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**FEASIBILITY STUDY OF CASSAVA
PRODUCTION AND MARKETING IN
ZIMBABWE**

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Glossary of terms and abbreviations

AGRITEX	Agricultural Technical and Extension Services
ARDA	Agricultural and Rural Development Authority
BUN	Biomass Users Network
CARD	Co-ordinated Agricultural & Rural Development Programme
CIF	Cost, Insurance and Freight
CSC	Commonwealth Science Council
CIAT	Centro Internacional de Agricultura Tropical
CZI	Confederation of Zimbabwe Industries
DDF	District Development Fund
DRSS	Department of Research & Special Services
EEC	European Economic Community
F&I	Food and Industrial Ltd
FOB	Free On Board
GMB	Grain Marketing Board
GTZ	German Agency for Technical Co-operation
IITA	International Institute of Tropical Agriculture
NGO	Non-governmental Organisation
NF	National Foods Ltd
NR	Natural Region
NRI	Natural Resources Institute
RRA	Rapid Rural Appraisal
RMS	Private Transport Company
SCF	Save the Children Fund
Triangle	Triangle Ltd
UZ	University of Zimbabwe
ZFU	Zimbabwe Farmers' Union

Exchange rates (September 1993)

£1 = Zimbabwe\$ (Z\$) 9.9
US\$1 = Z\$6.5

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SUMMARY

This report presents the findings of three visits to Zimbabwe between June and October 1993 to identify potential industrial markets for cassava products and assess the feasibility of producing and processing the crop in communal areas.

The study was initiated at the request of the Commonwealth Science Council (CSC, based in London), and the Biomass Users Network (BUN, based in Harare) during a workshop in Harare in May 1993 in which Dr Poulter and Dr Westby of NRI participated.

The stockfeed industry was identified as the largest immediate market for cassava in Zimbabwe. Seasonal demand for beef fattening rations is highest between June and October which is when climatic conditions for sun-drying of fresh roots are best in the country. The stockfeed industry offers about Z\$500 per tonne of dried cassava.

Demand from other industries such as starch manufacturing, flour processing, brewing and fuel production may only arise once a self-sustaining cassava economy producing considerable quantities of raw material is established.

Table 1 summarizes the findings and gives details of size and particulars of each potential market.

The net forex savings due to the utilisation of 20,000 tonnes of dry cassava in stockfeed is of the order of US\$1.5 million. However, this amount of forex can only be saved if the demand from the feed industry can actually be met by corresponding Zimbabwean supply of roots.

In the course of the Rapid Rural Appraisal exercise in communal areas of Masvingo, Mashonaland East and Manicaland Provinces, very little cassava was seen. Food security and cash were identified as the farmers' main motivations to engage in cassava production. Farmers would like to try out the crop on small plots before embarking on larger scale production (ie. on more than one acre). Drought resistance and the possibility of growing the crop on marginal soils are the main advantages of producing cassava.

The main constraints to agricultural production are, besides low rainfall, lack of funds to purchase inputs and lack of draught power. Fencing is a particular necessity with regard to cassava since the crop requires protection against domestic and wild animals during the dry season when it would be the only green vegetation present.

Table 1: DEMAND FOR CASSAVA PRODUCTS IN ZIMBABWE

Sector	Quantity and product required	Fresh roots equivalent	Comments
Stockfeed	20,000 tonnes of dried chips or meal in the short-term;	54,000 tonnes	There is an immediate demand for dried cassava from the stockfeed manufacturers in Harare, Bulawayo, Gweru and Triangle. Thus, this is the main market to get cassava production underway. Besides the large manufacturers, dried cassava can also be sold to commercial farmers and ranches, as well as to communal livestock schemes. Export potential to Botswana exists but demand levels are not known exactly.
	115,000 - 188,000 tonnes of dried chips or meal in the medium- and long-term.	310,000 - 508,000 tonnes	
Starch	7,700 tonnes of dried chips from peeled roots.	23,000 tonnes	Demand is not certain and may only occur medium to long-term. Food & Industrial who are the country's only starch manufacturer indicated that they prefer to concentrate on maize based starch for at least the next five years. Quality of cassava starch is better from fresh roots compared to dry input. However, Food & Industrial's production technology is based on dry matter input.
Flour	500 tonnes of high quality root meal.	2,000 tonnes	Demand is not certain and may only occur in the long-term. The fact that Zimbabwean food processors and bakers do not have any experience with cassava represents a major obstacle.
Brewing	10,000 tonnes of dried chips from peeled roots.	30,000 tonnes	Demand is not certain and may only occur in the medium- or long-term. Doubts about toxicity appear to be the main obstacle to the use of cassava in the brewing industry.
Ethanol	240,000 tonnes of fresh roots, or equivalent in dried chips from peeled roots.	240,000 tonnes	Demand is not certain and may only occur in the long-term once a large-scale Zimbabwean cassava economy is established. In addition, cheaper processing technologies would be required. 240,000 tonnes of cassava could produce about 40 million litres of ethanol corresponding to about 13% of the current petrol consumption.
Summary:	Potential short-term demand (< 5 yrs) :	54,000 tonnes of fresh roots;	
	Possible medium-term demand (5-8 yrs):	310,000 - 508,000 tonnes of fresh roots;	
	Possible long-term demand (> 8 yrs):	605,000 - 803,000 tonnes of fresh roots.	

Partial crop budget calculations show that cassava can compete against other cash crops in communal lands. Cotton, which is the main competing crop, is more profitable on a net income per season basis but less if income per labour day is used as indicator. Other cash crops (ie. mainly groundnuts and sunflowers) and the subsistence crops maize and small grains are less profitable for either indicator.

The cassava budget calculations are based on the following main assumptions:

- Potential average yield: 15 tonnes of fresh roots per hectare after 18 months of growth (pers. comm. Marcio Porto, CIAT/IITA); ie. 12 tonnes in Natural Region (NR) V, 15 tonnes in NR IV, and 18 tonnes in NR III.
- Price: Z\$500 per tonne of dried cassava chips.

The results of a sensitivity analysis show that cassava may face difficulties to take off as a cash crop if dried root prices were of the order of Z\$400 or if average yields dropped below a level of 12 tonnes per hectare.

Nevertheless, aside from the cash crop option, farmers also showed interest in growing cassava as a food security crop. However, only on-farm trials will lead to a better understanding of whether or not surplus production in the form of dried chips will be sold to feed millers.

Production of cassava based animal fodder by communal farmers is another option to be considered. ARDA administered small-scale dairy schemes and cassava growers in Binga have been identified as possible producers and users of cassava based stockfeed.

The following two options for mechanised cassava processing have been identified:

- On-farm chipping with manually operated machines and sun-drying on small concrete drying floors;
- Small-scale entrepreneurs run processing units at village level including motorized chippers, 500sqm drying floors, and, if required, feed mixing facilities.

The cost calculations show that processing by motorized chippers would only be more profitable than hand-driven machines if at least 250 tonnes of fresh cassava were available per processing unit. It is unlikely that villages in communal areas will produce such an amount of roots within the next three years owing to, among other things, lack of planting material.

Over the next three to four years manually-operated

chippers which are shared by 5 to 10 farmers are the most appropriate technology where cassava is produced for cash. Chipping the roots with handknives appears to be suitable for situations where farmers will only produce small quantities of cassava for on-farm consumption.

RECOMMENDATIONS

It is recommended to continue cassava research and production in Zimbabwe on the basis of a five year pilot project. The information generated during this period should allow subsequent work to be planned.

It is recommended to promote cassava equally as a potential food security and cash crop in areas belonging to Triangle's catchment area (all Districts of Masvingo Province, parts of Chipinge and Zvishavane Districts). This means that in this area the project should include a commercial component focusing on the feed millers and users as potential markets.

In Mashonaland East and the parts of Manicaland which lack marketing infrastructure emphasis should be put on local human consumption. This may include sale of fresh roots in small urban centres.

In Binga and Rusitu, adaptive research into the use of locally produced cassava based animal feed should be undertaken.

It is recommended that an RRA be carried out in potential cassava growing provinces which were not visited in October 1993: especially Matabeleland North and South.

Farmers should be given planting material of low cyanogen drought-resistant varieties as soon as possible so that they can acquaint themselves with the crop. It would be AGRITEX's responsibility to identify farmers who are willing to diversify their production.

Farmers as well as extension staff in the potential cassava growing districts should be trained on aspects related to cassava production, processing, and utilisation.

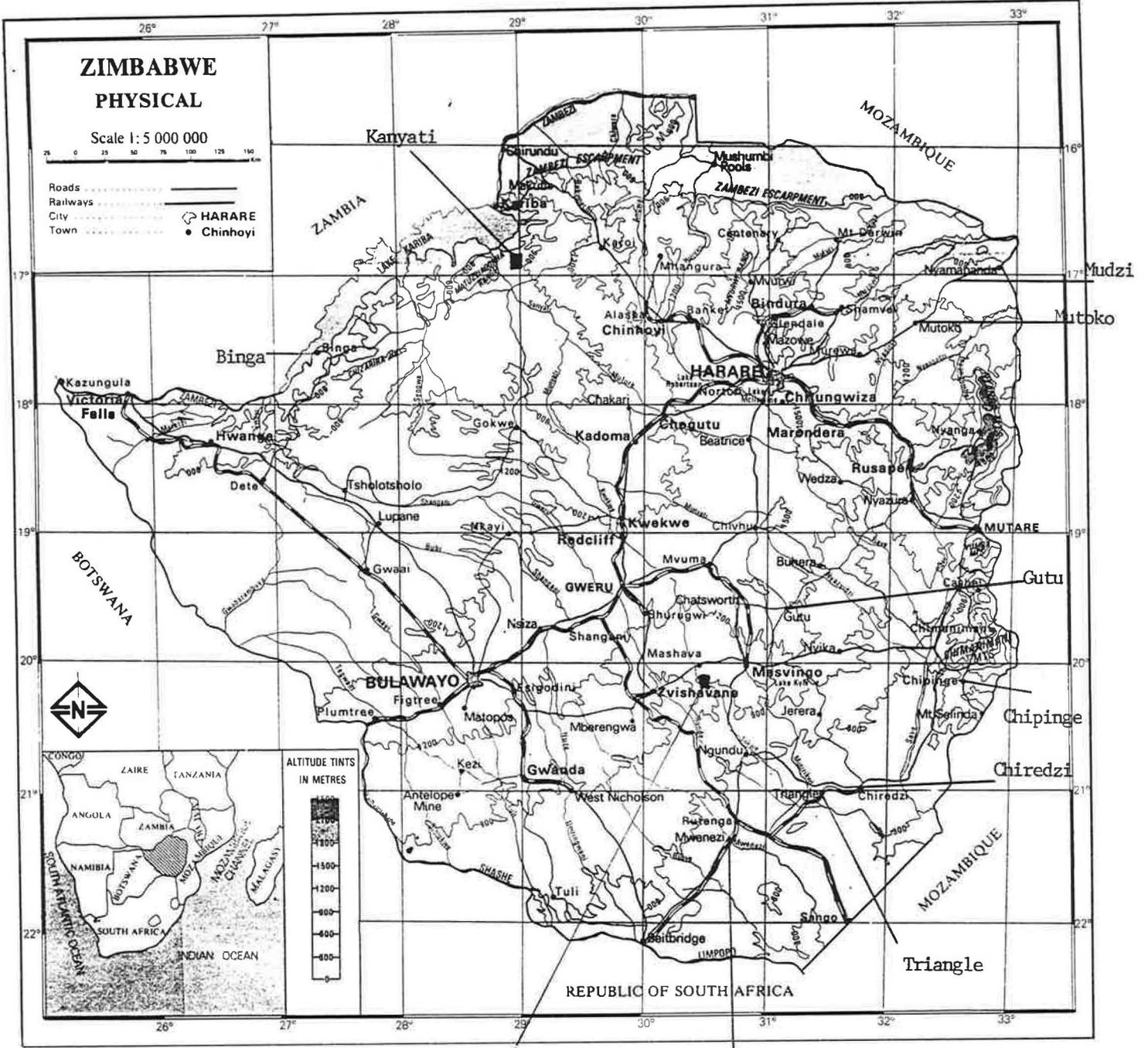
Research should concentrate on the following areas:

- Characterisation of locally available germplasm, and identification of drought-resistant low cyanogen cassava varieties adapted to marginal soils of Zimbabwe;
- Adaptive on-farm research on agricultural practices, processing, utilisation and marketing of cassava; this would require a strong socio-economic component;
- Small-scale processing techniques, (ie. hand-operated chippers and feed mixing facilities) and

utilisation of cassava based animal feed in communal livestock schemes; NRI has the expertise to assist in these fields.

A cassava production plan should be established, based on quantity and quality of planting material available. More drought-resistant low cyanogen cassava planting material, yielding 15 tonnes per hectare and more, has to be imported if research shows that varieties presently grown in Zimbabwe do not match the required criteria.

It is recommended that staff responsible for cassava research, multiplication and extension in Zimbabwe should jointly elaborate the main components of the cassava project document to be submitted to the Government's planning commission. It is advised that an agro-economist be included in the study team.



Chivi

Mwenezi

INTRODUCTION

1. At present, cassava production in Zimbabwe only takes place on a very limited scale. The crop was identified as having potential for increasing diversification in Zimbabwean agriculture. However, the potential markets for cassava, especially in relation to industrial use, were not known.

2. The study was initiated at the request of the Biomass Users Network (BUN, based in Harare), and the Commonwealth Science Council (CSC, based in London) during a workshop in Harare in May 1993 in which Dr Poulter and Dr Westby of NRI participated.

3. Its primary objective was to identify potential markets for cassava products and assess the viability of producing the crop in marginal lands of Zimbabwe. The strategy to be developed was supposed to provide guide-lines for a national project for cassava.

4. The field survey was carried out during three visits to Zimbabwe: 1 - 15 June, 20 July - 24 August, and 4 - 24 October 1993. During the first two visits emphasis was put on marketing aspects. The major stockfeed millers, starch producers and users, brewers, and ethanol producers were visited in Harare, Bulawayo and Triangle. The third visit concentrated on the Rapid Rural Appraisal during which informal group discussions were held in 13 villages in Mashonaland East (Mutoko and Mudzi Districts), Manicaland (Chipinge District) and Masvingo Province (Gutu and Chivi Districts).

5. The terms of reference for the study were to:

- determine suitable areas for cassava production and likely costs of production,
- determine the likely costs of production, processing and marketing of identified products,
- undertake sensitivity analyses of production, processing and marketing,
- determine the market demands for dried cassava chips and other cassava products including the volume of demand, quality of product required and prices,
- make recommendations on the location of the identified small-scale pilot processing plants,
- determine the potential for savings in foreign exchange brought about by the project,
- carry out a Rapid Rural Appraisal to determine farmers' motivations to grow cassava and identify potential constraints to agricultural production.

6. The study is sub-divided into three chapters: Chapter I

focuses on potential cassava markets in Zimbabwe, Chapter II presents the results of the RRA including crop budgets of the areas considered, and Chapter III focuses on aspects related to processing cassava.

