annex 3. At the household level grinding services will be provided by existing hammermills. The project will therefore not procure additional hammermills for grinding cassava for human consumption. In each of the two provinces a factory complex comprising offices, accommodation for staff and a structure to house the mill will be built. Office equipment will comprise computers, telephones, copiers, furniture, etc.

Each of the stockfeed processing mills will be manned by a general manager, a clerk, a bookkeeper and 10 general workers. Additional requirements include the managers car, staff houses and 1 x 3,5 tonne truck for deliveries. Stockfeeds from the two factories will be sold to local farmers for use in production of pigs and poultry.

4.4 Proposed Developments

The proposed developments fall under two main categories, viz, cassava production and stockfeed processing. The developments associated with stockfeed processing were adequately covered in the previous section so this section will concentrate on the farm plan. The project area has 408 351 households of which 85 per cent or 347 098 are rural. The project will be developed over a period of four years and based on the adoption curve. The adoption curve classifies a population on the basis of adoption. It comprises five broad categories which include innovators, early adopters, early majority, late majority and laggards. The categories are delineated on the basis of rate and timing of adoption.

In this context, 2,5 per cent of the population or innovators will be targeted to adopt cassava production in the first year. The

second year will target the 13,5 per cent of the population which is the early adopters category and the third year will target the early majority being 34 per cent of the total number of households. The fourth year will target the late majority being 34 per cent of the population. It is assumed that there will be no significant adoption by the 16 per cent of the households comprising the laggards hence production will reach the threshold in year four. Table 4.1 below shows the adoption rate, cumulative adoption and projected cumulative production of cassava. Adoption rates are based on the classical adoption curve, cumulative adoption is calculated from the adoption rates and census figures of the project area, and cumulative production is calculated from cumulative adoption and production estimates given in Annex 2.

Table 4.1: Adoption and cumulative production of Cassava

Year	Adoption Rate %	Cumulative adoption (Households)	Cumulative Production in MT Based on Wet Mass
Year 1	2,5	8 677	3 645
Year 2	13,5	55 535	22 325
Year 3	34,0	187 432	78 722
Year 4	34,0	319 529	134 203
Year 5	00,0	319 329	134 203

Cumulative production of cassava is calculated on a projected average yield per plant multiplied by the projected planting population and the number of households. Annex 2 provides details on the assumptions on which production is based.

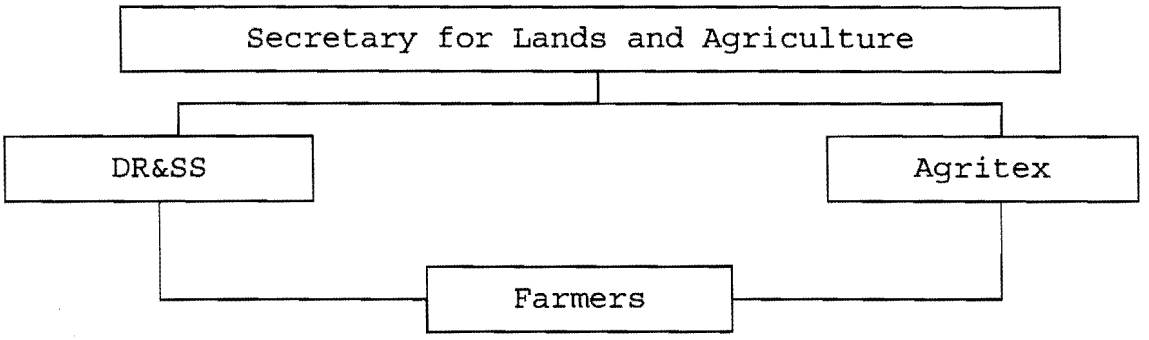
The use of the adoption curve in the development programme has two distinct advantages. Adopting this approach enables the synchronisation of the supply of inputs especially planting material with projected increase in production. Secondly, it gives a more realistic estimation of projected production.

4.5 Organization and Managerial Systems

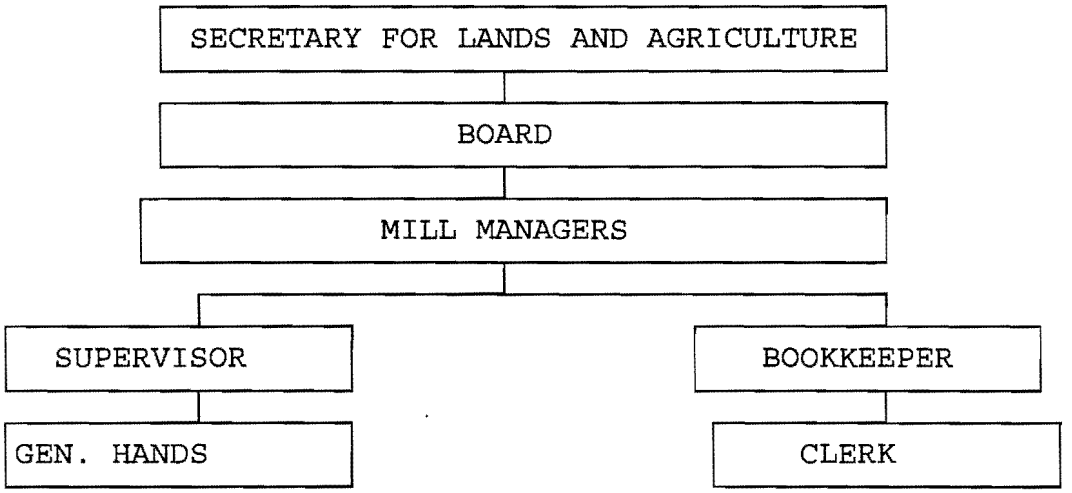
The whole project will be managed by the Secretary for Lands and Agriculture. The three Organisations involved in the implementation are Department of Research and Specialist Services(DR&SS), Agritex and the Stockfeed Factory. The main functions which falls under the project are processing, training and research. Farmers would need to be trained on production and utilisation of cassava. DR&SS will provide research services pertaining to cassava development. It will also co-ordinate the establishment of nurseries. Both DR&SS and Agritex will provide training on processing and use of cassava. Agritex will provide extension on production.

The project will be implemented through the Departments of Agricultural Technical and Extension Services (Agritex), and Research an Specialist Services(DR&SS). Agritex has an office in each of the 13 districts in the study area. At the grassroots there is at least one extension worker per ward. The district extension offices will co-ordinate with DR&SS and in turn co-ordinate with the grassroots through field extension officers. All these structures report to the Secretary for Lands and Agriculture through their respective Directors. The proposed organogram for management and implementation of the project are as shown below.

Structure Showing Relations Between Farmers and Support Institutions



Organogram for the Management of Mills



In order to enhance the effectiveness of the implementation process a Committee comprising farmers representatives, DR&SS, Agritex, the Factory and the Policy and Planning Division will be established. The main function of this Committee will be to facilitate the implementation of the project.

4.6 Activities

The previous sections described the main components of the project and this section concentrates on defining the main activities

falling within these components. These activities are summarised as below. Annex 5 provides details on the schedule of activities.

- Mobilisation of funds;
- Establishment of an Implementation Committee;
- Procurement of factory equipment and vehicles;
- Multiplication of planting material;
- Distribution of planting material;
- Identification of beneficiaries;
- Recruitment of factory staff;
- Demonstrations and training on the safe use of cassava;
- Construction of accommodation and offices

Following the completion of the project document mobilisation of funding for the project will begin. This exercise is expected to take about 3 months. Within the same period an implementation Task Force will be set up to spearhead the project. After securing funding the expansion of the multiplication and distribution exercise will commence. Thus, the procurement of distribution vehicles should take place almost at the same time or earlier. Extension on production also begins around this time. These two activities are ongoing. Furthermore, this activity will go in tandem with the identification of beneficiaries. Towards the end of the production season demonstrations and training on processing and utilisation of cassava begin.

The construction of factories should commence half way through the first year of implementation. This goes in tandem with the procurement of mills. It is then followed by the installation of mills. These activities also go along with the recruitment of factory staff.

4.7 Costs and Financing

The costs of the project are tied to the activities highlighted above. The total cost of the project is US$ 499 000. These are apportioned as listed below. The project will be financed by donors. Government of Zimbabwe will provide staff and land. The main cost sub-heads for the project are as follows:

ITEM	COST(Z$)
4 x 7 tonne trucks*	4 000 000
2 x Stockfeed Mills*	2 400 000
6 x field days	180 000
1 x twin cab pick up*	800 000
Travel and Subsistence	1 500 000
Accommodation and offices*	4 000 000
2 x Mill managers	420 000
2 x Mill clerks	120 000
2 x Bookkeepers	240 000
20 X General hands	480 000
Fertilisers, planting material, agro-chemicals, office equipment.	1 500 000
Study Tours	800 000
Maintenance	2 400 000
Fuel	400 000
TOTAL	**19 240 000**

* Denotes investment capital

The total costs of capital items is $11,2 million and the main capital items are vehicles, mills, buildings and study tours. The items falling under the recurrent costs sub-head include labour, inputs, fuel and maintenance. The total annual budget for these

items is $1.9 million. Travel and subsistence and study tours account for $2.3 million of the total budget. This project will be financed by Donors. The Government of Zimbabwe will provide the manpower to run the project, and land. The project life is 10 years.

4.8 Conclusions

In this chapter a description of the proposed project on cassava production which is one of the main elements of the study is provided. Most of the facts and figures provided are based on research conducted by the author. The project proposal is based on the logical framework. The use of cassava in the preparation of human food, confectionaries and as a stockfeed is elaborated.

A semi intensive mode cassava production is identified to be most compatible with the current farming systems and sweet varieties are deemed to be the most appropriate variety for the proposed project. This is based on taste, shorter gestation period and other factors. The processing of cassava for household use and large scale commercial production of stockfeeds are summarised.

The main developments include establishment of stockfeed mills and building up cassava production. The growth in cassava production is based on the classical adoption curve. The management of cassava production will largely be an affair of farmers, Department of Research and Specialist Services, and Agritex. Stockfeed mills will be established under a "Built Operate and Trasnfer" and as such will initially be owned by Ministry of Lands and Agriculture with an autonous management structure put in place to run the enterprises. The total cost of the project is Z$19,24 million of which capital items account for Z$11,2 million. The project life is

ten years.