CHAPTER I: THE ZIMBABWEAN MARKETS FOR CASSAVA PRODUCTS

THE MOST IMMEDIATE MARKET - THE STOCKFEED INDUSTRY

History of Cassava's Use in Stockfeed in Zimbabwe

7. About 20 to 25 years ago, cassava meal was imported from Malawi for inclusion in animal feed. However, supply from this country became erratic leading to imports being stopped.

8. Triangle Ltd planned to start a cassava scheme in 1989/90 and dried root chips were to be used as stockfeed. In the long term Triangle was considering installing a factory to produce starch for the Zimbabwean and South African markets. In collaboration with AGRITEX, 1000 farmers were identified to produce the root crop on 1000 hectares in the Save Valley at a distance of between 50 and 200 km from Triangle's plant. However, the scheme was abandoned for the following reasons:

- not enough planting material was available;
- the quality of the planting material obtained from the Binga cassava co-operative was considered low and, the price asked for this material high;
- lack of transport to distribute the planting material;
- on-set of the drought at the beginning of the 1990s.

9. The reasons given for abandoning the project also suggest that Triangle considered the costs of initiating a full scale cassava production in the Lowveld to be too high.

Production and Consumption of Stockfeed in Zimbabwe

The national stockfeed industry

10. The commercial stockfeed manufacturers forecast an industrial feed production in the range of 350,000 - 390,000 tonnes for 1993 without considering the quantity of maize grain compounded on farm by livestock producers. This is 20 to 25% below the quantity produced in the drought year 1992 when demand for feeds far outweighed supply due to scarcity of raw materials. Neither year can be considered normal due to the impact of the drought: in 1992 the stockfeed demand was exceptionally high whereas in 1993 it is low because of depleted cattle herds and abundance of rangeland.

11. Statistical data concerning stockfeed production and sales in Zimbabwe over the last 10 years are sketchy. Tables 2 and 3 summarize information available for the years 1987 and 1993.

12. Between 1980 and 1985 the total amount of stockfeed used in Zimbabwe was in the range of 451,000 - 659,000 tonnes out of which 299,000 - 439,000 tonnes were processed by industrial manufacturers. 1982 - 1984 was considered a drought period which explains the higher quantities produced

Table 2: Sales of Manufactured Animal Feed in Zimbabwe

(in tonnes)

Feed Markets:	Dairy	Beef	Poultry	Pigs	Sundries	Total
Estimated sales 1993						
Northern Zimbabwe	90,000	48,000	100,000	20,000	24,000	282,000
Southern Zimbabwe	36,000	37,500	22,000	4,500	5,000	105,000
Total 1993	126,000	85,500	122,000	24,500	29,000	387,000
Total sales 1987	125,000	155,000	35,000	95,000	15,000	425,000

Source: Agrifoods (pers. comm., 1993), and Amira (1992)

Table 3: Raw Materials used in 1987 by the Zimbabwean Feed Manufacturers

	tonnes	%
Locally Produced		
Maize grain	120,000	28.2%
Maize by-products	84,000	19.8%
Wheat by-products	52,000	12.2%
Cottonseed meal	41,000	9.6%
Soy bean meal	45,000	10.6%
Sunflower seed meal	4,500	1.1%
Groundnut meal	3,000	0.7%
Molasses	22,500	5.3%
Meat and bone meal	5,000	1.2%
Blood meal	1,100	0.3%
Limestone flour	6,500	1.5%
Monocalcium phosphate	1,700	0.4%
Cottonseed hulls	22,500	5.3%
Miscellaneous products	2,600	0.6%
Total	411,400	96.8%
Imported		
Urea	6,300	1.5%
Fish meal	450	0.1%
Salt	6,000	1.4%
Feed additives	850	0.2%
Total	13,600	3.2%
Total Raw Materials	425,000	100.0%

Source: Amira (1992)

and consumed during these years compared to the years immediately before and afterwards. More details of the stockfeed market during the period considered are shown in appendix 9.

13. It appears that in 1993 the market segment for beef feed is likely to be lower than in previous years which again is linked to the effects of the drought. Beef cattle herds were restocked after the disastrous drought and at the same time there was an abundance of rangeland after favourable rainfall during the last rainy season. Stockfeed demand in the dairy, pig and poultry sectors is more constant on interseasonal and interannual bases. In 1993, both the market segment for dairy (32%) and poultry feeds (31%) with 120,000 - 130,000 tonnes each, outweigh the beef market with 85,500 (22%).

14. In 1987 the beef industry was the largest segment of the feed market (with 36% of the total), followed by dairy (29%), poultry (22%), and pig (8%) producers. Maize grain and maize by-products were the main raw materials used in the feed industry followed by wheat by-products, soy bean meal, cottonseed meal, molasses, and cottonseed hulls. Urea and salt were the main raw materials not locally available.

15. According to feed millers the quantity of maize grain compounded into stockfeed corresponds to between 27 and 30% of the total. It is estimated that in 1993 about 100,000 tonnes of maize grain will be processed by the feed millers compared to 120,000 tonnes in 1987. These figures do not include about 150,000 - 200,000 tonnes of maize used on farms with roughage or mixed with concentrates purchased from the feed industry. Thus, maize and its by-products represents the primary energy source used in Zimbabwean stockfeed.

16. National Foods Ltd and Agrifoods Ltd are by far the two major stockfeed manufacturers in Zimbabwe with National Foods having a market share of 55 to 60% and Agrifoods 40% to 45%. However, the liberalisation of the Zimbabwean economy, including the grain markets, may well see the rise of new small- and medium-scale stockfeed manufacturing companies.

17. The stockfeed production capacity of National Foods is:
30 - 40 tonnes/hour in Harare,
20 tonnes/hour in Bulawayo,
10 tonnes/hour in Gweru.

18. For 1993, National Foods forecast their production of animal feed as follows : 120,000 tonnes in the Northern Region (Harare plant) and 85,000 tonnes in the Southern Region (Bulawayo and Gweru plants). In 1994, National Food hope to produce a total of 220,000 - 230,000 tonnes of feeds. This is assuming that the livestock production expands again and cattle producers regain confidence after difficult climatic and economic times.

19. Agrifoods' plants have a capacity of :
60 tonnes/hour in Harare, and
30 tonnes/hour in Bulawayo.

20. In 1993, Agrifoods expect to produce 165,000 - 170,000 tonnes of stockfeed of which about 30% will come from the southern part of the country. Thus, the main raw material requirements in the stockfeed industry occur in the North of the country (60 - 70%) where livestock production systems are more intensive.

21. Nevertheless, the plants located closer to potential cassava growing areas, ie. Gweru and Bulawayo, also require large quantities of inputs. 30% of the 1993 market would be 116,000 tonnes of feed. Assuming a cassava inclusion rate of 25% would mean that 29,000 tonnes of dried cassava (equivalent to 78,000 tonnes of fresh roots) would be required for stockfeed in that part of the country.

Stockfeed production and utilization by Triangle

22. Triangle Ltd produce stockfeed mainly to make use of the molasses and bagasse left after producing sugar and ethanol from sugar cane. In normal years, Triangle produces 15-20,000 tonnes of stockfeed to be used in its own feedlots which have a maximum capacity of 18,000 heads of cattle. Cattle farmers in surrounding areas, including sometimes Nuanetsi Ranch, bring their cattle to Triangle's feedlots where they are kept for about 90 days before being slaughtered. Triangle do not have their own cattle but are being paid for the services they provide. In 1993 there are almost no cattle in Triangle's feedlots since farmers and ranchers are restocking their herds.

23. During the three month period in Triangle's feedlots, beef cattle receive about 1.25 tonnes of stockfeed based on the following average rations:

Starch (mainly maize and sorghum)	40-50%
Protein Meal	5%
Molasses	30%
Bagasse	15%
Minerals, Others	5%

24. Triangle is prepared to purchase 2,000 tonnes of dried cassava from farmers in their catchment area (all Districts of Masvingo Province, parts of Chipinge and Zvishavane Districts).

Nuanetsi Ranch and potential demand for stockfeed

25. Nuanetsi Ranch, with 800,000 acres of rangeland one of the country's largest ranches, is, as yet, not involved in feed-lotting. The carrying capacity of the ranch is about 30,000 head of cattle based on 9,000 - 10,000 breeding cows. Maximum sales in a year with normal rainfall are in the range of 4,000 steers and 1,500 - 2,000 heifers. At present, the animals are kept for 3.5 years on the Veld before being sold. The inclusion of a 3 month feed-lot system could be

profitable since this would considerably reduce the time during which animals occupy rangeland; possible reduction of grazing time could be from 3.5 to 2.5 years. Thus feed-lotting could increase the throughput of animals on the ranch. 6,000 animals fed during a 3 month period would require about 6,000 - 7,500 tonnes of animal feed. A 25% cassava component would correspond to 1,500 - 1,900 tonnes of dried chips or 4,000 - 5,000 tonnes of fresh roots.

Potential demand from commercial and communal farmers

26. Cattle farmers who mix their own stockfeed are another potential market for dried cassava. Mr Foury of Chiredzi uses in a normal year about 5,000 tonnes of animal feed and would be interested in using dried cassava as ingredient in his stockfeed provided cassava prices are competitive.

27. Although communal farmers possess the biggest number of cattle in the country, the use of industrially processed feed-stuffs is negligible compared to other livestock sectors. However, this may change in the future with the increased number of fattening and dairy schemes.

28. The livestock industry including the manufacturers of feed are first of all interested in cassava as a cheap source of energy to replace maize to a certain degree. Factors influencing the total demand for stockfeed in Zimbabwe and potential quantities of cassava required by the industry are outlined below.

Factors influencing stockfeed demand

29. The 1992 drought had a severe impact on the country's cattle population: in the communal areas (including resettlement schemes and small-scale commercial farmers), the number of cattle decreased by about 23% from 4.53 million to 3.51 million head whereas the commercial beef cattle herd declined from 1.64 million to about 1.5 million head. Although most of the animals could be sold for slaughter, a large number also died due to lack of feed and water.

30. As discussed above, beef is the most cyclical of the feed markets due to its dependence on rainfall and adequate grazing which is the main feed source for Zimbabwean beef cattle. Thus, after the drought in 1992 when demand for stockfeed was very high, in 1993 consumption of manufactured diets was low due to a depleted cattle herd.

31. In the commercial beef industry stockfeed is used to fatten the cattle for about 2.5 to 3.5 months before selling the animals for slaughter. Although the communal herd is more than double the size of the commercial herd, the former only consumes a minimal proportion of industrially manufactured feeds.

32. Feed consumption in the dairy, pig and poultry sectors is less erratic but is also influenced, like the beef sector, by unfavourable economic conditions in the country. The recession in the Zimbabwean economy at the beginning of the 1990s also affected these sectors leading to more or less stagnant production figures.

33. Thus, the trend in medium- and long-term demand for the different categories of stockfeed not only depends upon rainfall conditions but also on the country's economic situation. National Food's rough estimates concerning potential growth in stockfeed demand until the year 2000 are outlined in Table 4.

Table: 4 Potential increase in stockfeed demand per livestock category until 2,000

Dairy:	Stagnating demand over the next 2 - 3 years, then 3 - 5% increase per annum;
Beef:	Stagnating demand over the next 2 - 3 years, then 5 - 7% increase p.a.,
Poultry:	5 - 7% increase p.a.,
Pigs:	7% increase p.a.,
Sundries:	3 - 4% increase p.a.

Source: National Foods, pers. communication (1993).

34. Thus, based on 1993 figures, the demand for industrially manufactured stockfeeds in 2000 can be estimated as indicated in Table 5.

Table: 5 Potential demand for industrially manufactured stockfeed in the year 2000 by livestock category (in tonnes)

	2000	1993 (est.)
Dairy:	153,000	126,000
Beef:	115,000	85,500
Poultry:	183,000	122,000
Pigs:	39,000	24,500
Sundries:	37,000	29,000
Total:	527,000	387,000

35. The growth of the human population (about 3% p.a.) is also an important factor influencing the demand for stockfeed since consumption of animal products will increase. In addition, demographic growth may lead to pressure on rangeland needed for increased production of cereals and other food crops. Thus, in the long-run, a greater number of livestock will be fed on stockfeed. An intensification of livestock systems is likely over the next 10 years in both the commercial and communal farming areas.

36. Communal lands may not see a considerable expansion in

livestock numbers, however factors such as economic development, population pressure, and environmental problems will lead to an intensification of animal production involving fattening and grazing schemes. These schemes may represent an important future market for cassava based stockfeed with the advantage that root production and processing will be close to the point of consumption.

Factors Influencing Future Demand for Cassava in Stockfeed

37. The search for cheap carbohydrate sources is the animal feed industry's primary motive to use cassava as a raw material. Due to the recent drought, the producer price for white maize, the main staple crop in Zimbabwe, was increased by GMB in 1992/93 from Z\$540 to Z\$900 per tonne to stimulate production and rebuild empty stocks. Although GMB's white maize selling price is Z\$1,070 per tonne, the feed millers can purchase yellow maize at a cheaper rate (Z\$880 per tonne) from the farmers or at GMB depots. The market for yellow maize, which is smaller in quantity compared to white maize, is deregulated and, in addition, there are still stocks which were imported during the drought period.

38. It seems unlikely that GMB will lower nominal prices for white maize in the near future, although the supply situation appears to be more stable now. In real terms, however, maize prices may decline due to a high inflation rate in Zimbabwe (25-30% in 1993). It seems possible that the producer price for yellow maize will decline to a level of around Z\$750 per tonne in 1994.

39. Sorghum and millets could be an alternative to maize for animal feed millers since they are both priced at about \$600/tonne at farm level; however, quantities of these two cereals are limited. The white sorghum price at the newly created Zimbabwe Agriculture Commodity Exchange is Z\$750 per tonne but since the markets for sorghum and millets are deregulated, millers can buy at a cheaper rate directly from producers in communal areas.

40. Triangle indicated that the maize price in 1993 was prohibitive to base stockfeed on maize, and so sorghum was considered as the main input. On the other hand, it appears that sorghum production in the Lowveld is low and quantities would be insufficient to supply Triangle's stockfeed industry. Thus, under conditions not influenced by a drought, the company is still likely to require maize from other parts of the country.

41. Maize by-products such as DFR (Defatted Residue Meal, Z\$500- 600/tonne) and maize bran (partly imported from Zambia, Z\$650-700/tonne) are also important components in Zimbabwean stockfeed. National Foods indicated that they have easy access to maize milling by-products within their company. Thus, cassava not only has to compete against maize grain but also against the milling by-products, the millets, and sorghum.

42. Due to the low protein content of cassava, a protein-rich balancer such as soya beans is required to obtain a feed value comparable to maize. Thus, the value of cassava depends not only upon the price of cereals but also on price of the protein balancer. In Mid-1993, the price of soya beans was Z\$1,500 - 1,600/tonne at the Agriculture Commodity Exchange of Zimbabwe.