CHAPTER FIVE

THE FEASIBILITY ANALYSIS OF THE PROPOSED CASSAVA PROJECT IN ZIMBABWE

5.1 Introduction

This Chapter focuses on the feasibility analysis of the proposed project. Technical, social, commercial, financial and marketing aspects are the main elements addressed in the analysis. The chapter comprises eight sections. The first section focuses on technical elements on cassava culture. The second section looks into the marketing environment for cassava and this is followed by the financial analysis of cassava, sensitivity analysis and, then the economic, SWOT analysis, and benefits respectively.

5.2 Technical analysis

5.2.1 Botany

Cassava is a perennial shrub which comes in two broad varieties based on taste, viz, sweet and bitter varieties. Sweet cassava has a low concentration of cyanogenic glucosides which in this case are usually concentrated in the peels. Bitter cassava has a higher concentration of cyanogenic glucosides which are distributed within the whole tuber. The classification of cassava according to cyanogenic glucosides content can be misleading given that the cyanogenic glucosides concentration depends among other things on environmental factors. Soils with high nitrogen content usually produce cassava with a high cyanogenic glucoside concentration (Onwueme, 1982).

Cassava grows well in both fertile and infertile soils (Onwueme and Hahn, 1989). However, it is a heavy feeder so if grown in fertile soils it quickly exhausts the soils. Secondly, high soil fertility generally promotes vigorous vegetative growth which delays tuber formation. The crop is susceptible to waterlogging.

Although the crop grows well in both heavy and light soils, heavy soils present problems in harvesting as it is normally difficult to uproot the crop. Onwueme (1982) indicates that manually one can harvest about 1000kg per day in light soils and only 500kgs in heavy soils. From an economic point of view it would therefore appear that the most ideal soils for this crop are light soils. Silvestre (1989) recommends an NPK fertiliser application of 10-10-20 for such soils. The application rate is about 10 kilograms per 10 metric tonne projected yield. This recommendation will be adopted in this project.

Cassava is a sub-tropical crop and as such tends to thrive very well in regions with rainfalls of 1000-1500mm per annum. Nevertheless cassava is drought tolerant and can therefore grow well in regions with a total rainfall of over 500mm. The most ideal growing temperatures range between 25 and 29^{0}C. It does not grow well at temperatures below 10^{0}C. Furthermore, it is susceptible to frost. When subjected to water and temperature stress the crop sheds off its leaves as a coping strategy. The climatic conditions of the study area given in Chapter 3 are compatible with the crop requirements.

Cassava is planted from seed, tissue culture and cut stems. The most common practice involves the use of stems and tissue culture. Tissue culturing is a high technological process under which stems are produced by multiplying selected genetic material. The main

advantage with this process is that important genetic characteristics can be selected and developed. Secondly, the planting material arising thereof is normally disease free or clean. With respect to use of stems the common procedure is to select cuttings on harvest. In this case thicker parts of the stems from the middle part are selected. The thicker parts are used because they produce higher yields. The selection of middle parts of the stem is deliberate and aims at selecting against diseases which are usually concentrated in the lower parts of the stem. It should be highlighted that the establishment of nurseries for cassava multiplication is the standard practice of producing planting materials. This involves multiplying clean planting material from which cuttings for planting are drawn.

As has already been highlighted above planting material is usually selected during harvesting. In this process either the planting material is replanted from holes where the cassava will have been uprooted or bundled and kept in shade or moist conditions until the planting season. In selecting cuttings it is very important to make sure that the planting material has at least three nodes. Stems are re-planted vertically, horizontally or slanted. Planting vertically entails that the holes have to be deeper so more labour is involved. The tubers arising thereof are normally compact but deep into the soil. This also involves greater labour in harvesting. With horizontal planting the tubers are normally spread and close to the surface. Harvesting is easier. In addition yields are higher. Slanted or tilted planting lie between vertical and horizontal planting in terms of yields, depth and drudgery (labour involving).

After planting, shoots normally emerge in the first three weeks. Planting can be done on ploughed land, ridges or unploughed land.

Weeding is critical in the first three months after planting within which period a canopy would not have developed. After three months a canopy would have developed and by then weeds cannot effectively compete with the crop.

Tuber formation starts in the eighth week and continues until the 6 - 9 month period at which time it usually ceases. No significant tuber formation takes place after 9 months. The period of maturity depends on the variety. Sweet varieties have a shorter gestation period and usually mature between 6 and 9 moths with an average gestation period of 7 months. Bitter varieties mature in a period of between 15 - 19 months and the gestation period can even be as long as 24 months. If left for a long period unharvested after maturation the tubers develop fibrous tissues (Onwueme, 1989).

From the foregoing the emerging technical issues related to the production of cassava in Zimbabwe include climatic aspects, diseases, varietal selection, environmental factors, planting orientation and selection of planting material. The following sections will analyse each of these issues in detail.

5.2.2 Climatic Aspects

Cassava will be grown in the north western parts of the country. The climate of this area has been given in section 4.5. In line with the botany of the crop the most appropriate varieties are those with water requirements of about 500mm, and temperature conditions of 18 - 32°c. The majority of cassava varieties tend to fit in these climatic conditions. The climatic aspect is therefore not a problem, if anything the crop provides the appropriate choice in terms of suitability to the drought conditions prevalent in the area.

5.2.3 Soil Factors

The soils in the project area range from sandy loams in Hurungwe to heavy soils in the Zambezi Valley. The heavy soils of the Zambezi present harvesting problems in that their plasticity makes tuber harvesting difficult. In addition they tend to depress yields by promoting excessive vegetative growth. In this light it would be more ideal to go full scale production in Hurungwe and pilot the Zambezi Valley.

5.2.4 Diseases

Undoubtably this is one of the greatest challenge the project will face. The main disease threats and pests are the cassava mosaic virus (CMV), mites, termites and bacterial blight. At a workshop organised by the Southern Africa Root Crops Research Network (SARNNET) held in January 1999 CMV was identified as one of the major challenges in the success of cassava production. To that end more work on the control of these diseases should be carried out. However, initially the following steps will be carried out in order to control the problem. Firstly, clean planting materials will be used. This will minimise the transmission of diseases to and from other areas. The mealybug or CMV vector tend to be very problematic in large cassava plantations. This problem will therefore be counteracted by inter-planting 2-3 rows of cassava between two acres of maize or other crops so as to avoid large continuous cassava tracts.

5.2.5 Varietal Selection

From the socio-economic analysis the most ideal varieties for

Zimbabwe are those with a shorter gestation period. In other words the crop should fit in a production season of about 6 - 7 months. Sweet varieties would therefore appear to fit very well into the socio-economic environment of the smallholder farming sector. This project should therefore concentrate on the production of sweet varieties. A lot of research has been conducted on those varieties and there is adequate planting material to sustain the project.

5.2.6 Planting Orientation

With regards to planting orientation the guiding principles include the need to maximise yield whilst minimising drudgery. In that regard the horizontal planting orientation is more in line with the project objectives hence this will be adopted. This is in consistency with the orientation/yield research findings discussed in Section 5.2.1 .

5.3 Analysis of the Marketing Environment under the Purview of Stockfeed Production and Human Consumption

The main environmental elements associated with cassava production are consumer, marketing, processing and procurement or supply analysis. The following sections will take an in depth analysis of each of these elements.

5.3.1 Consumer Analysis

The consumption of cassava comes at two levels, viz, primary and secondary. The primary level involves direct consumption. On the other hand secondary consumption entails using cassava as a stockfeed. Consumer analysis will therefore take cognisance of these two levels of consumption.

The question of the availability of effective demand has repeatedly come under the spotlight in fora where cassava production is discussed. It would be difficult to assert with confidence that there is an effective demand for cassava in Zimbabwe at the moment. However, one can talk of potential demand. It is within the context of this potential that one gathers confidence to pilot cassava production. Cassava has several advantages over other crops. These have already been highlighted in various chapters of this document. However, as a recap they include drought tolerance, multiplicity of uses, low input requirements, affordability, ease to store and ease to produce. These advantages are of major significance in terms of enhancing food security. The current lack of consumer test for the crop should therefore not be viewed as a deterrent but a challenge.

Within the context of food security and/or direct human consumption of cassava, demand potential exists in the baking industry, cassava meal production and direct consumption. In Tanzania baking flour blends comprising 20-30 per cent cassava meal with the rest being wheat and other ingredients has successfully been used for baking biscuits. There appears to be no noticeable taste differences between these biscuits and those baked wholly from wheat. Similarly tastes carried in Malawi indicate that there are no noticeable taste differences on "sadza" cooked from mealie meal blends comprising 30 per cent or less cassava. There is therefore a very great potential for blending cassava with maize meal or wheat flour.

Under stress conditions especially during droughts cassava appears to be a viable source of food. This has been amply demonstrated in Section 1.4. Cassava can also be used indirectly to provide cheap protein through using it as a stockfeed. In Zimbabwe the prices of stockfeeds has increased by over 200 per cent over the past 3

years. Given that feeds are a major cost item in dairy and livestock production the rise in stockfeed prices has triggered a wave of price increments on meat and livestock products. Farmers are looking for cost reduction options in order to remain commpetitive. There is, therefore, a lot of potential in this area. This potential has been discussed in various chapters in this document.

5.3.2 Marketing Analysis

The main elements of this analysis include price, distribution, product aspects and promotion. The price of raw materials is key to the success of the stockfeed manufacturing process. This and cost of finished products will determine the degree of competitiveness of the crop in relation to other crops which compete for the same resources. The project price of dry cassava is Z$2000 per tonne dry weight. This will compete very well with the main competitor, maize, whose average price is projected to be around Z$4800 per metric tonne this year.

The bulkiness of both the wet and dry raw material is a major distribution constraint. The short shelf life of fresh cassava further compounds the problem. In terms of logistics it would therefore be ideal to bring processing facilities closer to production units. A further dimension to this is that either a central processing system is put in place or small scale intermediate processing facilities are provided at the farm level. A dual approach is more consistent with the goal in that it encourages direct consumption at the household level whilst channeling surplus into animal feed production. The chemical composition of the product offers opportunities for a wide range of uses which include baking, human and animal consumption, and

industrial use. Currently the use of cassava for all these purposes in Zimbabwe is still minimal. However, it should be underscored that this commodity is relatively new to Zimbabwe and as such needs to be developed.