43. Technical knowledge is widely available with regard to possible levels of cassava in animal feed rations. For example, parts of Europe's stockfeeders rely heavily on Thai cassava pellets (about 5 million tonnes p.a.) which replaced to some extent European grain as a feed component. The Common Agricultural Policy (CAP) of the EEC led to changes in relative prices forcing feed compounders in the Common Market to seek substitutes for expensive grains in order to avoid high feed prices.

44. Studies carried out on the use of cassava in animal feed show the potential of the root crop in animal nutrition. Market studies on the European stockfeed market identified possible dry cassava levels of 40 - 50% in beef fattening and dairy cow feeds (Phillips, 1974). Zimbabwean research done by DR&SS at Henderson Research Station showed that it is possible to obtain satisfactory results in steer fattening with a 44% content of cassava meal. This corresponds to a fattening ration where two thirds of maize is substituted by cassava while maintaining the protein content at 11 - 12% through an increased proportion of protein concentrate. Feed intake decreased marginally when levels of cassava reached 44% of the ration. Only in the case where the cassava content was 66% was the ration not readily taken by the steers which was most probably due to the powdery nature of milled cassava flour.

45. With regard to the pig industry, European manufacturers successfully trial-fed cassava at the 60% level (Phillips, 1974). Lekule *et al.* (1992) also conducted work to compare relatively cheap cassava based pig rations to diets based on hominy feed and bloodmeal. Although the hominy based feed achieved the best result, it was shown that 40kg pigs also performed well on 63% cassava root meal mixed with 30% cottonseed cake, 2.5% fishmeal, and 2.5% bloodmeal. Performance was lower when the cassava / cottonseed mix was only supplemented by either fishmeal or amino acids.

46. Research carried out in 1983 by Dr Mandisodza of the Zimbabwean Pig Industry Board showed the best results when cassava meal was included at 20% and 40% levels in pig diets; the results were comparable to that of a low fibre maize meal diet. Performance was lower when the cassava content was 60%.

47. Concerning poultry feeds, research also showed that relatively high cassava levels are possible. Although the study of the European feed market indicates possible cassava contents of up to 60% in some poultry diets, Balagopalan *et*

a1. (1988) cite studies reporting lower optimal cassava levels (ie. 20% in layer diets). Mr Keen, National Foods' stockfeed nutritionist, indicated that poultry feeding trials could be carried out at Henderson Research Station.

48. The acceptance of cassava based animal diets by livestock producers is likely to be positive when the feed is manufactured by the commercial millers. The livestock producers have confidence in the sophisticated technology used in the Zimbabwean stockfeed manufacturing industry.

49. The livestock industry is unlikely to purchase bigger quantities of cassava based animal feeds produced by communal farmers' groups in the early phase of the project. The livestock producers will only accept it after successful trials and if the prices of the diets thus manufactured are competitive. The cassava project would have to provide technical and marketing assistance to farmers who are interested in processing the roots into stockfeed.

Quantities of Dried Cassava Required by Stockfeed Manufacturers

50. Although the Zimbabwean feed manufacturers are aware of the potential of cassava in stockfeed diets, they are not likely to initially include the highest possible cassava levels.

51. Agrifoods estimate that for the whole of Zimbabwe the maximum levels of inclusion of cassava meal and corresponding quantities could be as follows in Table 6.

52. The figures were given for a low price of cassava root meals: not more than Z\$400 per tonne. If a higher price of around Z\$500 was considered, the quantity demanded can be expected to be in the range of about 20,000 tonnes of dried cassava corresponding to roughly 20% of maize grain used in commercially manufactured stockfeed.

Table 6: Estimated maximum annual usage of cassava meal in Zimbabwe (tonnes of cassava root meal)

	Maximum Cassava Inclusion	Total North	Total South	National Total
Dairy	12%	10,800	4,300	15,100
Beef	20%	9,600	7,500	17,100
Poultry	16%	16,000	3,500	19,500
Pigs	60%	12,000	2,700	14,700
Misc.	20%	4,800	1,000	5,800
Total		53,200	19,000	72,200

Source: Agrifoods, pers. comm. (1993)

53. In the long-run, the content of cassava in the commercially manufactured stockfeed may reach levels of 20 to

30%. Thus the quantity of dried cassava required in the year 2000 by the feed millers could be in the range of 105,000 - 158,000 tonnes, based on an annual stockfeed consumption of 527,000 tonnes. In addition, it is possible that on-farm mixers would include cassava at a level of 5 - 10% in their animal diets, corresponding to 10,000 - 30,000 tonnes in the year 2000. Thus, the total amount of dried cassava required in 2000 may amount to 115,000- 188,000 tonnes.

54. According to the feed millers, Botswana represents a large potential export market for Zimbabwean stockfeeds since this country has only a very limited production of starchy crops which could be used for animal diets. This may represent an interesting option for future cassava growing communities close to the Botswana border.

55. Therefore, the possibility of combining cassava production and processing with a feed compounding operation should be investigated in closer detail. Besides supplying the export market, cassava groups could also sell their feed to neighbouring livestock schemes. Dr Mandisodza, Chairman of the Pig Industry Board, said that pig production groups in communal areas could be interested in cassava based feeds. In addition, he also mentioned that he was involved in pig feed trials carried out in the 1980s. He said that there was the possibility of starting a communal pig production close to Masvingo where the breeding sows would be managed by a committee at a central point (in this case perhaps on an ARDA dairy estate) from where the communal farmers would buy weaners to fatten. These farmers would at the same time be represented in the management committee through their group representatives. According to Dr Mandisodza, the COLCOM abattoir in Masvingo has a pig slaughtering line which is underutilized.

56. Selling ready made stockfeeds to pen-fattening schemes in communal lands would be another option. Friedrich-Ebert-Stiftung (NGO) together with Zimbabwe Farmers' Union assist communal beef fattening schemes in Matabeleland North and South within the framework of a revolving fund. They indicated that Matabeleland South was a centre for communal cattle raising and, thus, beef farmers in this region around Gwanda could be interested in using cassava based beef rations. At present, these schemes buy stockfeed from National Foods. Therefore, the farmers' criteria for choice would be the price of cassava based feeds compared to that from the millers. This assumes that cassava feeds would have the same feed values.

Potential Prices for Cassava Chips Purchased by the Feed Millers

57. Different studies show that dried cassava chips are usually valued at about 80% of the price of the main cereals used in stockfeed manufacturing (CIAT, 1989; Lynam, 1989; Wholey, 1992).

58. Animal feed millers use least-cost ration models which calculate the value of cassava in relation to the price of the protein balancer (eg. soya beans) required to obtain a feed approximating the nutritional value of maize grain. In this context, Dr John Wood of NRI suggests that the chips should be priced below the mentioned 80% benchmark in order to provide a strong incentive for the feed millers to start utilizing cassava. In addition, as mentioned above, prices of other cereals and milling by-products also play an important role in the determination of the price of dried cassava.

59. National Foods indicated the following prices and corresponding quantities of dried cassava root meal they would be interested in.

Table 7: Cassava meal prices offered by National Foods

Landed price of cassava root meal	Rate of inclusion	Approximate quantity in total stockfeed ¹⁾
\$450/tonne	20%	40,000 tonnes
\$470/tonne	10-12%	20-24,000 tonnes
\$500/tonne	5-7%	10-14,000 tonnes.

Note 1): based on 200,000 tonnes of stockfeed produced p.a.
Source: National Foods (1993, pers. comm.)

60. These prices are well below 80% of the actual maize price and are based, according to National Foods, on the prices of all raw material available mid-1993. The price of \$500 per tonne of root meal corresponds more or less to 80% of the producer price of sorghum.

61. Agrifoods estimated the value of cassava products in two letters dated 20 May 1993 and 3 August 1993. In the first letter, the estimated landed values of dried cassava products and corresponding quantities potentially used by the company were stated as follows:

Table 8: Cassava product prices offered by Agrifoods

Cassava product	Estimated landed value	Estimated monthly usage
Cassava Root Chip Meal	Z\$850/tonne	500 tonnes
Cassava Stem Meal	Z\$500/tonne	100 tonnes
Cassava Leaf Meal	Z\$600/tonne	60 tonnes

Source: Agrifoods (1993, pers. comm.)

62. In the second letter, they estimated the feed value of cassava at roughly 80% of that of maize, thus obtaining a market value of about Z\$720 per tonne. At the same time, it was stated that, if the price of cassava root meal was very cheap, i.e. not more than Z\$400 per tonne, Agrifoods would not expect the Zimbabwean feedmillers to utilize an amount in

excess of 70,000 tonnes per annum. This indicates that Agrifoods' potential buyer price is more likely to be in the range of Z\$400 - 500 per tonne, especially when it would come to the purchase of larger quantities of root meal.

63. Triangle suggested a producer price for dried cassava chips of the order Z\$500 per tonne. The estimated chip value was given in comparison to the producer price of sorghum in mid-1993, which, as already mentioned, was about Z\$600 per tonne. Triangle also said that they see potential cassava prices in relation to the feed value of their by-products from sugar and cotton production.

64. Compared to this, the price of the cheapest beef fattening ration in Zimbabwe was around Z\$800 per tonne in mid-1993.

65. Triangle are also prepared to use their means of transport to collect the chips from central collection points in the cassava growing zones in their catchment area. However, they have not decided yet whether they will charge farmers for the transport as is the case with cotton.

66. At this point it should also be pointed out that it is essential that the stockfeed manufacturers commit themselves to favourable producer prices before a larger-scale cassava project is started. Farmers are unlikely to adopt the new crop if price incentives for cassava production are not given, especially in a situation when producer prices for other crops such as maize and cotton are comparatively favourable. This point is of major importance to get a Zimbabwean cassava production off the ground.

Quality Requirements for Dried Cassava Chips in Stockfeed Industry

67. National Foods would prefer cassava meal instead of chips and would be prepared to pay a premium for the former. This is because their milling equipment is already quite well utilized for milling other products. However, the processing equipment is there and no other investments would be necessary to mill chips.

68. Agrifoods indicated interest in cassava pellets but their price figures were given for cassava root meal, stem meal and leaf meal.

69. Triangle is more interested in dried cassava chips as input in its stockfeed production since they sometimes stock their inputs over several months and this seems easier with chips compared to cassava meal.

70. Dry cassava quality requirements stipulated by feed millers in Latin America are as follows:

- Maximum moisture	14%
- Maximum fibre	4%
- Minimum protein	2%
- Maximum ash	5%
- Aflatoxins	None

Source: CIAT, 1989.

71. The quality requirements of the Zimbabwean feed manufacturing industries can be expected to be similar.

POTENTIAL CASSAVA MARKETING CHAIN

72. Two possible future marketing chains for cassava in stockfeed were identified:

- Short-term marketing chain focusing on the Lowveld and Triangle's stockfeed business;
- Medium- to long-term marketing chain based on an integrated approach including stockfeed processing by farmers themselves.

73. The first option (option a), which is outlined in Figure 1, appears to be the only strategy to get a substantial Zimbabwean cassava production off the ground. Triangle show interest in using cassava as input in their stockfeed production and are willing to collect the dried chips from villages located in surrounding areas (50 - 200kms). As already mentioned above, Triangle started to look into the possibility of initiating cassava production in the Lowveld but the project was abandoned.

74. The potential use of dried chips as a cheap energy source in stockfeeds is at the origin of Triangle's renewed interest in cassava. Concerning the possible risk that Triangle could, for whatever reason, step back from its commitment to buy cassava, the project should assist the farmers in this case in selling chips to other outlets such as ARDA estates, the more distant large-scale feed millers or directly to private cattle ranchers. In this context, the project should try from an early stage on to develop more diversified markets other than Triangle in order to avoid total reliance on one end-user.

75. Option b), which is outlined in Figure 2 is based on an integrated approach to using cassava in stockfeed. However, this approach only seems realistic in the medium- to long-run and only if a large-scale Zimbabwean cassava production can be started. Besides efforts put into producing significant quantities of roots, this would also require an important research component concerning agricultural aspects but also processing of fresh roots into chips, meal and stockfeeds.

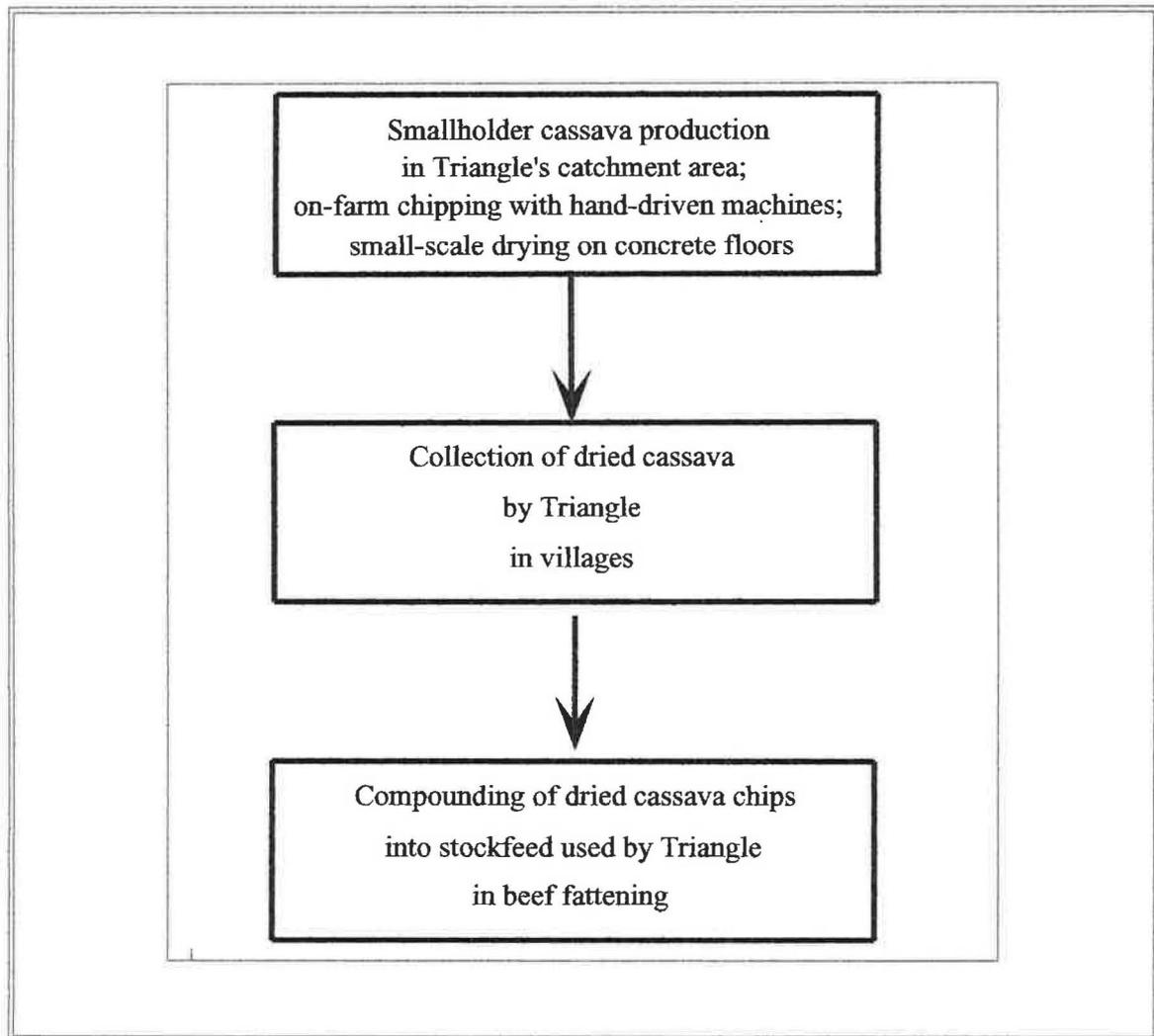
76. In this context the project would have to select a low-cost motorized chipping technology suitable for the conditions prevailing in Communal Lands of Zimbabwe. A

processing technology based on models developed by CIAT for Latin American cassava producing countries may not be entirely appropriate for Zimbabwean conditions.