5.3.3 Procurement Analysis

This is more pertinent to the stockfeed manufacturing factories. The critical issues include a regular supply of wet or dry cassava, oilseed cake, vitamins and minerals. The production of sunflower and soya bean oil in Zimbabwe has reached maturity. Thus, these ingredients will be sourced from large and small scale processors. Currently there is little competition in the procurement of these raw materials so no procurement problems are envisaged. The supply of vitamins and minerals is abundant. The fundamental issues regarding processing are the availability of adequate volumes. In this instance there will be excess processing capacity at the inception of the project. However, the supply of cassava is expected to be build up over time to meet the demand for human consumption and stockfeed manufacture.

5.4 Financial analysis

Financial analysis is a tool used to measure the project worth or attractiveness of an investment. This tool uses a number of criteria which, inter alia, include the net present value, internal rate of return, payback period and net benefit cost ratio and return per dollar variable cost. The payback period is the period over which a project's total discounted or undiscounted net cashflows cover the total cash outlay. The decision to accept or reject a project is based on investors required payback period. The net benefit cost ratio is the ratio of the total discounted net

cashflows of a project as realised under the project life and the total initial capital outlay. Under this scenario an investor selects a subjective required net benefit cost ratio which normally covers inflation and risk plus a premium/profit. These measures of project worth weigh the risk versus its return. The most popular and powerful evaluation criteria are the net present value and internal rate of return.

The financial analysis has three main components which include cassava enterprise, stockfeed manufacturing factories sub-project and the Government perspective of the financial analysis or the composite analysis. The criteria used in measuring the project worth are return per dollar variable cost, net present value and internal rate of return. Several assumptions are used in this analysis and these include:

1. Prior to this project the land which will be used was idle and as such the without the project net cashflows or opportunity cost of land is assumed to be zero. The net cashflow of the project therefore constitute the incremental cashflow;

2. All costs in the cashflow budgets are quoted at the project site;

3. It is assumed that inputs and other stockfeed ingredients are readily available. This arises from the fact that the market is liberalised and supply is now heavily dependent on business lucrativeness. Thus if the project offers lucrative prices for these inputs then they will be readily available;and,

4. Assumed prices are as quoted in the cashflows.

A detailed analysis of each of the enterprises comprising the project are given in Section 5.4.1 below.

5.4.1 Cassava Enterprises - Farm Investment Analysis

The analysis of the viability of cassava production or farm investment analysis as it is popularly known basically assesses the profitability of producing cassava. It measures the attractiveness of the enterprise to the farmer. This analysis is the foundation or basis of the overall project success. A viable cassava enterprise makes it worthwhile for the farmer to venture into cassava. It also makes it worthwhile to invest in stockfeed production. Thus, the processes are interlinked. This analysis uses simple enterprise budgets to assess the attractiveness of cassava production. In this context the parameters used are the gross margin and return per dollar variable costs. The gross margin is used to measure profitability of the enterprise. The return per dollar variable cost is used to assess the extend to which the gross margin covers overheads. A minimum of 150 per cent is generally used as a guide on enterprise attractiveness in Zimbabwe. It should be highlighted that the weakness of this criteria is that it is based on average performance. Different farms have different cost structures and perform differently such that for some the threshold is higher than this figure whilst it is lower for others.

The viability analysis of cassava enterprises is based on the farm plan and assumptions given in Annex 2. This plan entails producing cassava on alleys or contour ridges. Each ridge or row will have two rows with a spacing of 80 centimetres and plant spacing of 80 centimetres. This gives a plant population of 100 per ridge or 300

per two acres. If planted continuously this spacing would give a population of about 9000 per hectare. The projected yield is about 12MT per hectare and this is based on the sigmoid curve(Cobb Douglas Curve) or input/output curve. The curve used assumes a normal distribution and as such is approximated by the following formula:

$$Y = 1/@*1/(2*2.71)*e^{-1/2((T-Tav)/@)**2}$$ (Adapted from Lucey 1994)

Y = weight at time T, @=standard deviation, T = time after planting, T_{av} = mean, * = multiply and ** = to the power, and e = exponential.

Fertiliser application rate is 10 kilograms per tonne yield. Being an extensive production process chemical application is assumed to be minimal or nil. The detailed analysis or cash budget which gives assumed rates, quantities and project costs, gross income and gross margin per household are given is Annex 6a. From the analysis the gross margin is Z$569 on a production of 420kgs wet mass. This gross margin is based on production on 3 alleys or six rows of cassava. As highlighted in Annex 3 these three alleys divide one hectare of maize into two halves. The return per dollar variable cost is 210 per cent. These results make cassava currently one of the most viable crops. However, it should be highlighted that the high viability is partly explained by the extensive mode of production under which input application is minimised. Secondly, it should be noted that it was assumed that the opportunity cost of land on which cassava is being produced is zero. This gives cassava an edge with respect to competitive utilisation of resources.

5.4.2 Stockfeed Factories

This enterprise is meant to absorb all surplus cassava(surplus to human consumption) and process them into stockfeeds. Thus, it is assumed that 70 per cent of total production will be for direct human consumption and the remainder will be channeled into stockfeed production. Therefore at the beginning of the project stockfeed production will not be of major significance in terms of absorbing surplus cassava since there will be little surplus as most of it will be consumed directly. However, it will play an instrumental role in catalysing the adoption of cassava production as a commercial window of the project.

The financial analysis of mills is given in Annex 6b. The total capital costs of the two mills, office and accommodation and vehicles is Z$11,2 million. The main running costs are fuel, maintenance and power. The overheads items are salaries, wages, telephones and consumables. The raw materials are dry cassava, soyabean cake, minerals, vitamins and minor ingredients. Soyabeans cake will be sourced from oil expressors. The throughput to the factories is assumed to be half of total production. Growth in throughput is based on the household adoption of cassava production i.e it is based on the adoption curve. The prices assumed in the calculations are as given in Annex 6b. Raw materials and stockfeeds are priced on a per tonne basis and other items are priced in bulk.

From the financial analysis the internal rate of return and net present value of the factories are 50,4 per cent and Z$2 875 334 respectively. The IRR is above the required rate of return of 43 per cent (Commercial Bank Interest Rate) and the NPV is well above zero. This signifies that this is a worthwhile project to invest

in.

5.4.3 Financial Analysis - Government Perspective

As highlighted in section 4.7 most of the resources for this project will be channeled in by Government through donors. In this regard it is important on the part of Government to ascertain whether its investment is financially sound. The reasons being that at some point Government would expect revenue from some of the enterprises in the form of taxes. The purpose of this section is therefore to assess the overall financial viability of the investment. Details of the Government perspective of the financial analysis are given in Annex 6C.

This analysis aggregates the farm enterprises and stockfeed mills sub-project to constitute the whole project. Additional costs such as Study Tours and, Travel and Subsistence allowances which will be borne by Government are also incorporated. A cost of capital of 43 per cent being interest charged on treasury bills is used.

The total cost of the project is Z$19,24 million. Net cashflows rise from Z$(435 136) in the first year to Z$64,2 million at maturity. The gross margin for the cassava enterprise is $569,08 per 3 alleys. The internal rate of return and net present value for the stockfeed factories are 50 per cent and Z$28,7 million respectively. The internal rate of return and net present value for the whole project is 14,6 per cent and Z$3,3 million respectively. On appraising viability using the net present value criteria the whole project is acceptable. However, when using the internal rate of return criteria the cassava and factory enterprises are acceptable whilst the whole project is not acceptable i.e. the IRR of 14 per cent is below the required rate of return of 43 per cent.

The fundamental aspects associated with this phenomenon are the very high costs of capital of 43 per cent and high cost of support services such as travel and subsistence allowances, and study tours. The downsizing of these activities will improve viability. However, these expenditure subheads fall under social services. The decision to downsize these activities should therefore be weighed against its impact in terms of compromising project success. It can therefore be concluded that the economic analysis should be used to evaluate the viability of the whole project. In other words the financial analysis of the whole project does not give conclusive results.

5.5 Sensitivity Analysis

A sensitivity analysis is a rigorous test meant to assess the resilience of a project to factors which impact adversely on its success. The approach adopted in this analysis involves identifying key success elements/factors which are bound to have a significant influence on project viability under adverse conditions. These critical factors are decline in yield of cassava and decline in the producer price of cassava. The main input is fertiliser and project viability is not very sensitive to the cost of this input so it is not a critical factor. The projected changes of these parameters under worst scenarios were estimated and subjective probabilities of these changes occurring were also estimated. The expected value of the parameter under distress conditions was then obtained by using the following formula:

> (1-m)V*P, where m is the percentage decline under distress, V is the parameter value under normal market conditions and P is the subjective probability of the occurrence of distress.

The values of these probabilities are summarised in the Table 5.1 below. The details of the calculations of the sensitivity analysis are given in Annex 7 and 8. However, a summary of the impacts is given in Table 5.1 below. Details are provided in Annex 7c and 8c.

Table 5.1: Summary of Sensitivity Analysis

Parameter	Normal Value	Probability of Occurrence	NPV	IRR
1. 40 % Decline in Yield	420kg/Ha	0,3	3 391 266	14,6%
2. 50% Price fall	Z$2000/MT	0,5	7 852 074	21,3%

A 40 per cent decline in the yield of cassava reduces the gross margin from Z$569 to Z$254. The factory viability is not affected much as the NPV and IRR almost remain static on Z$28 753 347 and 50 per cent. However, the overall project is severely affected. The NPV and IRR decline from Z$28 753 347,00 and 50 per cent to Z$3 391 266,00 and 14 per cent respectively. This underscores the significance of yields to the overall success of cassava production in Zimbabwe.

A 50 per cent decline in the price of cassava has a similar effect as yield reduction in terms of impact on gross margin. It reduces the gross margin from Z$569 to Z$254. The factory profitability improves significantly as indicated by the rise in NPV and IRR from Z$28 753 347 and 50 per cent to Z$33 214 155 and 55 per cent respectively. This situation normally arise from surplus production in which case the factories will tend to benefit relative to farmers owing to enhanced bargaining power on price determination. However, the overall project is severely affected. The NPV and IRR decline from Z$28 753 347 and 50 per cent to Z$7 852 074 and 21

per cent respectively.

It can therefore be concluded that farmers are the most exposed party in this project. Pricing and yields will play a pivotal role in the success of the project in terms of motivating adoption and sustaining production. In addition the viability evaluations give conflicting results with the whole project being acceptable under NPV but not acceptable under the IRR criteria. The guiding principles in terms of decision making in this context were discussed in Section 5.4.3.

5.6 Economic analysis

5.6.1 Approach

The purpose of the economic analysis is to assess the impact of the project on the welfare of the society. In other words the rationale of the exercise is to assess whether resources are being put to best use or used efficiently. The analysis first catagorises all inputs and outputs into tradables, non tradables and non traded goods. These categories are given in the Table 6.2 below.

Table 6.2: Classification of inputs/outputs into tradables, non tradables and non traded items.

Tradables	Non Tradables	Non Traded
1.Factory Equipment 2.Trucks 3.Vitamins and minerals 4.Skilled labour 5.Fuel	1.Power 2.Fertiliser, Phosphates 3.Unskilled labour 4.Accommodation and Offices 5.Unskilled labour	1.Cassava 2.Soyabean Cake 3.Telephone Services

Most of the tradables are sourced from some of the most competitive

markets in the World. For example, vehicles will come from Japan, a very competitive market; muriate of potash from Jordan, a very competitive market as well; the same applies to vitamins, factory equipment and fuel. Thus the fob prices of these items are a good estimation of efficient prices.

The calculation of economic prices involves decomposing project costs and incomes into local and foreign content. This assumes that values of tradables quoted in the financial analysis are costs at the project site. Further adjustments were made to obtain border or economic prices for tradables. These adjustments include removal of transfer payments (taxes, duties and subsidies). This results in import parity prices. Finally economic values of the local component were then calculated.

Telephones services present a challenge in the economic analysis. Within the World Trade Organisation they are regarded as a tradable services. However, by the nature of the service each of the supplier countries charges its own prices and collects almost the whole amount charged. This makes it difficult to come up with an international competitive price or price in alternative use. Consequently, it was assumed that this service is non traded in which case the domestic price was used.

Although cassava and soyabean cake are traded internationally they were considered as non traded goods owing to that fact that they are largely exported into the European Union and this market is highly distorted hence it is felt that quoting European Union prices would distort the analysis. However, given that these goods are intermediate opportunity costs were used in determining their economic values as recommended by Gittinger(1982). A similar (evaluation based on opportunity cost) approach was adopted for

power, locally manufactured fertiliser components and unskilled labour. In addition the opportunity cost of unskilled labour was based on the wage for seasonal peaks. The calculations are detailed in Annex 9a. Economic prices of skilled and semi skilled labour were based on opportunity costs (international prices). This follows from a general assumption that there is shortage of such manpower.

With respect to tradables the general approach was to disaggregate the prices into local and foreign component then calculate the import parity prices. The exchange rate premium was accounted for by multiplying all non tradables by a conversion factor of 0,833 which was provided by the National Economic Planning Commission. The calculations and conversions are given in Annex 9A.

The economic values of buildings were based on the opportunity cost of these assets. In this respect the market prices of similar structures in the project area were used as estimates of opportunity cost.

5.6.2 Results

The parameter used to assess the economic viability of a project is the economic rate of return (ERR). The utility of this parameter depends on the methodology and accuracy of the calculations. Thus, it is important to scrutinise the calculation of the economic rate of return given in Annex 9a-d. The economic rate of return of the project is 31,5 per cent. When this is compared with the Government borrowing rate of 8 per cent (the required rate of return) it can be concluded that the project is very viable. The net social gain at the present value as per this calculations is Z$18,2 million. This is a measure of the net contribution of the project to

national income.

5.7 Strengths, Weaknesses, Opportunities and Threats

This section puts the first five chapters in perspective by linking up all the critical elements which influence the success of this project. It is a prelude to project justification. The major strengths, weaknesses, opportunities and threats as they relate to cassava production in the study area given below. This Section summarises the study findings into a framework for strategic analysis.

5.7.1. Strengths

The major strengths of this project are as follows:

1. Human and physical factors of production are available;
2. There are ideal soils and climate for the production of the crop;
3. Government policy favours the production of the crop;
4. Zimbabwe has the technology for the production and processing of the crop;
5. There are sound implementation structures which guarantee its success;
6. It enjoys Donor support;
7. The crop has a wide use of ranges at both the domestic and industrial use; and,
8. Cassava production in Zimbabwe is financially viable.

5.7.2 Weaknesses

The major weaknesses of the project are as follows:

1. Cassava will be produced as a secondary crop and this compromises farmers commitment to the crop;
2. It competes for labour and other resources with other crops;
3. Most of the available varieties are vulnerable to diseases, have high gestation periods and low yields and therefore not very suitable for Zimbabwe;
4. It is regarded as an orphan crop by both researchers, farmers and extension; and,
5. A shorter growing season will be adopted and this results in lower yields.
6. Cassava has a low protein and calcium content hence cassava based diets need protein and calcium suppliments.

5.7.3. Opportunities

The opportunities for the production and processing of cassava are as follows:

1. High and rising prices of grain make cassava a cheaper substitute;
2. The current policy of diversification offers it opportunities for growth; and,
3. Its wide range of uses offers opportunities for growth.

5.7.4. Threats

The project is threatened by the following:

1. Zimbabweans do not currently have a taste for the crop and this threatens its adoption. This should be viewed in the context of the consumer analysis given in section 5.3.1.
2. Diseases are a major threat to viable production of the crop.
3. Cassava contains poisonous cyanogenic glucosides which if consumed above certain levels may be lethal.

In conclusion it can be inferred that in weighing the threats, opportunities. strengths and weaknesses the strengths and opportunities seem to outweigh the threats and weaknesses thereby offering scope for success.

5.8 Benefits

5.8.1 Higher standard of living

Higher employment levels and incomes, improved food security (nutrition) and enhanced economic activities will lead to a higher standard of living in the project areas. Details of projected increases in these parameters are given in the log-frame, annex 4.

5.8.2 Employment

Production of cassava in Zimbabwe is expected to create a substantial number of new jobs. It is estimated that more than 50 new jobs will be created per province in the formal sector. In addition a substantial number of jobs will be created downstream through the multiplier effect. Within the smallholder farming community a significant reduction in underemployment is expected. Furthermore, it will create income generating activities for the communal farming sector.

5.8.3 Nutrition and Food Security

The production of cassava will improve the nutrition of communal populations. This will be through increased consumption of meat and meat products arising from higher production, and increased consumption of cassava arising from increased overall production of food crops. Furthermore, higher incomes arising thereof will stimulate diversification in consumption.

5.8.4 Revenue

The economic analysis indicates that cassava production in Zimbabwe will increase national income by over Z$18 million at the present value. Within this context the revenue base will also increase. Thus, government is expected to benefit from the collection of additional tax revenues through company and sales tax from new investments.

5.8.5 Soil Conservation

Cassava has a large foliage which serves as a wind shield. Thus, owing to its large foliage cassava will drastically reduce wind erosion in the communal areas.

5.8.6 Higher Overall Crop Production

Cassava will be produced in contour ridges/alleys as a secondary crop. This integration of cassava with other crops which does not entail displacement of one crop will increase overall crop production in the communal areas.

5.8.7 Provision of Forage

Cassava leaves are highly palatable to livestock and human beings. Thus, in addition to the use of the cassava tuber as a stockfeed, its stover will provide forage for livestock.

5.8.8 Increased Export Earnings

The substitution of maize with cassava will pave way for a higher maize surplus. This will provide scope for increasing maize exports.

5.9 Conclusion

In this Chapter the study carries out a thorough feasibility analysis of the proposed cassava project. Technical aspects which influence the success of cassava production such as botany, climate, soils, diseases, varietal selection and planting orientation are analysed. The analysis shows that although these factors are critical to the success of cassava production they as such do not severely constrain the success of the project. Secondly, a marketing analysis is presented. This analysis attempts to assess the impact of critical marketing aspects on the success of the project. Lack of consumer taste and preferences is identified as one of the major constraints on the adoption of cassava.

The main appraisal analysis presented is the financial and economic analyses. A budget for cassava production is presented in analysing the cost-benefit for cassava production. The test parameters used are net profit, return per dollar (Z$) variable cost and gross

margins. These budgets are used to build up cashflows for the stockfeed factories and whole project or Government perspective. In the analysis it is demonstrated that cassava production and stockfeed processing are very viable enterprises. Similarly the economic analysis shows that the project is very viable. However, the Government perspective of the analysis indicates that the project is not very viable mainly because of high expenditures on study tours, travel and subsistence, field days and trucks.

In addition a SWOT analysis is presented in order to provide a qualitative summary of the results of interviews with various stakeholders and guide on strategic options. It highlights problems and opportunities which is crucial in strategic policy formulation. From this analysis the issue of consumer taste and preferences for cassava remains nagging. Nevertheless, the proposed project's benefits which are likely to counter that problem include improvement of standard of living, employment ceration, enhanced nutrition and food security, revenue generation, soil conservation, higher overall crop production and increased export earnings.

CHAPTER SIX

CONCLUSIONS

6.1 Conclusions and Policy Implications

This study evaluates the viability of cassava production as a food security option. It analyses the food security concept. From this analysis it emerges that food security is underpinned by supply, effective demand, nutritional balance and sustenance in supply and demand. A review of the global food security situation reveals that the situation is pathetic. The food security problem is envisaged to deteriorate as the world population increases. With respect to the focal point, Zimbabwe, the study indicates that the situation is equally bad. Although the country has signicantly increased food production in the rural areas since 1980 there is still widespread poverty and food insecurity. Malnutrition is rampant.