77. Concerning the management of processing units, private operators are unlikely to invest in a cassava processing technology unless there are large quantities of raw material available. This is unlikely to be the case within the next three to four years.

78. The practicality of some of the issues related to option b), eg. export of cassava based feeds to Botswana and adequate quality control, would require further study once a large scale Zimbabwean cassava production will be established. In the shorter term, the opportunities for on-farm use or use by near neighbours to minimise transportation in the system should be considered, particularly where reliable local markets for meat or other livestock products exist.

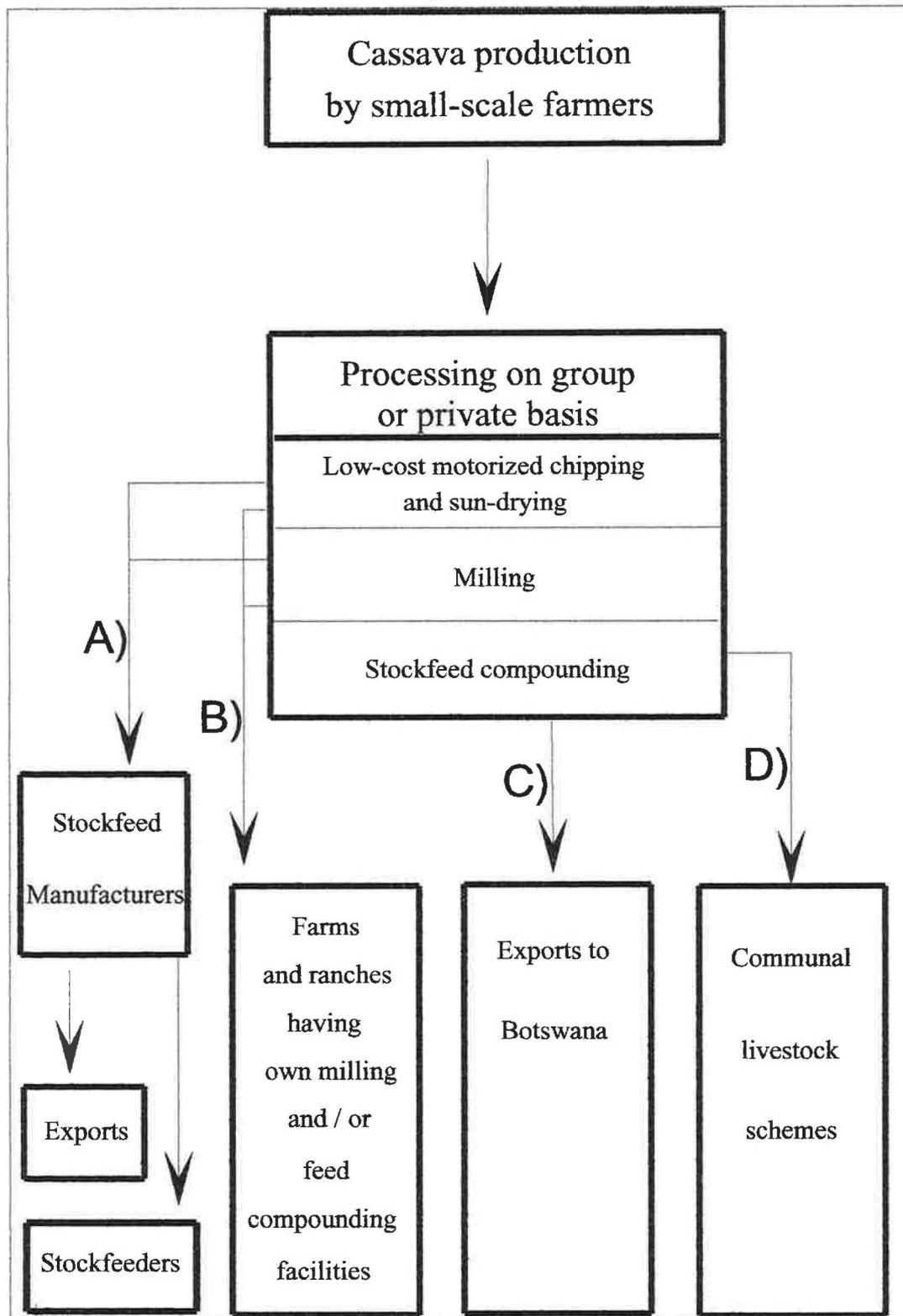
Figure 1 : Short - term cassava marketing strategy



Note:

Triangle is prepared to purchase 2,000 tonnes of dried cassava p.a. at a price of Z\$500 per tonne; the viability of production and processing will be analysed in the following chapters.

Figure 2 : Possible medium- to long-term cassava marketing strategy



Note:

- A): Demand is certain, however supply depends on factors such as yields and prices paid by feed millers.
- B): Demand will only develop if ranchers and farmers see the benefit of cassava based feed-stuffs.
- C): Export potential exists, but crop has to be well established before this option can be envisaged.
- D): There is an immediate potential demand for cassava in communal dairy schemes, however only trials can show to what extent the crop can replace other feed-stuffs.

OTHER POSSIBLE LONG-TERM MARKETS FOR CASSAVA

Starch

79. The starch requirements of the Zimbabwean industry for 1993 are estimated in Table 9.

Table: 9 Starch demand in Zimbabwe, 1993 (in tonnes)

	tonnes	%
Paper industry:	1,470	35
Food industry:	990	23
Textile industry:	1,380	33
Adhesives:	150	4
Others	210	5
Total	4,200	100

Source: Food & Industrial, pers. comm.

80. Out of the total demand of 4,200 tonnes, 3,000 tonnes are required in the form of ordinary grade starch and about 1,200 tonnes as acid modified starch mainly demanded by the textile industry. In addition to these quantities, about 840 tonnes are produced for export to Malawi, Zambia, and Mozambique. Thus, the total quantity of starch produced in 1993 in Zimbabwe will be of the order of 5,000 tonnes. Drought and economic recession made the market shrink by about 10% compared to 1991/92. However, F&I's management hopes to increase sales by about 10% p.a. until the year 2000.

81. The South African market is only supplied sporadically and Zimbabwean starch lost its competitive edge during the recent drought.

82. Food and Industrial Ltd, a member of the Delta Group, have a monopoly in Zimbabwean starch production. Maize is their sole raw material. The capacity of the starch plants corresponds to 65 tonnes of maize grain or about 45 tonnes of starch per day. The annual capacity thus is of the order of 15,500 tonnes of starch assuming that production takes place over 49 weeks and seven days per week.

83. According to Food and Industrial's management, the company wants to gear up its maize starch processing technology in order to make better use of maize by-products such as protein, oil, etc. A five year contract was recently signed with an American company for technology transfer to this end.

84. F&I felt no need to look for other starch sources since under normal conditions maize was abundant in the country. Thus, cassava could only be interesting for Food and Industrial if financial incentives were high. Therefore, F&I should not be considered as a short-term market for cassava in Zimbabwe. F&I's reaction regarding the production of

cassava based starch has to be seen in relation to their monopoly position as sole supplier of industrially manufactured starch on the Zimbabwean market. On the other hand, starch users such as the cardboard manufacturers indicated that starch only represents a small component among their total production costs. Thus, there is no pressure from the market to supply cheaper starch.

85. Several years ago, as already mentioned above, Triangle considered investing in a plant to produce cassava starch. However, the project was abandoned due to the factors outlined above. In 1993, Triangle said they may consider the relocation of their South African sister company's starch plant to the Lowveld if there would be sufficient supply of cassava. At present, there is not enough cassava for Tongaat-Hulett's starch factory in Natal, South Africa.

86. To sum up, the large-scale industry should not be relied upon as an immediate buyer of cassava as a raw material for starch production. This can only be considered once a sustainable Zimbabwean cassava economy is established. Demand for Zimbabwean starch can be expected to be around 10,000 tonnes in the year 2,000. Assuming that 50% of this demand could be met by cassava starch would mean that about 23,000 tonnes of roots or the equivalent of dried chips from peeled roots would be required. This is based on an extraction rate of around 22%.

87. Concerning the raw material to be used by F&I, it has to be mentioned that they would prefer dried chips since their technology is conceived for dry matter processing. This would be of advantage for the potential growers since the roots will be grown in areas distant from Chitungwiza where F&I's starch manufacturing plant is located.

88. Disadvantages of using dried chips as input in starch extraction have been reported in the literature (Balagopalan *et al.*, 1988). These are:

- The viscosity characteristics of starch obtained from dried chips is inferior to starch from fresh roots;
- The process of disintegration, drying, and rehydration is not only more complicated but also more expensive compared to an industry based on fresh roots supply;
- Chips should be of good quality, which means washing and peeling prior to chipping; however, this may represent a difficulty for farmers inexperienced with cassava and located in areas where water may be scarce particularly during the dry season.

89. The cardboard manufacturing industry, which, at present, uses maize starch as main input in its binding medium, has shown interest in cassava as a potential alternative source of starch. However, the companies do not have any experience with the wet end application of cassava starch in the paper industry. Only after a 3 week trial would they be in a position to give a firm answer in relation to cassava starch. Nevertheless, they indicated that they would be willing to substitute maize starch by cheaper cassava starch if the

efficiency of processing does not suffer.

90. In the paper and cardboard manufacturing industry starch represents only a small cost component compared to other inputs. Price of maize based starch is of the order of Z\$2,000-5,000 per tonne depending on form and quality.

91. The local NGO Sarvadoya, which is based in Gwanda District in Matabeleland South, showed interest in, among other things, processing fresh cassava into starch to satisfy small-scale village demand for glues, textile starch, etc. Obviously, the market for products thus produced would be small compared to the total industrial demand for starch. Nevertheless, this could be an interesting starting point for the development of small-scale cassava starch processing units requiring low quantities of water. The approach is interesting in so far as positive technological results could be transferred to other dry parts of the African continent.

92. In summary, it is unlikely that there will be a demand for cassava from the large-scale starch manufacturers in the near future. However, if the industry requires fresh or dried cassava for trials it should be given to them if supply is readily available. Small-scale processing may represent an option to be developed on village level in Matabeleland South.

Flour

93. Cassava flour can be used at varying degrees in the food processing industry to produce products such as: bread, cakes, crisps, sausages, ice-cream cones, biscuits, etc.

94. Table 10 shows results of experiments carried out by CIAT in collaboration with the Colombian food processing industry.

95. The quantity of cassava flour to be potentially used by the Zimbabwean food industry can be estimated at 500 tonnes per annum. However, companies like Cairns Foods who, at present do not have any experience with the crop, would have to carry out trials before making any commitment.

96. Cassava flour could theoretically also replace part of wheat flour used in the baking industry. At the beginning of the 1990s about 240,000 tonnes of flour were used per annum for bread baking. The bakers hope to double their production until the year 2000. The potential cassava requirements would be of the order of 24,000 - 48,000 tonnes of high quality meal (corresponding to 96,000 - 192,000 tonnes of fresh roots) assuming an inclusion rate of 5 - 10%.

97. However, considering a substantial lack of experience in dealing with cassava, the Zimbabwean food and baking industry is unlikely to use cassava flour as a raw material in the future. Only in the long-run, when large quantities of cassava are produced in the country, the industry may be

willing to consider trials involving changes in technology, recipes, etc. The bakers' principal criteria would be the maintenance of quality standards.

Table 10: Results of food industry trials of cassava flour in Colombia

Product category	% substitution for wheat flour	Comments on product made with cassava flour
Processed meats	100	Better consistency, water absorption, good colour;
Biscuits/cookies	5-50	Firmer texture, good taste, crisper;
Cakes	5-30	Good taste, good volume;
Pastas/noodles	20-35	Good quality;
Ice-cream cones	5-100	Firmer, maintains texture well;
Packet soups	20-100	Good taste.

Source: Wheatley and Best, 1991

98. In the past, the bakers used (or had to use) 5% of maize meal blended with wheat flour to save wheat imports. However, neither the consumers nor the producers were happy with the product.

99. Blue Ribbon Foods Ltd, a major Zimbabwean milling company, showed interest in a cassava project. This needs to be seen in the light of diversification efforts undertaken by the company following a newly emerging competition in the milling sector from small and medium size millers and cereal traders. Before making any commitment, however, Blue Ribbon would require samples of dried cassava to carry out quality experiments.

Brewing

100. Chibuku was the driving force behind the Zimbabwean cassava research carried out in the 1980s. However, the programme was abandoned in 1989 due to toxicity issues related to cassava. Abundance of maize may have played an important role as well.

101. The issue of cyanide detoxification appears to be Chibuku's main concern in relation to substituting maize by cassava in the brewing industry. Thus, with regard to future use of cassava in the brewing industry, the managers of Chibuku have to be convinced that cassava based beer will be absolutely free of cyanide.

102. The total quantity of maize used per annum by Chibuku breweries is of the order of 40,000 - 50,000 tonnes. According to the technical direction of the company, up to 20% of this quantity could be replaced by dried cassava

chips. Thus, the potential demand for cassava from the brewing industry will not be above 10,000 tonnes of chips or 30,000 tonnes of roots.

103. It was also mentioned that trials could be undertaken at three small-scale breweries close to potential cassava growing areas (eg. Binga). The minimum quantity of cassava required for trials by Chibuku is of the order of 500kg.

104. However, the cassava programme should not rely on a demand for cassava from the brewing industry in the near future since it may take at least 3 years until the technical staff have acquired all the knowledge required for producing cyanide free beer. Chibuku's management is unlikely to accept cassava as a raw material unless they are convinced that toxicity is not an issue. After all it was Chibuku who carried out research on cassava for almost a decade during the 1980s and then abandoned it.

Ethanol

105. The conversion factor for processing fresh cassava into ethanol is about 168 litres of alcohol per tonne of roots based on 30% fermentables.

106. Approximately 25 to 30 million litres of ethanol were produced annually by the Triangle ethanol plant before it had to stop production due to lack of cane supply during the 1991/92 drought. The production capacity of the plant is 40 million litres of ethanol per annum.

107. In Zimbabwe ethanol is blended with petrol at a rate of 10 to 13%. At the beginning of the 1990s, about 300 million litres of petrol are required per annum. The quantity of cassava required to produce 40 million litres of ethanol or about 13% of the current petrol consumption would require 240,000 tonnes of fresh roots.