The study further highlights that access to means of production (land, labour and capital), geographic location, incomes and droughts have a major influence on food security in Zimbabwe. In this regard it will be appreciated that previous food security policy strategies were geared towards addressing the aforementioned problems. These strategic options include food aid, food subsidies, irrigation development, development of marketing infrastructure, resettlement, minimum wage policies and establishment of strategic reserves, price controls, free inputs, etc. These options have been confronted with the problem of disequity as is the case with smallholder maize miracle and lack of sustainability as is the case

with food reserves, early resettlement schemes, some irrigation schemes and others. The challenge to policy makers is therefore to formulate food security policy strategies which improve household food security, reduce social imbalances and are sustainable. The advocacy for cassava production aims to achieve these goals.

The cassava option seeks to address food security problems related to droughts, resource imbalances, lower incomes and geographical locations. It further seeks to adress the problem of social imbalance (disequity) and sustainability. It adopts a three pronged strategy which invloves:

* Producing a drought tolerant and low input crop which thrives in various environmental conditions including marginal areas;
* Producing a cash crop (cassava which is used in stockfeed manufacturing) hence give rural families greater flexibility to buy other food staffs; and,
* Produce a cheap main stockfeed ingredient hence increase the scope for producing meat cost effectively making it affordable with the consequent effect of increasing meat consumption, thus improve food security from a nutritional balance point of view.

Despite being currently a minor crop in Zimbabwe cassava is one of the most widely grown crops worldwide. It is of major economic and social significance. In the evaluation process the study analyses the suitability of Mashonaland Central and Masholand West for cassava production. It emerges that the physical, climatic, soil and demographic features do not significantly constrain cassava production. Furthermore, the study also highlights that cassava production can be successfully intergated into the current farming

systems. However, the long production cycle of cassava presents rotational problems. This study suggests the use of retired land or alleys (semi-intensive mode of production) for this crop to deal with this problem. Nevertheless, more work on the integration of cassava with the current crops grown in Zimbabwe needs to be carried out.

The study highlights building up cassava production and the establishment of stockfeed mills as the main elements of the proposed cassava project. The growth in cassava production is based on the classical adoption curve. The management of cassava production will largely be an affair of farmers, Department of Research and Specialist Services, and Agritex. Stockfeed mills will be established under a "Built Operate and Trasnfer" and as such will initially be owned by Ministry of Lands and Agriculture with an autonous management structure put in place to run the enterprises. The total cost of the project is Z$19,24 million of which capital items account for Z$11,2 million. The proposed management structures are meant to enhance sustenance.

The study carries out a thorough feasibility analysis of the proposed cassava project. This analysis is within the context of assessing the viability of cassava as a food security option. Technical aspects which influence the success of cassava production such as botany, climate, soils, diseases, varietal selection and planting orientation are analysed. The analysis shows that although these factors are critical to the success of cassava production they as such do not severely constrain the success of cassava production in Zimbabwe. However, as has been indicated above the long production cycle of cassava makes cassava production less compatible to current farming practices. Secondly, a marketing analysis is presented. This analysis attempts to assess the impact

of critical marketing aspects on the success of the project. Lack of consumer taste and preferences is identified as one of the major constraints on the adoption of cassava. The study proposes the piloting of cassava production in two provinces as a risk management strategy in this area. However, as this proceeds, further studies on cassava consumption should be an integral part of the future work on cassava production in Zimbabwe.

The main economic appraisal tools used in the study are the financial and economic analyses. A budget for cassava production is presented in analysing the cost-benefit for cassava production. The test parameters used are net profit, return per dollar (Z$) variable cost, gross margins, net present value (NPV), internal rate of return (IRR) and economic rate of return (ERR). The cassava enterprise budgets are used to build up cashflows for the stockfeed factories and whole project or Government perspective. In the analysis it is amply demonstrated that cassava production and stockfeed processing are very viable enterprises. Similarly the economic analysis shows that the project is very viable. However, the Government perspective of the analysis indicates that the project is not very viable mainly because of high expenditures on study tours, travel and subsistence, field days and trucks.

In addition a SWOT analysis is presented in order to provide a qualitative summary of the results of interviews with various stakeholders. It highlights problems and opportunities and this is crucial for strategic policy formulation. From this analysis the issues of consumer taste and preferences for cassava, and longer production cycle remain nagging. However, cassava production has a lot of potential. In addition it offers several benefits which are likely to counter the aforementioned problems and these include improvement of standard of living, employment generation, enhanced

nutrition and food security, revenue generation, soil conservation, higher overall crop production and increased export earnings.

The general conclusions are that cassava is a viable food security option for Zimbabwe. The production of cassava is as a strategic option for sustaining food security. It has a multiplicity of uses and in terms of food security it offers greater flexibility in that it can be consumed directly, it can be easily marketed with proceeds being used for buying other food items, it can be used to produce a variety of foods, and it can be used in meat production (another important element of food security). It is easy and cheap to produce which enhance access. In addition, and unlike most other crops it is drought tolerant, it is not input intensive and adapts to a wide range of environmental conditions. And, although it is currently not of major significance in Zimbabwe, it is widely produced worldwide for human and animal consumption. Millions of people worldwide thrive on it. Thus, Zimbabwe stands to benefit from its production as well.

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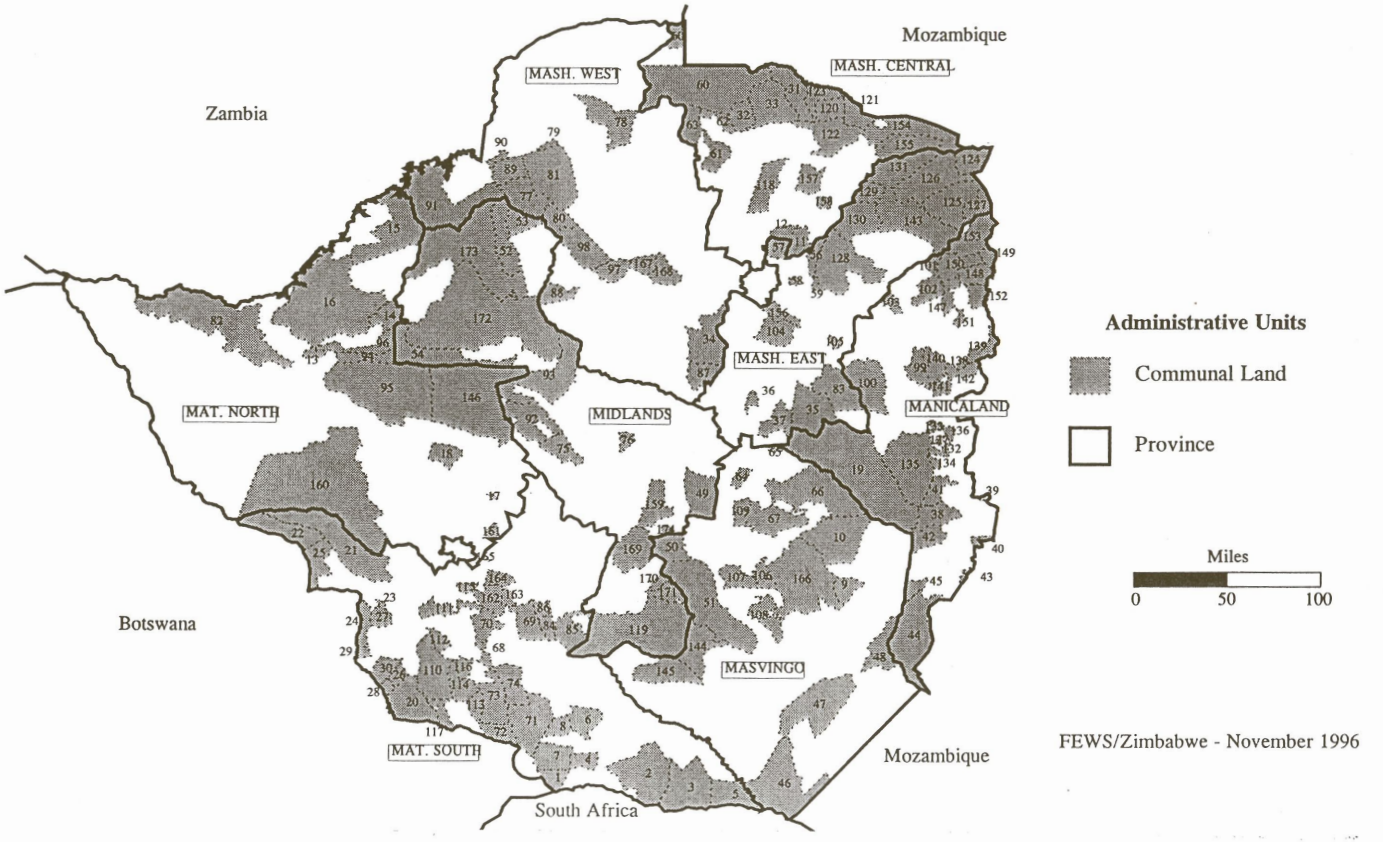
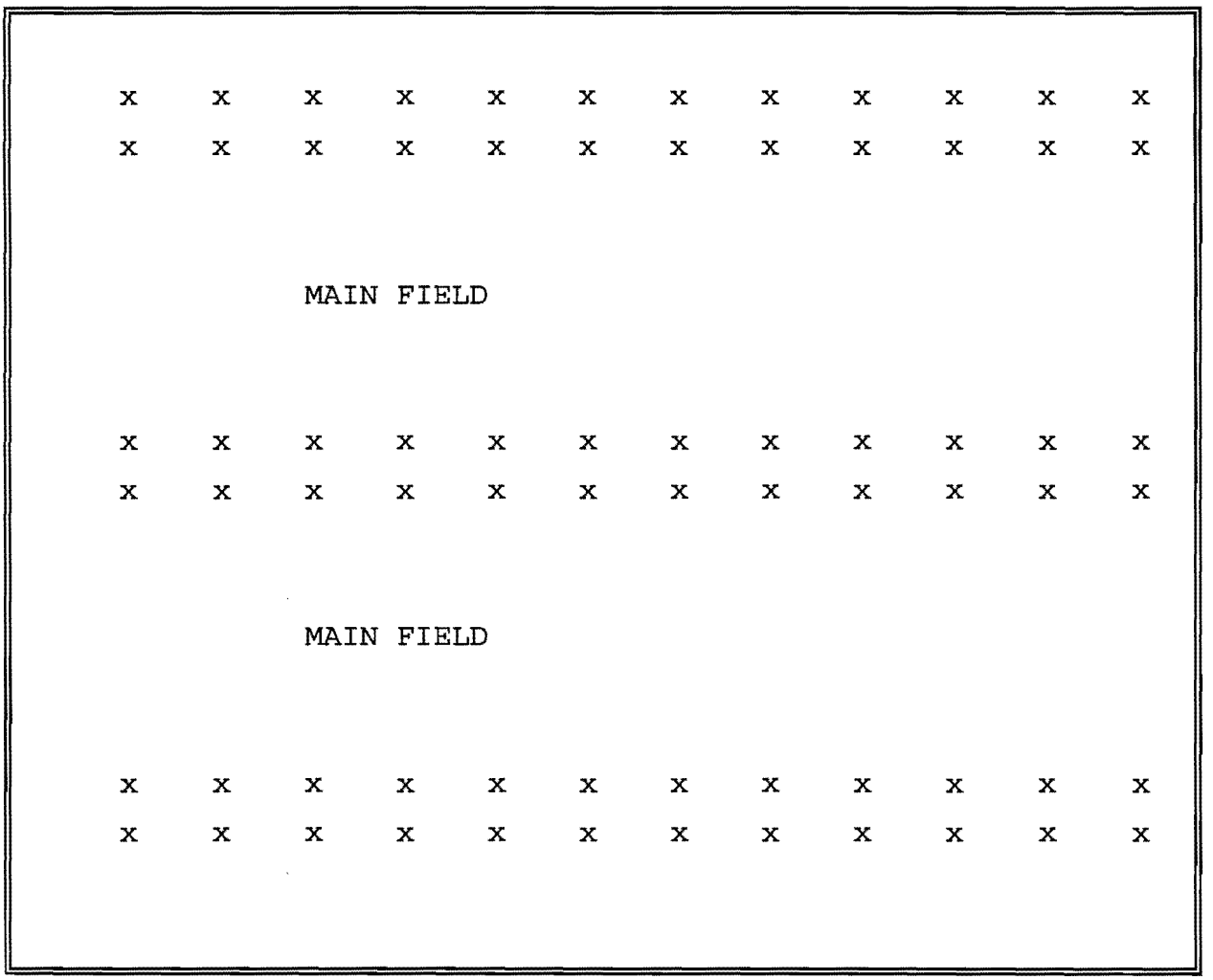
Annex 1