108. Weak points concerning cassava based ethanol production are as follows:

- Cassava needs additional preparation and processing to produce fermentable sugars. This would require additional equipment. In the case of sugar cane all the equipment already exists (Pazvakavamba, 1992).
- Cassava peels and fibre cannot be utilised to generate steam and power contrary to bagasse from sugar cane.
- The energy requirements to produce ethanol from cassava are high.
- Cassava supply is too small.

109. Thus it is unlikely that Triangle will undertake the necessary investments due to the above constraints. Demand for cassava may only come from the ethanol programme once a large-scale Zimbabwean cassava production is established.

POSSIBLE FOREX SAVINGS BY PRODUCING CASSAVA IN ZIMBABWE

110. Cassava production in Zimbabwe can generate foreign exchange in two ways:

- increase of exports;
- substitution of imports.

111. The first option mainly refers to the case of maize which could be replaced by cassava in the stockfeed, starch and brewing industries. Concerning the manufacturing of cassava-based stockfeeds it is important to remember that a protein balancer is required to assure nutritional levels stipulated by the feeders¹⁾. This means that the potential benefit of exporting maize would partly be offset by increased demand for products such as soya beans which either have to be imported or which would not be available any more for exports.

112. With regard to maize substituted by cassava in the brewing and starch industries, it is assumed that no additional inputs would be required to accompany cassava.

113. The second option refers to the cases of wheat flour and petrol which can be blended to some extent with cassava based products as described above. Petrol is entirely imported and wheat to some extent.

114. The forex generated or saved by using cassava in the different industries can be summarized as follows in Table 11.

Table 11: Possible Forex Savings due to Cassava production in Zimbabwe

Commodities to be replaced by cassava	Market potential	Quantities replaced by cassava products	Value in million US\$
Maize saved in:			
- Stockfeed	Export	115-188,000T	15.6 - 25.4
- Starch	Export	7,700T	1.0
- Brewing	Export	10,000T	1.4
Wheat:	Imp. Subst.	2,500T	0.5
Petrol:	Imp. Subst.	40,000MT	8.2
Less lost export opportunities for soya beans		28,750 - 47,000T	6.9 - 11.2
Sum of forex generated or saved			19.8 - 25.3

1) It is assumed that the ratio between cassava and soya bean in stockfeed should be around 4 : 1 to assure sufficient protein levels.

115. The corresponding calculations are based on the following price assumptions:

Maize:	135.4 US\$/tonne, FOB, Harare;
Wheat:	205 US\$/tonne, CIF, Harare;
Soya beans:	238.5 US\$/tonne, FOB, Harare;
Petrol:	204 US\$/MT, CIF, Beira (to be pumped to Zimbabwe).

116. The above calculations do not include imported intermediary inputs in the production, transport and marketing of cassava, maize and soya beans.

117. The above calculations are based on the assumption that a full-scale cassava production will take off the ground in Zimbabwe and all potential markets will be satisfied. Provided that would be the case then the forex savings could only be expected in the long-term (ie. in more than 10 years). In the short- and medium-term, the only forex savings may occur due to the substitution of maize by cassava in stockfeed. 20,000 tonnes of maize liberated for export could generate about US\$2.7m less about US\$1.2m due to increased soya bean requirements.

118. It should be remembered that besides the stockfeed market the demand for cassava in starch, beer, flour and ethanol production is not certain. In addition, it is difficult to forecast figures without exactly knowing the potential of cassava supply in Zimbabwe. Forex saving may well be very low (ie. close to zero) if the prices offered by the feed millers are not high enough to stimulate the production of cassava as a cash crop.

CHAPTER II: THE RAPID RURAL APPRAISAL

CONDUCT OF THE RRA

119. It was planned to carry out a Rapid Rural Appraisal (RRA) based on the recommendations of the Cassava Marketing Study (carried out by BUN and NRI) and of the nation-wide cassava survey initiated by AGRITEX. The RRA was programmed to be finished by the start of the planting season (beginning of November) so that recommendations could be used for the agricultural season 1993/94.

120. Due to the fact that collection and processing of the nation-wide cassava survey data took more time than anticipated, a re-writing of the objectives for the RRA became necessary. Instead of concentrating the RRA on a few selected villages, it was agreed to visit more areas with a view to identifying sites where a cassava programme could potentially start in communal areas.

121. 13 villages in the following Districts were visited in the course of the RRA:

- Gutu (1),
- Chivi (2),
- Mwenezi (2),
(all in Masvingo Province);

- Mutoko (3),
- Mudzi (1),
(all in Mashonaland East);

- Chipinge (4),
(all in Manicaland).

The locations of the Districts are shown in the maps of appendix 4.

122. The survey concentrated on the following key points:

- Crops grown in the villages;
- Constraints to agricultural production; and
- Farmers' incentives for cassava production.

123. Due to the fact that most of the farmers who participated in the informal group discussions did not have experience related to cassava, an introduction on production and utilisation of cassava was necessary. With regard to the utilisation of the roots, the following three options were given:

- Human consumption;
- Sale in the form of dried chips;
- Animal fodder.

124. Case studies of all the villages visited are presented in Appendix 3.

EXISTING AGRICULTURAL PRODUCTION

Main Crops Produced

125. Cereals are the principal crops cultivated in the villages visited during the RRA. The villages in Natural Region V relied more on small grains (sorghum and millets) for home consumption whereas maize dominated in the other Regions. Although cereals are primarily subsistence crops, surplus is sold to either GMB or private traders.

126. Communal farmers give more importance to their subsistence crops which usually occupy the larger part of their farms and are planted before the cash crops.

127. Cash crops produced in the villages include cotton, groundnuts, sunflower, tobacco, and vegetables.

128. In many villages of the communal areas of the Lowveld, cotton was only introduced in the second half of the 1980s. It is not produced by all farmers and in general, the size of the plots planted for cotton are relatively small (half a hectare or less). On several occasions it was stated that farmers who are better endowed with resources are more likely to produce cotton. For example, cotton growers in Rimai (Chipinge District) usually have relatively bigger farms whereas in Chizumba (Mwenezi District), which is some distance from Triangle's collection point, it is mainly farmers owning their own scotchcarts who are in the position to produce cotton. Often these are masterfarmers who are being trained by Agritex in cotton production.

129. The other cash crops are also planted only on a limited scale. A communal farmer with 3 hectares of total arable land is unlikely to produce sunflowers on more than half a hectare. Tobacco is only produced by a few communal farmers (e.g. roughly 5% in Musilizwi) and on small plots. Vegetables such as tomatoes, cabbage, onions, etc are mainly produced in Mutoko District where growers are assisted by an EEC financed ARDA vegetable marketing project. Compared to other areas, there are more fenced fields around Mutoko. The size of the fenced plots varies between 0.2 up to about 0.7 hectares, according to local AGRITEX extension workers.

130. Vegetable production is being started close to the village visited in Mudzi District. Better use of the water stored in the dam will allow vegetable production in 30 - 50 small-scale gardens (0.1 hectares each).

131. In Chivi District there is also a small-scale vegetable project based on women's groups. However, production is first of all for household consumption and sale to the local market.

Constraints to Agricultural Production

132. The following constraints to agricultural production were identified in almost every village:

- Low and unreliable rainfall;
- Lack of draught power;
- Lack of cash to purchase inputs such as fertilizer, seeds, etc.

and in some cases:

- Transport;
- Availability of tools and implements;
- Labour;
- Land size and fertility;
- Wildlife such as monkeys, hogs etc.

133. The communal farmers of the South-East were especially hit by the 1991/92 drought. Villages such as Chizumba have lost 90% of their animals including draught power. Nevertheless, not only in this region but also in Mashonaland East, the lack of draught power always figured among the three main constraints to agricultural production. The lack of draught power was also given as a reason why, in some cases, not all the land could be utilised.

134. Farmers who do not have a plough and draught power often hire the equipment. The rates are about Z\$30-50 per acre (Z\$ 74 - 124 per hectare) to be ploughed by draught power. To hire a tractor with plough from District Development Fund (DDF) usually costs Z\$160 per hectare.

135. Lack of cash to purchase inputs such as seeds, fertilizer, etc. was another major constraint mentioned by farmers. At the same time, farmers are reluctant to take credit from Agricultural Finance Corporation (AFC) because they are afraid of repossession in the case of a drought year without harvests.

136. Transport problems are mainly due to the absence of scotchcarts, but lack of draught animals such as donkeys or oxen is also a problem. In Musilizwi, for example, only 20% of the farmers have a scotchcart. Villages which are further away from the main roads in particular encounter difficulties in transporting produce to collection points of GMB or Triangle Ltd. Transport of a 90kg bag of grain over a short distance (maximum 10 km) usually costs Z\$3 - 5.

137. Lack of tools and implements was stated relatively more often as a constraint in areas where there is a vegetable production.

138. Labour shortages are likely to occur during the planting and harvesting seasons. For example, in Chivi Ward 1, it was mentioned that children go to school which means they are less available for farm work. The lack of draught power and the subsequent need for hand tillage may equally lead to labour shortages, especially at the on-set of the rainy season when land needs to be prepared. In times of peak labour demand, farmers also tend to hire casual labour at a

rate of about Z\$8 per day. Table 12 gives an overview of seasonal agricultural activities in Masvingo Province.

Table 12: Seasonal Agricultural Activities in Communal Areas of Masvingo Province

Months	Activities
Sept. - Nov.	Land preparation
Nov. - Dec.	Main planting season
Dec. - Jan.	Cultivating rapoko
Jan. - March	Weeding, plant maintenance, etc.
March- April	Harvesting grains and groundnuts
May - June	Harvesting cotton and tobacco
July - Oct.	Marketing of produce

139. Land size or fertility were only mentioned as constraints in about a quarter of the villages participating in the RRA. According to the survey, the average land size per farmer in the villages visited is between 3 and 4 hectares. These farm sizes correspond to arable land available; in addition farmers have access to communal grazing lands. It was also stated during the survey that farm sizes have a tendency to decline since after the farmer's death farms are divided between children.

140. A study undertaken by GTZ - CARD (1985) in Gutu District found sizes of arable land per communal farmer varying between 3.2 hectares in Natural Region (NR) III, 3.7 hectares in NR IV and 5.4 hectares in NR V. The ploughed land varied between 2.6 hectares in NR III, 3.2 hectares in NR IV and 4.0 hectares in NR V.

141. Regarding soil fertility, farmers are usually aware of the value of the use of manure but the death of animals, especially in the South East, during the drought led to lower supplies of manure.

EXISTING CASSAVA IN COMMUNAL AREAS

Cassava Production

142. Cassava was found in all Districts visited. However, the crop was more established in Mutoko, Mudzi and Chipinge Districts compared with Gutu, Chivi, and Mwenezi. In the latter Districts, most of the planting material was recently introduced on a small scale by AGRITEX in order to bulk up planting material and do on-farm trials. One farmer met in Chivi (Ward 5) has 300 plants for which he received the cuttings from AGRITEX. According to AGRITEX, the total number of plants in that Ward is between 500 and 1,000.

143. In the other Districts farmers usually have between 5 and 20 plants in their garden. However, only a fraction of the farmers grow cassava (roughly estimated between one fifth

and one third). In most of the cases it was said that cuttings are planted during the dry season when roots are usually consumed. After an average rainy season there is still enough moisture left in the soil to allow cuttings to sprout. However, a lot of planting material was lost during the 1991/92 drought when cuttings dried out after being planted in the moisture-less soil.

144. Only a few mature cassava plants were encountered in the course of the RRA. Thus, it was impossible to get a picture of potential cassava yields under marginal farming conditions. Roots of a plant up-rooted in Madhuku which was about one year old (planted in November 1992) weighed approximately 0.5 - 1kg. It was suggested that this low yield may partly be due to planting practices (ie. vertical planting of sticks).

145. Cassava plants not introduced by AGRITEX were of unknown origin. Communal farmers with small numbers of plants in their gardens usually mentioned other communal areas or occasionally neighbouring countries such as Mozambique or Malawi as origins of the planting material.

Constraints to Cassava Production

146. Farmers usually mentioned problems related to moles, termites, etc. when asked about constraints to cassava production. Farmers were not aware of any particular diseases. Nevertheless, the cassava plot managed by a women's group in Seke (close to Harare) seemed to be infested with the *African Cassava Mosaic Virus*.

147. The need for fencing to protect the crop from domestic and wild animals was stated as a major constraint to cassava production. Cassava will be among the very few green plants in the field during the dry season between April and October. Thus, cassava fields are likely to be damaged by goats, cattle, donkeys, wild hogs, etc.

148. However, costs of fencing are high. One kilometre of four strand cattle fence costs about Z\$5,000. It is assumed that a fence preventing smaller animals from entering the field will cost about double that amount.

149. Transportation of fresh and processed cassava was also identified as a potential constraint. Small-scale growers with less than half an acre of cassava may be able to carry fresh roots by hand or on their heads from the field to the processing site but larger scale producers would require draught powered transport. Fields should be located in the range of 1 to 2 km from the processing site.

150. Low rainfall is another constraint in so far as the crop would require two rainy seasons so that producers can achieve satisfactory yields.

Processing and Utilisation of Cassava

151. No machines are used for processing cassava which, at present, basically involves peeling prior to boiling. Occasionally, roots are dried and pounded into meal.

152. In Manicaland and Mashonaland East farmers are used to the consumption of boiled cassava but also know how to dry and grind the roots in order to include the meal in *sadza*. One small-scale farmer in Mutoko District also said that about 20 to 30 years ago (when he was a child) his family fed pigs with boiled cassava.

153. In Masvingo Province, farmers appeared to have less experience with cassava and in Mwenezi, the toxicity issue was raised. Thus, it appears that farmers in Masvingo Province would require more training in relation to processing, utilisation and consumption of cassava.

154. Farmers in Madhuku showed the RRA group four different processed cassava products: boiled roots, dried roots, cassava flour, and *sadza* partly made from cassava meal.

155. Asked about appropriate processing technologies, farmers did not reject the idea of using manual chippers. In one case, farmers said they could start processing roots by hand before embarking on more sophisticated technologies. It appears to be important to develop appropriate processing technologies in concordance with increasing production.

Farmers' Motivations to Increase Cassava Production

156. Before being asked to rank their motivations to grow cassava, farmers were given the following three options: cassava as food crop, cash crop, animal fodder.

157. In all villages the top motivation to grow cassava was either for food or cash. Farmers were more likely to opt for cassava as a food security crop in areas where cassava is already known and consumed to some extent or where there was an acute food shortage during the 1991/92 drought.

158. In the South East of the country the possibility of selling dried cassava was emphasised in villages located in Triangle's catchment area. Concerning Masvingo Province, farmers in Gutu and Chivi Districts had a quite strong preference for cassava as a cash crop whereas the villagers of Mwenezi gave food security as the primary reason. This needs to be seen in light of Mwenezi's serious food security problem during the last drought.