Zimbabwe Communal Lands Reference Map



Annex 2

The proposed plan of production for cassava



X X Cassava rows

Average size of plot per household = 2 acres

Average length of one acre = 40 metres

Average width of one acre = 10 metres

Number of lines per alley or contour ridge = 2

Intercrop spacing = 0.8 metres

Number of plants per line = 50

Number of plants per alley or ridge = 100

Average weight of tuber = 0,2kg

Average number of tubers per plant = 7

Average yield per plant =0,2 x 7 =1,4kg

Production per 2 acres =1,4 x 100 x3 = 420kg

Estimates are based on the sigmoid curve.

Annex 3

Diagram of the processing mill

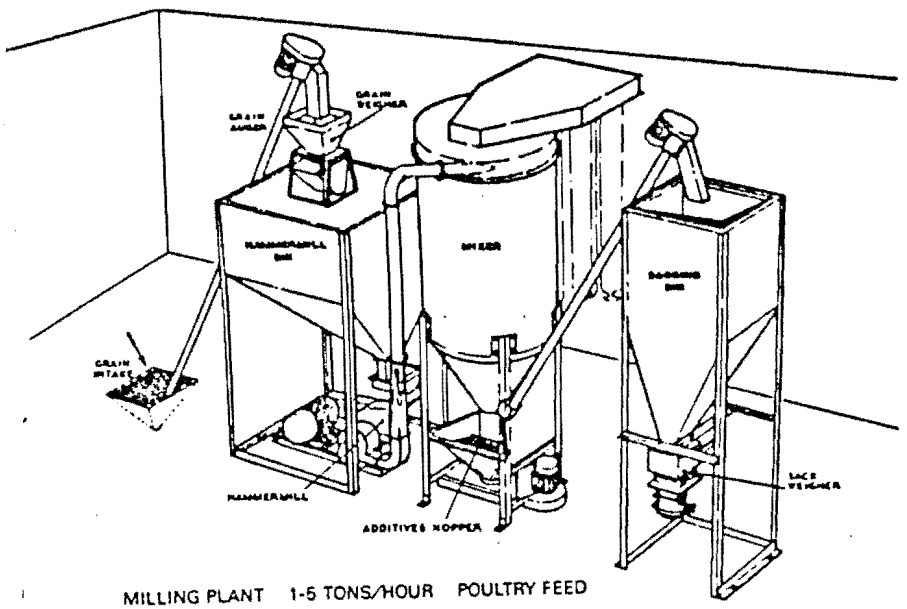
FEED MILLS

ONE to EIGHT TONS / HOUR

ANIMAL FEED PLANT

POULTRY...PIGS...CATTLE...SHEEP...HORSES...RABBITS

GRAIN INTAKE AND WEIGHING-GRINDING - MIXING
WEIGHING AND BAGGING - SACK STITCHING



MILLING PLANT 1-5 TONS/HOUR POULTRY FEED

Annex 4

Logframe : Cassava Project

Narrative Summary	Objective Verifiable Indicator	Means of Verification	Assumptions
Goals Increased food security	- Overall cassava consumption increased to 50 000mt by year 4	- National Statistics from Central Statistical Office - Agricultural Statistical Bulletin	- Macro-stability prevails - Increased production of cassava will enhance cassava consumption. - Input and output prices remain stable
Purpose To increase cassava production for human and livestock consumption.	- Cassava production increased to 134 203MT by year 4.	- Project Reports	- Farmers are motivated - Livestock producers switch from more expensive maize feeds to cassava feeds. - Livestock industry continues to grow
Output 1. Cassava 2. Stockfeeds	1. Cassava production to increase from 3 645mt in year 1 to 134 203mt by year 4 2. Stockfeed production to increase from 20 000t in year 1 to 150 000mt in year 4	1.Project records 2.Factory records	- Funds are made available - All inputs are procured on time - All pre-conditions are met

Inputs			
Finance/Capital	1. 4 x 7 tonne truck 4000000 2. 2 x Stockfeed Mills 2400000 3. 6 X field days 180000 4. 1 x twin cab pick up 800000 5. Travel and Subsistence 1500000 6. Accommodation 4000000 7. Study Tours 80000	Project budgets and reports	- All funds are made available on time
Labour	8. 2 x Mill managers 400000 9. 2 x Mill clerks 120000 10 2 x Bookkeepers 240000 11. 20 General hands 480000 12. Fuel 400000 13. Maintenance 2400000		
Land	11. nil		
Agricultural inputs	12. Fertilisers, planting material, agro-chemicals,etc. 1500000		

ANNEX 5 : SCHEDULE OF ACTIVITIES

ACTIVITY	TIME FRAME	RESPONSIBILITY
Mobilisation of funds	First 3 Months	Policy and Planning Division
Establishment of an Implementation Committee	First Month	ARDA and, Policy and Planning Division
Procurement of Vehicles	Fourth Month	
Identification of Beneficiaries	Fifth Month	AGRITEX and Local Authorities
Expansion of the Multiplication and Distribution Exercise	Sixth Month	DR&SS and AGRITEX
Extension on Production	Sixth Month	AGRITEX
Employment of factory Managers	Sixth Month	Committee/Min of Lands and Agriculture
Construction of Factory Buildings	Eighth Month	Factory Manager
Demonstrations and Training on cassava processing and utilisation	4 Months After Planting	DR&SS and AGRITEX
Procurement of Mills	Tenth Month	Manager

Annex 6A

Financial Analysis

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Investment Plan \ Enterprise Budget

Variable Costs			Unit	Quantity/Ha	Rate/Cost	Total Cost/Value
	Labour					
		Prior to Harvest	Man days'	2	50	100
		Harvesting and Marketing	Man days'	2	50	100
	Tractor					
		Prior to Harvest	Hours	0	250	0
		Harvest and Marketing	Hours	0	250	0
	Fertiliser					
		10:10:20	Kg	4.2	2.6	10.92
	Planting Material		Stems	300	0.2	60
	Herbicides		Kg	2		0
	Insecticides		Kg			0
	Insurance		$			0
	Levy		$			0
	Sundries		$			0
	Total Variable Costs		$			270.92
	Gross Income		$	0.42	2000	840
	Gross Margin		$			569.08

Annex....6 B

CASHFLOWS FOR STOCKFEED FACTORIES

					Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capital Outlay															
	Mills			2400000	2400000										
	4 x 7 Tonners			4000000	4000000										
	1 x Pick-up			600000	600000										
	Accomodation and Offices			4000000	4000000										
Running Costs and Overheads															
	Salaries:	2 Managers		420000		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
		Clerks		120000		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
		B/Keepers		240000		240000	240000	240000	240000	240000	240000	240000	240000	240000	240000
		G/Hands		480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
	Maintenance			480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
	Fuel			80000		80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
	Telephones			5000		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
	Power			414720		414720	414720	414720	414720	414720	414720	414720	414720	414720	414720
	Cost of Raw Materials		Ratios												
		Cassava	0.5	2000		505197	3094245	10910869.2	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8
		Soyabeans cake	0.48	4850		1176098.616	7203402.36	25400503.5	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
		Other ingredients	0.02	5000		50519.7	309424.5	1091086.92	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58
Total Costs					11000000	3971535.316	12846791.86	39642179.62	66002356.72	66002356.72	66002356.72	66002356.72	66002356.72	66002356.72	66002356.72
Gross Income				3500	0	3536379	21659715	76376084.4	130203750.8	130203750.8	130203750.8	130203750.8	130203750.8	130203750.8	130203750.8
Net Cashflow					-11000000	-435156.316	8812923.14	36733904.78	64201393.88	64201393.88	64201393.88	64201393.88	64201393.88	64201393.88	64201393.88
Discount Rate					1	0.7	0.49	0.34	0.24	0.17	0.12	0.08	0.06	0.04	0.03
Discounted Cashflows					-11000000	-304609.4212	4318332.339	12489527.63	15408334.53	10914236.96	7704167.265	5136111.51	3852083.633	2568055.755	1926041.816
Net Present Value					28753347.27										
Internal Rate of Return					0.504462453										

Annex ...6.C

FINANCIAL ANALYSIS - GOVERNMENT PERSPECTIVE

					Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capital Outlay			Cumulative Adoption (H/holds)			3645	22325	78722	134203	134203	134203	134203	134203	134203	134203
	Mills				2400000										
	4 x 7 Tonners				4000000										
	1 x Pick-up				600000										
	Accomodation and Offices				4000000										
	Travel and Subsistence				1500000										
	Study Tours				800000										
Running Costs															
	Planting Material			60		218700	1339500	4723320	8052180	8052180	8052180	8052180	8052180	8052180	8052180
	Labour - preharvesting			100		364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
	Labour - harvesting			100		364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
	Fertiliser			10.92		39803.4	243789	859644.24	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76
	Salaries:	2 Managers		420000		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
		Clerks		120000		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
		B/Keepers		240000		240000	240000	240000	240000	240000	240000	240000	240000	240000	240000
		G/Hands		480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
	Maintenance			480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
	Fuel			80000		80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
	Telephones			5000		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
	Power			414720		414720	414720	414720	414720	414720	414720	414720	414720	414720	414720
	Cost of Raw Materials		Ratios												
		Cassava	0.5	2000		505197	3094245	10910869.2	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8
		Soyabeans cake	0.48	4850		1176098.616	7203402.36	25400503.5	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
		Other ingredients	0.02	5000		50519.7	309424.5	1091086.92	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58
Total Costs					13300000	4959038.716	18895080.86	66666543.86	102360633.5	102360633.5	102360633.5	102360633.5	102360633.5	102360633.5	102360633.5
Gross Income				3500	0	3536379	21659715	76376084.4	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6
Net Cashflow					-13300000	-1422659.716	2764634.14	9709540.54	27843117.12	27843117.12	27843117.12	27843117.12	27843117.12	27843117.12	27843117.12
Discount Rates					1	0.7	0.49	0.34	0.24	0.17	0.12	0.08	0.06	0.04	0.03
Discounted Cashflows					-13300000	-995861.8012	1354670.729	5238223.784	6682348.108	4733328.91	3341174.054	2227449.369	1670587.027	1113724.685	835293.5135
Net Present Value					3391266.122										
Internal Rate of Return					0.14684831										

Sensitivity Analysis - Yield Decline of 30 Per Cent

Investment Plan \Enterprise Budget

Variable Costs		Unit	Quantity/Ha	Rate/Cost	Total Cost/Value
Labour					
	Prior to Harvest	Man days'	2	50	100
	Harvesting and Marketing	Man days'	2	50	100
Tractor					
	Prior to Harvest	Hours	0	250	0
	Harvest and Marketing	Hours	0	250	0
Fertiliser					
	10:10:20	Kg	4.2	2.6	10.92
Planting Material		Stems	300	0.2	60
Herbicides		Kg	2		0
Insecticides		Kg			0
Insurance		$			0
Levy		$			0
Sundries		$			0
Total Variable Costs		$			270.92
Gross Income		$	0.294	2000	588
Gross Margin		$			317.08

CASHFLOWS FOR STOCKFEED FACTORIES

Capital Outlay			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Mills		2400000	2400000										
4 x 7 Tonners		4000000	4000000										
1 x Pick-up		600000	600000										
Accomodation and Offices		4000000	4000000										
Running Costs and Overheads													
Salaries:	2 Managers	420000		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
	Clerks	120000		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
	B/Keepers	240000		240000	240000	240000	240000	240000	240000	240000	240000	240000	240000
	G/Hands	480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Maintenance		480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Fuel		80000		80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
Telephones		5000		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Power		414720		414720	414720	414720	414720	414720	414720	414720	414720	414720	414720
Cost of Raw Materials	Ratios												
Cassava	0.5	2000		505197	3094245	10910869.2	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8
Soyabeans	0.48	4850		1176098.6	7203402.36	25400503.5	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
Other ingre	0.02	5000		50519.7	309424.5	1091086.92	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58
Total Costs			11000000	3971535.3	12846791.86	39642179.62	66002356.72	66002356.72	66002356.72	66002356.72	66002356.72	66002356.72	66002356.72
Gross Income		3500	0	3536379	21659715	78376084.4	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6
Net Cashflow			-11000000	-435156.3	8812923.14	38733904.78	64201393.88	64201393.88	64201393.88	64201393.88	64201393.88	64201393.88	64201393.88
Discount Rate			1	0.7	0.49	0.34	0.24	0.17	0.12	0.08	0.06	0.04	0.03
Discounted Cashflows			-11000000	-304609.4	4318332.339	12489527.63	15408334.53	10914236.96	7704167.265	5136111.51	3852083.633	2568055.755	1926041.816
Net Present Value			28753347.3										
Internal Rate of Return			0.50446245										

Annex.....7C

FINANCIAL ANALYSIS - GOVERNMENT PERSPECTIVE

				Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capital Outlay	Cumulative Adoption (H/holds)				3645	22325	78722	134203	134203	134203	134203	134203	134203	134203
Mills				2400000										
4 x 7 Tonners				4000000										
1 x Pick-up				600000										
Accomodation and Offices				4000000										
Travel and Subsistence				1500000										
Study Tours				800000										
Running Costs														
Planting Material			60		218700	1339500	4723320	8052180	8052180	8052180	8052180	8052180	8052180	8052180
Labour - preharvesting			100		364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
Labour - harvesting			100		364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
Fertiliser			10.92		39803.4	243789	859844.24	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76
Salaries:	2 Managers		420000		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
	Clerks		120000		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
	B/Keepers		240000		240000	240000	240000	240000	240000	240000	240000	240000	240000	240000
	G/Hands		480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Maintenance			480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Fuel			80000		80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
Telephones			5000		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Power			414720		414720	414720	414720	414720	414720	414720	414720	414720	414720	414720
Cost of Raw Materials	Ratios													
	Cassava	0.5	2000		505197	3094245	10910869.2	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8	18600535.8
	Soyabeans	0.48	4850		1176098.6	7203402.36	25400503.5	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
	Other ingre	0.02	5000		50519.7	309424.5	1091086.92	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58
Total Costs				13300000	4959038.7	18895080.86	66969543.86	102360633.5	102360633.5	102360633.5	102360633.5	102360633.5	102360633.5	102360633.5
Gross Income			3500	0	3536379	21659715	76376084.4	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6
Net Cashflow				-13300000	-1422660	2764634.14	9406540.54	27843117.12	27843117.12	27843117.12	27843117.12	27843117.12	27843117.12	27843117.12
Discount Rates				1	0.7	0.49	0.34	0.24	0.17	0.12	0.08	0.06	0.04	0.03
Discounted Cashflows				-13300000	-995861.8	1354670.729	5238223.784	6682348.108	4733329.91	3341174.054	2227449.369	1670587.027	1113724.685	835293.5135
Net Present Value				3391266.12										
Internal Rate of Return				0.14684831										

Senitivity Analysis - Cassava Price Decline of 50 Per cent

Investment Plan and Cashflow Budget

Variable Costs			Unit	Quantity/Ha	Rate/Cost	Total Cost/Value
	Labour					
		Prior to Harvest	Man days'	2	50	100
		Harvesting and Marketing	Man days'	2	50	100
	Tractor					
		Prior to Harvest	Hours	0	250	0
		Harvest and Marketing	Hours	0	250	0
	Fertiliser					
		10:10:20	Kg	4.2	2.6	10.92
	Planting Material		Stems	300	0.2	60
	Herbicides		Kg	2		0
	Insecticides		Kg			0
	Insurance		$			0
	Levy		$			0
	Sundries		$			0
	Total Variable Costs		$			270.92
	Gross Income		$	0.42	1250	525
	Gross Margin		$			254.08

Annex.... 88

CASHFLOWS FOR STOCKFEED FACTORIES

Capital Outlay			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Mills		2400000	2400000										
4 x 7 Tonners		4000000	4000000										
1 x Pick-up		600000	600000										
Accomodation and Offices		4000000	4000000										
Running Costs and Overheads													
Salaries:	2 Managers	420000		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
	Clerks	120000		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
	B/Keepers	240000		240000	240000	240000	240000	240000	240000	240000	240000	240000	240000
	G/Hands	480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Maintenance		480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Fuel		80000		80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
Telephones		5000		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Power		414720		414720	414720	414720	414720	414720	414720	414720	414720	414720	414720
Cost of Raw Materials	Ratios												
	Cassava	0.5	1250		315748.13	1933903.1	6819293.3	11625334.88	11625334.88	11625334.88	11625334.88	11625334.88	11625334.88
	Soyabeans	0.48	4850		1176098.6	7203402.4	25400503	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
	Other ingre	0.02	5000		50519.7	309424.5	1091086.9	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58
Total Costs				11000000	3782086.4	11686450	35550604	59027155.8	59027155.8	59027155.8	59027155.8	59027155.8	59027155.8	59027155.8
Gross Income			3500	0	3536379	21659715	76376084	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6
Net Cashflow				-11000000	-245707.4	9973265	40825481	71176594.8	71176594.8	71176594.8	71176594.8	71176594.8	71176594.8	71176594.8
Discount Rate				1	0.7	0.49	0.34	0.24	0.17	0.12	0.08	0.06	0.04	0.03
Discounted Cashflows				-11000000	-171995.2	4886899.9	13880663	17082382.75	12100021.12	8541191.376	5694127.584	4270595.688	2847063.792	2135297.844
Net Present Value				33214155.4										
Internal Rate of Return				0.55202293										