159. In Chipinge District (Manicaland), two villages preferred cassava first of all for food (Madhuku, Muzite) and two for cash (Musilizwi, Rimai). However, it appears that Madhuku would be better located to start cassava as a cash crop owing to its excellent road connections with Triangle. On the other hand, Musilizwi may face transport problems with

an expanded cassava production because Triangle's lorries do not come close to the village. Muzite also is disadvantaged by its remote location.

160. In Mutoko and Mudzi Districts (Mashonaland East) food was usually stated as the primary reason to expand cassava production. Only the Mushani farmers put cash before food security. It should be mentioned that the option of producing cassava for cash was mentioned by the RRA team, but not particularly stressed owing to the absence of potential marketing channels like those in the South. In these districts, the RRA team had to be careful not to raise false hopes for a new cash crop.

161. In Mutoko District cassava could easily be included on a small scale as a subsistence crop in the already existing vegetable gardens. However, it seems unlikely that it can compete against the vegetables produced for cash.

162. In Mudzi, cassava could play a stronger role as a food crop since this district (compared to Mutoko) is disadvantaged as regards agricultural production. Vegetable production takes place on a much smaller scale than in Mutoko which, at the same time, means that fenced areas are limited.

163. Stockfeed was never given a top priority in the villages visited during the RRA. Only in two cases (Chivi, Ward 1 and Neshuro) was stockfeed mentioned as the second most important priority. The low priority generally given to cassava as stockfeed needs to be seen in the light of the grazing conditions at the time of the survey which were plentiful for the small number of cattle left after the drought.

164. Nevertheless, a few farmers with draught animals showed interest in cassava-based animal feeds. Some of these farmers already use their own products such as cereals and oilseeds as animal feeds. In one village in Mutoko District, the extension worker pointed out that farmers are quite active in poultry production and could therefore be interested in cassava as well. At present, they feed grain, cowpeas, etc to chickens.

165. It may take 5 to 6 years until the depleted communal cattle herds will be restocked again. Therefore, the majority of farmers owning cattle in marginal areas may not be very interested in cassava-based cattle feed. However, in the long-run, an intensification in communal animal production can be predicted. This may be linked to increasing pressure on land due to environmental degradation, population growth, etc. (See also chapter on cassava markets). Economic development will also lead to an increased demand for animal products.

166. In parts of the country (e.g. Matabeleland), cattle fattening schemes are being developed by communal farmers and are showing satisfactory results. At present, these schemes use stockfeeds purchased from commercial feed millers. In the future, once the crop is better established, these

farmers might consider cassava-based stockfeeds as well.

167. ARDA - dairy schemes based on small-scale farmers (e.g. Rusitu in Manicaland) appear to have problems with fodder supply during the dry season. Cassava produced and processed on-farm could be an option to bridge this gap. A protein balancer would be required in this case.

168. The sale of cassava-based stockfeed by communal farmers' groups could be another long-term option. Neighbouring communal livestock schemes or ranchers could be potential buyers.

169. In Binga, cassava-based stockfeed could be mixed with fish meal and small grains to produce a balanced stockfeed. Fish is caught in the Zambesi River and according to Save the Children Fund, who are active in the area, fishermen catch considerable amounts of smaller species which are dried. However, this option should only be considered if there is enough protein available for human consumption.

PROFITABILITY OF CASSAVA IN COMMUNAL LANDS

Assumptions and Requirements

170. To calculate the profitability of cassava production in communal areas of Zimbabwe, a number of assumptions had to be made owing to the absence of full-scale production at present. These assumptions were derived from standard literature on cassava production and processing and from findings of the RRA. Dr M Porto of CIAT/IITA contributed yield estimates.

171. Average annual rainfall in the areas visited is in the range of 400 - 800 mm; within this range Natural Region (NR) III receives about 600 - 800mm and Natural Regions IV and V 400 - 650 mm. Thus, rainfed cassava in communal lands must be looked upon as a biennial crop and potential yields are estimated as follows: 18 tonnes per hectare in Natural Region III, 15 tonnes per hectare in Natural Region IV, and 12 tonnes per hectare in Natural Region V. These figures are largely based on Dr Porto's estimates which conclude that on average 15 tonnes per hectare after 18 months of growth are possible in the area considered provided the recommended cultural practices and good genotypes are used.

172. Cassava is tolerant of a wide range of soil qualities. In the South-East of Zimbabwe soil types range from granity, sandy soils around Masvingo to vertisols in the Lowveld. Although the soil quality is very good in the Lowveld, average rainfall is only of the order of 400 - 500 mm, thus limiting the yield potential. The high proportion of swelling clays in the vertisols of the Lowveld will not hamper harvesting if this is done outside the rainy season.

173. Fencing is a requirement for a biennial cassava production because the crop will be the only green matter

around during the dry season and, thus, will be prone to attacks by cattle, goats, donkeys, and wildlife. As already mentioned, fencing costs are very high: about Z\$10,000 for one kilometre of goat-proof fence. As highlighted in the RRA, communal farmers are constantly short of cash to purchase inputs for agricultural production. Therefore, it appears unlikely that farmers can afford fencing larger areas for cassava production.

174. Subsidies may be required for fencing areas of more than one acre. It is important that farmers work in groups to avoid fencing of each individual plot. One hectare of land requires 400 metres of fence whereas 14 hectares would require 1,500 metres costing Z\$15,000. Assuming a group size of seven farmers cultivating one hectare each, 2 groups could produce cassava on a 14 hectare plot. The annualised fencing cost per hectare would amount to Z\$ 174 (see Appendix 8 for details); however, due to the fact that cassava will be grown on a biennial basis, the actual fencing costs per crop cycle will be double that amount. In addition, maintenance costs (5% p.a. of the initial investment) need to be included as well. Thus the total fencing cost per hectare amounts to Z\$456 over a two year period.

175. In the context of fencing it is also important to make the right choice of fencing material; the use of wooden poles may enhance the already existing environmental degradation in marginal lands of Zimbabwe.

176. Live fencing might be a possibility for reducing costs, however there exist a number of potential pitfalls (pers. comm. Peter Thorne):

- Live fencing would require labour inputs for establishment and maintenance and, in addition, planting material and management information have to be readily available;
- The most productive, fast-growing and palatable trees such as *Leucaena*, *Gliricidia* etc may face difficulties in South-Eastern Zimbabwe due to low rainfall patterns;
- *Acacia*, which are more drought resistant, are, on the other hand, less palatable and have a relatively long establishment period, perhaps of three years and more, before they become animal-proof.

177. Aside from fodder species, unpalatable plants such as JCL (*Jatropha curcas* L.) could also be considered as live fencing (pers. comm. Dr Loos, AGRITEX/GTZ, Masvingo). They not only provide protection against freely roaming animals, but also produce nuts, the oil of which can be used as a fuel substitute, for medicinal purposes, etc.

178. Labour requirements to produce and process cassava in the South-East of Zimbabwe are estimated as in Table 13 for a 15 tonne yield.

Table 13: Labour Requirements in Cassava Production and Processing

	Labour days/hectare
Clearing previously used land:	6
Soil preparation (2-ox team, single-furrow plough):	4
Taking and preparing cuttings:	6
Planting cuttings:	14
Maintenance:	15
Harvesting (2 days/tonne of fresh roots):	30
Transporting fresh roots with scotchcart (2 loads of 1,000 kg per day):	7.5
Chipping with manually-driven chipper (50 kg per hour or 1 tonne in 2.5 days):	37.5
Drying (1 day per tonne):	15
Transporting dried cassava with scotch-cart (2 loads of 500 kg per day):	3
Total:	138

Source: Partly Sylvestre (1989) and partly own estimates.

179. This estimate of potential labour requirements should be regarded as provisional; only further on-farm research will provide exact figures on labour input in cassava production in marginal lands of Zimbabwe.

180. It is expected that soil preparation will primarily be done by using draught power (either donkeys or oxen) in combination with a single-furrow mouldboard plough. Due to the fact that draught power is a major constraint in communal lands, it is assumed that the majority of farmers will have to hire draught power.

181. The traditional hoe will be the main tool for other soil preparation activities, planting, weeding, and harvesting.

182. It is assumed that farmers will not incur costs for planting material. During the first years of a larger-scale Zimbabwean cassava production it would be the project which would have to provide growers with free cuttings. At a later stage farmers could then use planting material from their own cassava production. In addition, no fertilizer inputs and chemicals are planned to be used.

183. Smaller quantities of cassava can be transported by headload over shorter distances but larger amounts of roots are likely to require draught powered transport. It can be assumed that the majority of farmers would have to hire scotchcarts and draught power to transport fresh roots from the field to the processing site (1 - 2 km) and then, from there, the dried chips to the centre of collection (up to 10 km). The cost of transport is estimated at Z\$10 per tonne of fresh roots whereas the transport of dried chips is expected to cost about Z\$2 per 50kg bag.

184. In the case where farmers would use their own means of transport, there would either still be an opportunity cost

for not using the equipment for other purposes, or costs would have to be considered for purchase and maintenance of animals and equipment.

185. Chipping and drying costs are based on the case where a manually-operated chipper will be used by seven farmers who would also share a 50sqm drying floor. The processing costs shown in table 14 below are based on the fixed costs for chipper (Z\$36.1/farmer per p.a.), drying floor (Z\$20.1/farmer p.a.) and maintenance costs (Z\$5.7/per farmer p.a.). It should be remembered that these fixed costs will be doubled due to the fact that cassava is a two-season crop in Zimbabwe. In addition, variable costs will include spare parts (Z\$20 for blades p.a.) and small tools (Z\$30 p.a. for rakes and shovels).

186. The labour requirements for processing are included in the total labour input figures due to the fact that chipping and drying is most likely to be done by the farmers themselves. More detailed processing costs are outlined in Chapter III where the case of chipping with manually-operated machines is compared to motorised chippers.

Comparative Crop Budgets

187. The crop budgets estimated in Table 14 for Masvingo Province²⁾, show that cassava can compete against other cash crops although one has to consider that cassava will be a two season crop. Only cotton offers a higher net income per season: Z\$896/hectare compared to Z\$724 for cassava. Other cash crops such as groundnuts (Z\$548) and sunflowers (Z\$439) and the subsistence crops maize (Z\$7) and small grains (Z\$128)³⁾ are less profitable.

188. With regard to the indicator net income per labour-day, cassava is the most profitable crop for the farmer. The farmer can expect a remuneration for cassava of the order of Z\$10.50 per day of labour input whereas it is Z\$6.84 for cotton. Compared to this, farm workers receive about Z\$8 per day.

189. Results for Natural Regions III and V of Masvingo Province, the details of which are outlined in Appendix 6, are similar. Cotton remains the main competitor for cassava. Tobacco which is planted on a small scale in Natural Region III of Masvingo has had a bad result due to a sharp fall in prices in 1993.

2) Masvingo Province was chosen for the comparative calculation of crop budgets because of Triangle's location and the company's commitment as potential buyer of dried cassava chips.

3) Mhunga, rapoko and sorghum have been summarised under the category of small grains. Although the GMB producer price is Z\$520 per tonne of small grains, some private buyers pay about Z\$600 for these cereals in communal areas.

Table 14:

**Masvingo Province, Natural Region IV
Estimated Crop Budgets (for 1 hectare)**

	Units	Crops					
		Cassava*	Maize	Small Grains	Cotton	Shelled *** Groundnuts	Sunflower
Income							
Yield	t / ha	15.00	0.50	0.50	0.65	0.50	0.50
Price	Z\$ / t	185	900	600	2,900	1,800	1,400
Gross income	Z\$	2,775	450	300	1,885	900	700
Production costs							
Fencing**	Z\$	456					
Soil preparation (hired animal draught power)	Z\$	75	75	75	75	75	75
Small tools	Z\$	20	20	20	20	20	20
Seeds	Z\$	0	82	30	58	90	43
Fertilizer	Z\$	0	154	0	154	88	61
Chemicals	Z\$	0	20	0	500	0	0
Transport of inputs (\$3/bag)	Z\$	0	9	0	9	6	3
Transport of fresh roots (\$10/tonne)	Z\$	150					
Chipping and drying, fixed costs	Z\$	124					
Chipping and drying, variable costs	Z\$	125					
Packing of produce	Z\$	30	4	4	10	6	4
Transport of output (\$2-4/bag)	Z\$	222	20	20	30	20	20
Seasonal interest on variable costs (10% real)	Z\$	62	38	15	86	31	23
Contingency allowance (5%)	Z\$	63	21	8	47	17	12
Total	Z\$	1,327	443	172	989	352	261
Net income ****	Z\$	1,448	7	128	896	548	439
Cropping seasons	Seasons	2	1	1	1	1	1
Net income/season	Z\$/season	724	7	128	896	548	439
Labour requirements	Man-days	138	78	87	131	147	110
Net income/ labour day	Z\$/day	10.49	0.09	1.47	6.84	3.73	3.99

Explanations:

* The price of cassava corresponds to Z\$500 per tonne of dried chips converted into fresh root equivalent by using a conversion factor of 2.7 (2.7 tonnes of fresh roots give 1 tonne of dried chips).

** Fencing costs are annualised (see also appendix 5).

*** It is assumed that farmers will use their own groundnut seeds, for which an opportunity cost is put.

**** The term "Gross Margin" was not used because part of the cassava production and processing costs are fixed costs.

190. The results for the Lowveld around Chisumbanje are comparable to those for Natural Region V of Masvingo Province.

191. In Mutoko, where growing conditions are more favourable, cassava would face competition from vegetables, flue-cured tobacco, cotton, maize, groundnuts, and sunflower, all of which are cash crops in that District.

192. Mudzi District, close to the border of Mozambique, has fewer cash crop opportunities due to less favourable growing conditions and a less developed marketing system due to its location far away from the main consumption centres.

193. To summarise, it appears that cassava will mainly have to compete against cotton as a cash crop in marginal areas of South-East Zimbabwe. Although cotton appears to be more profitable on a net income per season basis, farmers may include cassava in their production system not only for food security purposes but also to diversify their cash crop production.

194. It must be remembered that these figures are based on a number of assumptions, which are outlined above. Therefore a sensitivity analysis (Table 15) has been used to highlight how possible changes in prices, yields, or fencing costs could affect the outcome.

Table 15: Sensitivity analysis for cassava crop budget in Masvingo Province, Natural Region IV (in Z\$).

Assumptions	Net income/ season/ha	Net income/ labour-day
Standard situation cassava (Z\$500/t of chips, yield 15t/ha)	724	10.49
No fencing costs	963	13.96
Dried cassava price Z\$400/t	446	6.47
Dried cassava price Z\$600/t	1,001	14.51
Dried cassava price Z\$700/t	1,279	18.53
Cassava yield 12t/ha	498	8.16
Cassava yield 18t/ha	950	12.10
For comparison standard situation cotton	896	6.84

Note: Only one variable is changed at a time, the others remain as in the standard situation.

195. The results of the sensitivity analysis show that cassava's net income per season per hectare would surpass the one of cotton if root yields were of the order of 18 tonnes per hectare. A 100% subsidy for fencing or dried root prices above Z\$500 per tonne of dried roots would equally lead to more favourable results for cassava. On the other hand, cassava may face difficulties to take off as a cash crop if dried root prices were of the order of Z\$400 or if average yields dropped below a level of 12 tonnes per hectare.

196. Although under normal conditions cassava can achieve results comparable to cotton, it is unlikely that farmers will devote larger proportions of their land to cassava without actually experiencing positive results. A farmer with about 3 hectares of land to plough is most likely to plant about 2 hectares to the subsistence crops maize, millets, and sorghum⁴). The remaining hectare may be planted, at present, to a variety of cash crops such as cotton and sunflower after the planting of the cereals is finished.

197. Therefore, it can be assumed that at the beginning, when cassava is introduced in a village, farmers will cultivate the crop only on a small area (most probably less than one acre) and on a trial basis. The up-take of cassava will then depend a lot on how it will perform yield-wise and how constraints such as fencing can be solved.

The Effect of a Cassava Project on Women

198. There is no clear evidence that cassava will be either a women's or a men's crop. The RRA revealed that, at present, both men and women are knowledgeable about cassava and, on a very limited scale, engaged in producing the crop.

199. Only a substantial increase in production can show whether a cassava project will be to the benefit of women. A lot may depend on whether it will become a food security crop or a cash crop. If cassava will be first and foremost produced as a subsistence crop then it is possible that women will have to do the bulk of the work related to producing and processing the crop.

200. On the other hand, if cassava becomes a cash crop then there is the possibility that men will be more interested in the crop although in some cases (eg. Chivi District) women also showed a strong priority for cassava as cash crop.

201. Thus, further socio-economic on-farm research would be required to study labour-divisional aspects related to cassava to determine whether women or men will be the principal beneficiaries of a large-scale cassava production.

Impact of Cassava on Environmental Degradation

202. There is no evidence that cassava denudes the soil. Nitrogen and phosphorus are retained in the stems and leaves and can thus, if not otherwise utilised, be re-cycled through the following crop (Robertson, 1992). In addition, cassava can contribute to preserve already degraded soils by providing cover.

4) A family of 6 - 8 members can be expected to consume about one tonne of cereals corresponding to the harvest from about 2 hectares in marginal lands of Masvingo Province.

203. Concerning the impact of cassava on the rehabilitation of soils degraded through cotton/wheat mono-culture, a cost-benefit analysis can show the profitability of the original situation compared to a cropping system which includes cassava. However, a clear understanding is required on the extent of potential changes in cotton and wheat yields following the inclusion of cassava into the cropping system. It appears that only further research on the performance of cassava in the cropping systems considered can lead to a conclusion on whether or not a net benefit increase can be expected.

CHAPTER III: PROCESSING OF CASSAVA

CHIPPING AND DRYING

204. Some introductory explanations regarding the processing of cassava is useful: Cassava must always be processed or consumed within a few days of harvesting owing to the perishability of the crop. Peeling of roots is not required if they are used for stockfeed. Sun-drying of cassava chips to a moisture content of 14% takes about 2 - 3 days on a concrete floor.

205. It is assumed that in Zimbabwe the best processing season would be May to September. This is based on the following reasons: the period corresponds to the main dry season, farmers would have more time to harvest and process cassava, and demand for cassava based stockfeed would be highest between June and October. In addition, this fits with the seasonality of the crop requiring two rainy seasons.

206. In various countries (eg. India, Ghana, etc.) traditional processing is done by slicing peeled or unpeeled roots with handknives. According to Balagopalan *et al.* (1988), one person can slice 24.2 kg of fresh roots per hour based on an average chip thickness of 12.5 mm. However, besides being a time consuming chore, this method may lead to inferior quality of dried chips since thick and unevenly shaped chips may cause delays in drying.

207. In the situation where large-scale cassava production was to emerge in Zimbabwe, two options for mechanised cassava processing have been identified:

- On-farm chipping with manually operated chipper and sun-drying on small-scale drying floors;
- Chipping and drying by private entrepreneur who operates motorised chipper on village level in combination with a 500 sqm drying floor.

208. The first option consists of on-farm chipping with manually driven chippers which can be shared between seven farmers who would also share a 50sqm drying floor. It is assumed that a locally produced chipper with a useful life of 4 years would cost about Z\$800.

209. The construction cost of a 50sqm concrete drying floor with a useful life of 20 years is estimated at Z\$1200. It seems necessary to construct concrete floors because the traditional drying floors include mud and cow-dung which may lead to the contamination of processed cassava. Rocks which are also traditionally used for drying agricultural produce in Zimbabwe could only be used for drying limited amounts of cassava.

210. The drying conversion factor on a concrete floor is estimated to be of the order of 2.7; ie. 2.7 tonnes of unpeeled fresh roots will yield 1 tonne of dried chips (CIAT *et al.*, 1992).

211. The advantages of the first option are as follows: low investment costs, low management requirements, equipment can be manufactured locally, chipping of cassava roots by small-scale hand-driven machines would provide on-farm employment and the farmer would be the direct beneficiary of the operation. The disadvantages of this technology are linked to its labour requirements and low chipping capacity.

212. Nevertheless, it is estimated that 50 kg of fresh cassava can be chipped per hour with a hand-driven chipper. This means one family can chip one tonne of roots within 2.5 working days.

213. Chipping with hand-operated machine and sun-drying on farm would result in processing costs of about Z\$160 per tonne of dried chips if one farmer would chip 5 tonnes of cassava p.a. The cost calculations take account of opportunity costs for family labour required to operate the chipper, spare parts, tools and packaging as outlined in Appendix 7.

214. The second option consists of motorized processing units which would be run by a private entrepreneur. In this case the owner of the unit would purchase fresh cassava from the farmers to sell it to the feed millers.

215. The cost of a chipper with integrated 4hp petrol motor and with a useful life of 5 years is estimated at Z\$6,000. NRI's Agroprocessing section has such a chipper and its capacity is in the range of 4 tonnes of fresh roots per hour (pers. comm. Richard Marder).

216. Sun-drying would take place on 500 sqm concrete drying floors, the construction cost of which is estimated at Z\$12,000 per unit⁵⁾. It is assumed that 300 to 400 tonnes of fresh cassava can be dried on such a floor within a 4 to 5 month period. However, this needs to be assessed under climatic conditions in Zimbabwe. CIAT (1989) calculated the ideal drying load at about 12 kg of fresh chips per sqm at the North Coast of Colombia.

217. The advantages of this option are linked to the high chipping capacity which is estimated at about 4 tonnes of fresh roots per unit. In addition, a central processing unit would be advantageous if further steps of processing such as milling or animal feed compounding would be envisaged. In this case a hammer-mill and a feed mixing facility could be added to the already existing chipping and drying facilities.

5) 40m³ of concrete are required for a 8 cm thick 500 sqm floor, ; this corresponds to 10.4 tonnes of cement plus 25m³ of sand, 33.4m³ of gravel and about 5,000 l of water, assuming that the drying floor will be built on sandy soils (CIAT, 1989). The cost of cement is Z\$ 37 per 50 kg bag or Z\$7,700 for the entire floor; it is assumed that the costs for sand, gravel and labour will bring the total construction cost of the floor to Z\$12,000.

218. The disadvantages of such an approach are as follows: High investment costs for machinery and drying floor and processing units would require large supply of roots to make business profitable.

219. The cost calculations (Appendix 7) show that motorised processing is only viable if there are large amounts of cassava available. Management costs are included in the calculation. They correspond to the remuneration of the owner's time (5 months) involved in running the processing unit.

220. The relation between processing costs and throughput is shown in Table 16.

Table 16: Processing costs in relation to throughput
(Motorised chipping)

Throughput p.a. in tonnes of fresh cassava	Processing costs in Z\$ per tonne of dried chips
200	188
250	159
350	131

221. Thus, it appears inappropriate to start processing with motorized chippers. On the other hand, it is unlikely that private entrepreneurs will start a chipping business in potential growing areas unless there are sufficient quantities of fresh roots produced.

222. A manually operated chipper seems to be more adapted to situations where the annual amount of cassava to be processed per chipping unit were below 250 tonnes. In fact it appears more profitable to install up to 7 manually driven chippers (shared by seven families each) with a seasonal capacity of around 35 tonnes each before embarking on a bigger centralised processing unit. The Central Tuber Crops Research Institute (CTCRI) based in Trivandrum, Kerala, India has developed a low-cost hand-operated chipping machine which may be considered by the project (Balagopalan, 1988). NRI could also assist in identifying an appropriate processing technology.

223. Unmechanised chipping with a handknife or a similar tool appears to be more profitable in cases where farmers would process less than 2 tonnes of cassava p.a. This is based on the assumption that one person can chip about 20 kg of cassava per hour. The type of drying floor, which may be rocks, and tools to be used is not considered in this calculation.

FEED MIXING

224. As already outlined above, another line of research should develop a technology to produce cassava-based animal feed rations by farmers groups. The type of technology to be used in such an enterprise will depend upon the alternative uses of the equipment. For example, hammer mills existing in communal lands can also be used for milling cassava chips. With regard to feed mixing facilities, manually-operated machines may be more appropriate especially during the first three to four years when cassava supply will be low.

225. Cassava producing and processing groups would have to purchase supplementary protein rich inputs such as soya bean meal, cotton-seed cake or manufactured concentrates to produce balanced feed rations which they could use for their own livestock or sell to neighbouring cattle schemes or farms. In October 1993, the prices of potential protein balancers for stockfeed were as follows in Harare:

- Cotton-seed cake: Z\$1239/tonne (for less than 15T),
Z\$1180/tonne (for more than 15T);
- Sunflower cake: Z\$1012/tonne (for less than 15T),
Z\$964/tonne (for more than 15T);
- Soya bean cake: Z\$1654/tonne (for less than 15T),
Z\$1575/tonne (for more than 15T).

(Source: Lever Brothers Ltd, Harare, telephone enquiry)

226. Villages with easy access to these products would be advantaged in using cassava in animal feed. Remote production areas without agro-industrial processing units in the vicinity may face prohibitive transport costs.

227. In this case, other options may be considered:

- The utilization of by-products from local maize mills;
- As far as possible, combining cassava with protein rich fodder plants or trees such as *Leucenia*.

228. The cost of these feed-stuffs will depend on the quantity and type of ingredients used and the mixing technology. If a feed mixing facility with specifications similar to the ones of the manually-driven cassava chipper would be used, then the annual fixed costs would amount to about Z\$62 assuming the unit would be shared by seven farmers (see previous section).

229. The cost of one tonne of animal feed made out of 400 kg of dried cassava, 300 kg of maize by-products, 200 kg sorghum, and 100 kg of soya bean cake can be estimated as follows in Table 17.

230. The calculations in Table 17 are based on a cassava price of Z\$500/tonne of dried chips. Transport costs only include the transport of soya beans; the other ingredients are assumed to be locally available. The total price of Z\$909 per tonne of feed has to be compared to the price of

feed rations sold by the commercial manufacturers, which are of the order of Z\$770 to above Z\$1,500 depending on the feed value of the product (NF price list, June 1993).

Table 17: Costs of producing one tonne of animal feed

Inputs	Z\$
Cassava:	167
Sorghum:	120
Maize by-products:	195
Soya bean cake:	165
Transport of soya-bean cake:	20
Grinding cassava, sorghum, and soya-bean cake:	70
Small tools:	20
Family labour (5 hours):	40
Fixed costs for feed mixer:	62
Interest on working capital: (0.75% over 3 weeks)	7
Contingencies (5%):	43
Total	909

231. Cassava based animal feed could be an option for Binga where Save the Children Fund in collaboration with ZFU works with farmers groups who already have some experience with cassava production. Locally available surplus fish from Lake Kariba may be considered as a protein supplement. In addition, the groups in Binga have some infrastructure (ie. warehouse, truck, diesel engine, hammer mill) potentially useful in connection with cassava processing and marketing.

232. An integrated cassava based feed processing line seems to be important in the case of Binga since this district has the disadvantage of being far away from the major stockfeed manufacturing centres. The distance between Binga and Bulawayo is approximately 450km and transport by road costs Z\$130 - 140 per tonne.

233. Gwanda District was also mentioned as a major communal cattle raising center in Zimbabwe where locally produced cassava based animal diets could be used by pen-fattening schemes. The Gwanda based NGO Sarvadoya could be approached in this context.

234. Small-scale dairy producers in schemes administered by ARDA may also be interested in using dried or fresh cassava as fodder (see also above section on farmers' motivations to produce cassava).

235. It should be remembered that only on-farm trials can give a definite answer on whether or not these options will be viable in the long term. RRA type exercises would be required to identify constraints and opportunities in more detail in areas not covered by the RRA in October 1993.

APPENDICES

1. Itineraries
2. References
3. RRA Case studies
4. Maps of RRA sites
5. Fencing costs
6. Estimated crop budgets;
Masvingo, Natural Regions III and V
7. Processing costs
8. The Zimbabwean stockfeed market 1980 - 1985

APPENDIX 1
ITINERARIES

APPENDIX 1

Itinerary first visit: 1-15 June 1993

- 31 May: Departure to Zimbabwe.
- 1 June 1993:
Harare Mr D Kwenda, Cassava Project Manager, Biomass Users Network;
Dr P de Groot, Project Officer, Commonwealth Science Council;
Mr C Chimombe, Director, Biomass Users Network;
Mrs L Tapfumaneyi, Senior Crop Specialist, AGRITEX;
Dr W J Ascough, Director, Development Technology Centre, University of Zimbabwe;
Dr Rukuni, Development Technology Centre, University of Zimbabwe;
- 2 June:
Harare Dr J M Chitsika, Technical Director, Chibuku Breweries;
Mr P Chigumira, Technical Director, Cairns Foods Ltd.;
Mr W Mhanda, Research & Development Manager, Cairns Foods Ltd.;
Mr M Ndudzo, General Manager, Industrial Development Corporation;
- 3 June:
Harare Mr M J Boyd-Clark, Chief Executive, Confederation of Zimbabwe Industries;
Mr P F Kunjeku, Projects Consultant, Confederation of Zimbabwe Industries;
Mr J Brown, Agricultural Consultant, Delta Corporation Ltd.
- 4 June:
Kanyati Kanyati and Gatshe Gatshe ARDA Land Use Project, EEC sponsored:
Mr J Bvuma, Project Co-ordinator;
Mr P John, Field Manager;
Mr A W Verhoek, Technical Assistant.
- 7 June:
Chiredzi Mr I M Mharapara, Head, DR&SS Lowveld Research Station;
- 8 - 9 June:
Triangle Triangle Limited:
Mr C J Lightfoot, General Manager, Planning & Development;
Mr D Ncube, Cotton Gin Manager;
Mr S A P Nortier, Commercial Director.
- 10 June:
Gwanda Dr P Kempadoo, Sarvadoya Development Education Organisation, local NGO;
Mr J L Dube, Extension Officer, AGRITEX.

- 11 June: Visit of cassava plant material multiplication site at Sanyati, Return to Harare via Kadoma.
- 14 June: Mr Katsaruware, Operations Manager, Harare Food & Industrial;
Mr R J Mazhetese, Quality Assurance Manager, Food & Industrial; Director of Zimbabwe Institute of Development Studies.
- 15 June: Dr J M Made, Deputy General Manager, Agricultural and Rural Development Authority;
Mr Elvis Tembo, Senior Agricultural Extension Specialist, Institute of Agricultural Engineering, AGRITEX.