Annex....8C

FINANCIAL ANALYSIS - GOVERNMENT PERSPECTIVE

			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capital Outlay	Cumulative Adoption (H/holds)			3645	22325	78722	134203	134203	134203	134203	134203	134203	134203
Mills			2400000										
4 x 7 Tonners			4000000										
1 x Pick-up			600000										
Accomodation and Offices			4000000										
Travel and Subsistence			1500000										
Study Tours			800000										
Running Costs													
Planting Material			60	218700	1338500	4723320	8052180	8052180	8052180	8052180	8052180	8052180	8052180
Labour - preharvesting			100	364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
Labour - harvesting			100	364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
Fertiliser			10.92	39803.4	243789	859644.24	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76	1465496.76
Salaries:	2 Managers		420000	420000	420000	420000	420000	420000	420000	420000	420000	420000	420000
	Clerks		120000	120000	120000	120000	120000	120000	120000	120000	120000	120000	120000
	B/Keepers		240000	240000	240000	240000	240000	240000	240000	240000	240000	240000	240000
	G/Hands		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Maintenance			480000	480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Fuel			80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
Telephones			5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Power			414720	414720	414720	414720	414720	414720	414720	414720	414720	414720	414720
Cost of Raw Materials	Ratios												
	Cassava	0.5	1250	315748.13	1933903.1	6819293.3	11625334.88	11625334.88	11625334.88	11625334.88	11625334.88	11625334.88	11625334.88
	Soyabeans	0.48	4850	1176098.6	7203402.4	25400503	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
	Other ingre	0.02	5000	50519.7	309424.5	1091086.9	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58	1860053.58
Total Costs				13300000	4769589.8	17734739	56877968	95385432.56	95385432.56	95385432.56	95385432.56	95385432.56	95385432.56	95385432.56
Gross Income			3500	0	3536379	21659715	76376084	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6	130203750.6
Net Cashflow				-13300000	-1233211	3924976	19498116	34818318.04	34818318.04	34818318.04	34818318.04	34818318.04	34818318.04	34818318.04
Discount Rates				1	0.7	0.49	0.34	0.24	0.17	0.12	0.08	0.06	0.04	0.03
Discounted Cashflows				-13300000	-863247.6	1923238.2	6629359.6	8356396.33	5919114.067	4178198.165	2785465.443	2089099.083	1392732.722	1044549.541
Net Present Value				7852074.29										
Internal Rate of Return				0.21296921										

Annex.....9A

Economic Analysis - Conversions for tradables

	Mills	7 Tonne Trucks			Fertiliser	Other Ingredients
Project Cost	2400000	4000000	600000	48000	2.6	5000
Freight and Insurance from Border to site	9000	9000	750	0	0.75	6
Clearance charges	12000	20000	3000	240	0.013	25
Local Content %	0	0.2	0.2	0	0.75	0
CIF + Taxes and Duties	2379000	3171000	476250	47760	-0.113	4969
Taxes	0	0.4	0	0.15	0	0.15
CIF+ Duties	2379000	2265000	476250	41530.43478	-0.113	4320.869565
Duties	0	0.4	1.15	0.11	0.05	0.25
Efficient Price	2379000	1617857.143	221511.6279	37414.80611	-0.107619048	3456.695652
Standard conversion factor	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333
Local content	21000	829000	123750	240	2.713	31
Shadow price of local component	17500	690833.3333	103125	200	2.260833333	25.83333333
Economic Prices/Values	2396500	2308690.476	324636.6279	37614.80611	2.153214286	3482.528986

	General Labour	Electricity	Soya Cake	Cassava-Prod	Managers	B/Keepers	Clerks	Cassava - F	Accomodation	Telephone
Financial Value	480000	414720	4850	2000	420000	240000	120000	3500	4000000	5000
Opportunity Cost	204000	414720	3000	2000	294000	192000	102000	3500	2000000	4250
Standard Conversion factor	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333	0.833333333
Shadow price/Economic Price	170000	345600	2500	1666.666667	245000	160000	85000	2916.666667	1666666.667	3541.666667

Variable Costs		Unit	Quantity/ha	Rate/Cost	Total Cost/Value
Labour					
	Prior to Harvest	Man days'	2	50	100
	Harvesting and Marketing	Man days'	2	50	100
Tractor					
	Prior to Harvest	Hours	0	250	0
	Harvest and Marketing	Hours	0	250	0
Fertiliser					
	10:10:20	Kg	4.2	2.1532143	9.0435
Planting Material		Stems	300	0.2	60
Herbicides		Kg	2		0
Insecticides		Kg			0
Insurance		$			0
Levy		$			0
Sundries		$			0
Total Variable Costs		$			269.0435
Gross Income		$	0.42	2000	840
Gross Margin		$			570.9565

Annex.... 9C

CASHFLOWS FOR STOCKFEED FACTORIES

Capital Outlay			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Mills		2396500	2396500										
4 x 7 Tonners		2308690.5	2308690.48										
1 x Pick-up		324636.63	324636.628										
Accomodation and Offices		1666666.7	1666666.67										
Running Costs and Overheads													
Salaries:	2 Managers	245000		245000	245000	245000	245000	245000	245000	245000	245000	245000	245000
	Clerks	85000		85000	85000	85000	85000	85000	85000	85000	85000	85000	85000
	B/Keepers	160000		160000	160000	160000	160000	160000	160000	160000	160000	160000	160000
	G/Hands	170000		170000	170000	170000	170000	170000	170000	170000	170000	170000	170000
Maintenance		480000		480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Fuel		37614.806		37614.806	37614.806	37614.806	37614.80611	37614.80611	37614.80611	37614.80611	37614.80611	37614.80611	37614.80611
Telephones		245000		245000	245000	245000	245000	245000	245000	245000	245000	245000	245000
Power		345600		345600	345600	345600	345600	345600	345600	345600	345600	345600	345600
Cost of Raw Materials	Ratios												
	Cassava	0.5	1666.6667	420997.5	2578537.5	8092391	15500446.5	15500446.5	15500446.5	15500446.5	15500446.5	15500446.5	15500446.5
	Soyabeans	0.48	4850	1176098.6	7203402.4	25400503	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
	Other ingre	0.02	3482.529	35187.264	215515.96	759948.36	1295538.101	1295538.101	1295538.101	1295538.101	1295538.101	1295538.101	1295538.101
Total Costs				6696493.77	3400498.2	11765671	37021058	61866246.75	61866246.75	61866246.75	61866246.75	61866246.75	61866246.75	61866246.75
Gross Income			2916.6667	0	2946982.5	18049763	63646737	108503125.5	108503125.5	108503125.5	108503125.5	108503125.5	108503125.5	108503125.5
Net Cashflow				-6696493.8	-453515.7	6284081.9	26625679	46636878.75	46636878.75	46636878.75	46636878.75	46636878.75	46636878.75	46636878.75
Discount Rate				1	0.917	0.842	0.772	0.708	0.65	0.596	0.547	0.502	0.46	0.422
Discounted Cashflows				-6696493.8	-415873.9	5291205.4	20555024	33018910.16	30313971.19	27795579.74	25510372.68	23411713.13	21452964.23	19680762.83
Net Present Value				107185369										
Internal Rate of Return				1.05958417										

Annex ...9D

ECONOMIC ANALYSIS - GOVERNMENT PERSPECTIVE

				Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capital Outlay	Cumulative Adoption (H/holds)				3645	22325	78722	134203	134203	134203	134203	134203	134203	134203
Mills				2396500										
4 x 7 Tonners				2308690.48										
1 x Pick-up				324636.628										
Accomodation and Offices				1666666.67										
Travel and Subsistence				1500000										
Study Tours				800000										
Running Costs														
Planting Material				60	218700	1339500	4723320	8052180	8052180	8052180	8052180	8052180	8052180	8052180
Labour - preharvesting				100	364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
Labour - harvesting				100	364500	2232500	7872200	13420300	13420300	13420300	13420300	13420300	13420300	13420300
Fertiliser				9.0435	32963.558	201896.14	711922.41	1213664.831	1213664.831	1213664.831	1213664.831	1213664.831	1213664.831	1213664.831
Salaries:	2 Managers			245000	245000	245000	245000	245000	245000	245000	245000	245000	245000	245000
	Clerks			85000	85000	85000	85000	85000	85000	85000	85000	85000	85000	85000
	B/Keepers			160000	160000	160000	160000	160000	160000	160000	160000	160000	160000	160000
	G/Hands			170000	170000	170000	170000	170000	170000	170000	170000	170000	170000	170000
Maintenance				480000	480000	480000	480000	480000	480000	480000	480000	480000	480000	480000
Fuel				37614.806	37614.806	37614.806	37614.806	37614.80611	37614.80611	37614.80611	37614.80611	37614.80611	37614.80611	37614.80611
Telephones				245000	245000	245000	245000	245000	245000	245000	245000	245000	245000	245000
Power				345600	345600	345600	345600	345600	345600	345600	345600	345600	345600	345600
Cost of Raw Materials	Ratios													
	Cassava	0.5	1666.6667		420997.5	2578537.5	9092391	15500446.5	15500446.5	15500446.5	15500446.5	15500446.5	15500446.5	15500446.5
	Soyabeans	0.48	4850		1176098.6	7203402.4	25400503	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34	43302047.34
	Other ingre	0.02	3482.529		35187.264	215515.96	759948.36	1295538.101	1295538.101	1295538.101	1295538.101	1295538.101	1295538.101	1295538.101
Total Costs				8996493.77	4381161.7	17772067	58200700	97972691.58	97972691.58	97972691.58	97972691.58	97972691.58	97972691.58	97972691.58
Gross Income			2916.6667	0	2946982.5	18049763	63646737	108503125.5	108503125.5	108503125.5	108503125.5	108503125.5	108503125.5	108503125.5
Net Cashflow				-8996493.8	-1434179	277695.74	5446036.9	10530433.92	10530433.92	10530433.92	10530433.92	10530433.92	10530433.92	10530433.92
Discount Rates				1	0.93	0.86	0.79	0.74	0.68	0.63	0.58	0.54	0.5	0.46
Discounted Cashflows				-8996493.8	-1333787	238818.34	4302369.2	7792521.101	7160695.065	6634173.369	6107651.673	5686434.317	5265216.96	4843999.603
Net Present Value				18225975.1										
Internal Rate of Return				0.31564315										