Itinerary second visit : 21 July - 24 August 1993

- 20 July: Departure to Zimbabwe;
- 21 July: Mr D Kwenda, Cassava Project Harare Manager, Biomass Users Network;
Mr J Collins, Director Stockfeeds, National Foods Limited;
- 22 July: Mr I Chisoro, Production Manager, Harare Hunyani Paper & Packaging Limited;
Dr Rukuni, Development Technology Centre, University of Zimbabwe;
Mr C Chimombe, Director, Biomass Users Network;
Mr M Mapako, Senior Technical Officer, Biomass Users Network.
- 23 July: Blue Ribbon Foods Limited to make Harare appointment with Technical Director;
- 26 July: Mr S Madlazi, General Manager, Harare Technical & Engineering Services, Blue Ribbon Foods Limited;
Mr Zembe, Economist, Grain Marketing Board.
- 27 July: Mr A Muti, Agro-Economist, ARDA; Trip to Bulawayo.
- 28 July: Mr D Hewitt, BRC Tapes and Tubes Bulawayo (Coro-pack products);
Mr Mabhena, Chief Extension Officer, Agritex, Matabeleland North;
RMS (Transport company);
Mr D Masendeke, Agricultural Extension Officer.

29 July: Return to Harare.

30 July: Dr L Mhlanga, General Manager, ARDA;
Harare Dr J M Made, Deputy General
Manager, ARDA;
Mr Dennison, Feed Nutritionist,
Agrifoods Ltd;

2 August: Mr C M Wenman, Technical Director,
Triangle Triangle Ltd;

3 August: Mr D Ncube, Cotton Gin Manager;
Triangle Mr S A P Nortier, Commercial
Director;
Mr Young, Manager, Nuanetsi Ranch;

4 August: Private grain miller;
Chiredzi Zimbabwe Electricity Supply
Authority;
Mr Fouri, Commercial Farmer and
Consultant;

6 August: Dr S Sabenda, Department of Animal
Harare Science, University of Zimbabwe;
Dr J Tiffin, Livestock Consultant,
Cattle Company Centre;
Freight Information Desk,
Railway Station;

9 August: Mr C D Amira, Managing Director,
Harare Agrifoods;
Mr F M Chinembiri, Principal
Agricultural Specialist (Animal &
Pasture), Agritex;

10 August: Mr S P Kuipa, Managing Director,
Harare Food & Industrial;
Mr R J Mazhetese, Quality Assurance
Manager, Food & Industrial;
Mr C Mudiwa, Chief Economist,
Agricultural Finance Corporation;
Ms C Plastow, Third Secretary (Aid),
British High Commission;

11-13 August: Desk Work due to two National
Harare Holidays;

16 August: Mr P Compton, Imtec Ltd., Importer
Harare and Distributor of agricultural
equipment;
Mr J Kerr, CPD Manager;
Dr Atwood, Senior Agricultural
Officer, Ministry of Agriculture;

17 August: Mr J Harvey, Programme Officer, CARE
Harare Zimbabwe;

Mr N Wyngard, Production Manager,
Lobels Bakery;
Ms M Campbell, Zimbabwe Agricultural
Commodity Exchange;
Mr C Eldridge, Director, Save The
Children Fund;

18 August:
Harare Dr P Gilbert-Green, Chief Executive,
Cattle Producers' Association;
Mr H L Kanemanyanga, Assistant
Operations Manager, ; National Oil
Company of Zimbabwe;
Mr R Marowa, Financial Accountant,
National Oil Company of Zimbabwe;
Dr K Mandisodza, Director, Pig
Industry Board;

19 August:
Harare Mr J Collins, Director Stockfeeds,
Mr Keen, Animal Nutritionist, both
National Foods Limited;
Mr C Peters-Berries, Head, Economic
Advisory Project;
Mr E N Zhou, Agro-Economic Advisor,
both Friedrich Ebert Stiftung;

20 August:
Harare Mr E Chikava, Senior Agricultural
Economist, Zimbabwe Farmers Union;

23-24 August:
Harare Wrap-up with Mr. Kwenda and Mr. Muti;

24 August:
Return to Uk.

25 August:
London Dr P de Groot, Project Officer,
Commonwealth Science Council.

Itinerary third visit : 5 - 22 October 1993

4 October
London Departure to Zimbabwe; with
Dr P de Groot, Project Officer,
Commonwealth Science Council.

5 October:
Harare Mr Kwenda, Cassava Project Manager,
Biomass Users Network;
Mrs L Tapfumaneyi, Senior Crop
Specialist, AGRITEX;
Mrs Dembetembe, Cassava Project
Officer;
Mr Kabefu, Agricultural Economist,
ARDA;
Mr M Mapako, Senior Technical
Officer, Biomass Users Network.

6 October:
Gutu Mr Rufu, Agricultural Extension
Officer, AGRITEX, Masvingo Province;

Agricultural Extension Worker,
Basira;
Village meeting in Basira.

7 October:
Chivi District Agricultural Extension
Officer, AGRITEX, Chivi District;
2 village meetings in Chivi Ward 1
and 5.

Masvingo: Dr F V Goericke, Programme Co-
ordinator, Co-ordinated Agricultural
& Rural Development Programme, ARDA-
GTZ;
Dr H Loos, Agronomist, AGRITEX-GTZ.

8 October:
Mwenezi Agricultural Extension Supervisor,
AGRITEX;
2 village meetings in Mwenezi
District.

11 October:
Mutoko Mrs Mwenye, Agricultural Extension
Officer, AGRITEX;
Small-scale commercial farmer;

12 October:
Mutoko Mr Chesango, District Agricultural
Extension Officer, AGRITEX;
1 village meeting;
1 small-scale farmer;

13 October:
Mutoko 2 village meetings;
Mr Jaure, Project Co-ordinator,
Mr Dube, Marketing Officer, both ARDA
Vegetable Marketing Project;
Mr Rashayi, Grain Marketing Board.

14 October:
Mudzi Mr Myambo, Acting District
Agricultural Extension Officer,
AGRITEX,
Meetings with 2 groups of same
village;

15 October: Return to Harare via Murewa to see
project of Pig Industry Board;
Visit of Mbare vegetable market;
Visit of BUN project site in Seke.

18 October:
Chipinge Mrs Tanyanyiwa, Agricultural
Extension Officer, AGRITEX;
1 village meeting in Madhuku.

19 October:
Chipinge Mr Madongera, Agricultural Extension
Supervisor, AGRITEX;
Village meeting in Rimai;

20 October:
Chipinge Village meetings in Musilizwi
and Muzite;
Acting District Agricultural
Extension Officer;

21 October:
Triangle

Mr D Ncube, Cotton Gin Manager;
Mr I Mharapara, Head, DR&SS
Research Station, Chiredzi;
Return to Harare;

22 October:
Harare

Wrap-up session and return to UK.

APPENDIX 2

REFERENCES

APPENDIX 2

References

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APPENDIX 3
RRA CASE STUDIES

APPENDIX 3

RRA CASE STUDIES

Gutu District:

Basira (Natural Region IV)
6.10.1993

7 men and 5 women participated in the meeting which was held under a tree outside the village. Although the gathering was spontaneous, the discussion proved to be lively.

A few farmers know cassava but they do not have cuttings. This is despite the fact that they do not know how to use it. Farmers mentioned that they would require more training and extension related to the production and utilisation of cassava.

The main constraints to agricultural production in Basira are as follows:

- Lack of draught power because animals died during the 1991/92 drought;
- Poor yields because of lack of cash to purchase inputs such as fertilizer, etc;
- Infertile soils because there is no cattle to produce manure.

Maize is by far the most important crop, followed by mhunga and rapoko. Maize yields were estimated at about 450kgs/hectare and mhunga and rapoko yields at 500 to 600kgs. The only cash crop is sun-flower.

Seasonal peaks in labour demand occur during planting (October, November) and harvesting (March, April) of grains. Villagers mentioned that it was especially important to do the planting exactly in time. Rapoko is planted before the rainy season because it can stay in the soil until the arrival of the rains.

It appears that there is no clear division of labour since men and women do most of their field work together.

Farmers indicated that land could be made available for cassava if its uses were known and if it were profitable. The average farm size is about 8 acres, however there is a tendency towards a smaller farm size due to heritage.

Asked for their main motivations to grow cassava, the villagers gave answers in the following order:

- Cash,
- Food,
- Animal feed.

Although cash was mentioned as the main reason to start a cassava production, there is a constraint related to marketing. The village is about 60 km away from Gutu which is the main marketing centre. Also, Triangle Ltd. do not come into this area to collect cotton, mhunga or other produce.

The farmers had a bad experience with custer beans of which production was promoted, however now there is no market.

Chivi District
Ward 1, Natural Region IV
7.10.1993

Farmers (29 men and 16 women) participated in meeting. Women strongly participated in discussion.

A few farmers (5-10%, roughly estimated) in the village have/had experience with cassava. In some cases the roots were boiled whereas other farmers included leaves in their daily meal. There were no problems with poisoning. One woman still has a few cassava plants; she dries the roots and prepares meal out of it for inclusion into *sadza*.

The main crops planted by the farmeres are:

- Maize;
- Groundnuts;
- Sorghum; and
- Millets.

Farmers prioritised the main constraints for agricultural production as follows:

- Lack of cash to purchase inputs such as fertilizers;
- Labour shortage since children go to school; thus, parts of the land are under-utilised;
- Supply of manure is inadequate.

With regard to the farmers' motivations to grow cassava, the following priorities were given:

- Cash,
- Fodder,
- Food.

The issue of fencing was raised since cassava plants will require some form of protection during the dry season against domestic animals such as goats. Farmers said that they could include cassava on a small scale in the fenced areas close to their homesteads.

They would not have the funds to construct fencing of larger areas (exceeding about half an acre). Fencing of larger cassava fields (up to 2 hectares) by a group of

farmers (5 to 10) is a possibility to be considered. Relatively large women's groups (20 to 40 members) already fence vegetable gardens which show a good level of production.

Concerning the availability of land, farmers indicated that they would sacrifice parts of their land if the profitability of the crop is assured.

Chivi District
Ward 5; Natural Region V
7.10.1993

Spontaneous gathering of 4 men and 3 women. One of the younger farmers already has 300 cassava plants the cuttings of which he received from Agritex. He plans to eat the roots, whereas Agritex is mainly interested in the planting material.

The following crops are planted in the village:

- Sorghum,
- Millets,
- Maize,
- Sunflower,
- Cotton.

The major constraints encountered in agricultural production were indicated as follows:

- Lack of money to buy inputs;
- Erratic rainfall patterns;
- Availability of tools and implements.

Labour was not stated as major problem; Women said cassava could be planted if profitability of crop was assured and cash would be generated.

The farmers' motivations to grow cassava were prioritised as follows:

- Cash,
- Food,
- Fodder.

The village has the advantage of being close to a collection point from where Triangle Ltd. transports cotton to its factory. Triangle could collect dried cassava chips after having distributing cotton seeds to the farmers of the ward. Thus, transport of dried cassava would not be a major constraint.

With regard to drying cassava chips, women are prepared to purchase cement on a group basis to construct a small-scale drying floor.

Mwenezi District
Chizumba, Natural Region V
8.10.1993

The village has a dam with about 1 to 2 acres of water in it. At present (October 1993), the water apparently is not well used.

About 12 men and 7 women were present during the meeting;

The farmers have only limited experience with cassava: One farmer has planted it in the past but up-rooted it when he was told that the plant was poisonous. One woman has eaten it during her childhood whereas another has grown a few plants and eaten it for breakfast.

One woman mentioned that they (the farmers) cannot distinguish between poisonous and non-poisonous cassava varieties. Thus, it appears that toxicity of the roots is a major issue, especially when it comes to human consumption.

The main crops grown for subsistence are:

- Millets,
- Sorghum,

whereas the main cash crops are:

- Sunflowers,
- Maize, and
- Cotton.

Cotton is planted only on a very limited scale since the produce has to be transported 22kms by scotch-cart to the rail-link from which it is transported to Triangle. Thus, only the wealthier farmers who own their own means of transport are in the position to grow cotton.

The village was severely hit by the 1991/92 drought, which led to the death of most of the animals including draught power.

Besides transport problems, the other constraints for agricultural production were given as follows:

- Lack of cash to purchase inputs,
- Labour.

Although labour was mentioned as a constraint, farmers are willing to accommodate the new crop. They are prepared to plant cassava as soon as possible.

Land is available for cassava, according to the farmers. However, due to the need for fencing, production could only start on a small scale.

The farmers prioritised their motivations to grow cassava

as follows:

- Food,
- Cash,
- Animal fodder.

The farmers' priority for human consumption has to be seen in relation to serious food shortages in the village after the recent drought. Animal fodder is not considered important since the few animals living at the moment in the village find good grazing conditions and, in addition, dry stover is left from harvest.

Neshuro, Natural Region V
8.10.1993

15 women and 4 men came to the meeting. It was not exactly clear why only a few men showed up. It was suggested that the men of the village were occupied with other activities.

The main subsistence crops planted are:

- Small grains (millets and sorghum),
- Maize.

The cash crops are:

- Cotton,
- Groundnuts,
- Sunflower.

Cotton (which was only introduced about 4 years ago in the area) is quite common since the village is close to the rail-link to Triangle and the transport costs are low.

Sunflower is only a side cash crop; a small quantity of millet was sold as well.

According to the farmers, the main constraints for agricultural production are as follows:

- Draught power;
- Cash to purchase inputs such as seeds;
- Transport.

Although there is the rail-link, there is also a shortage of draught power for scotch-carts to transport goods over small distances.

As regards cotton, the main limitations are labour and pest control.

With regard to labour, the situation is not entirely clear. The limited number of men who showed up at the village meeting may indicate a shortage of labour to some extent. On the other hand it was also said that labour

could be hired if necessary (at Z\$8/day).

Land is apparently under-utilised due to a shortage of draught-power.

Although not directly mentioned by the farmers, amount (500mm p.a.) and pattern (badly distributed) of rainfall are certainly further limitations to agricultural production.

The farmers stated their priorities in relation to a potential cassava production as follows:

- Food,
- Fodder,
- Cash.

The priority for cassava as a food crop has to be seen in the light of food shortages after the 1991/92 drought. However, it seems surprising that farmers put fodder before cash. At the moment, animals have plenty to eat, but in the long-term, animal fodder may again become an issue.

Mashonaland East Province

Mutoko District

11 - 13.10.1993

Mutoko is a growth point situated on the road Harare - Nyamapanda (Border with Mozambique). The distance to the capital is about 140km.

AGRITEX, ARDA, and GMB were visited for information on agricultural production, transport systems, and producer prices.

The District belongs to Natural Regions IIb and III. Average rainfall in the District is around 650mm. Vegetable production is abundant around Mutoko and ARDA assists the producers through a EEC financed vegetable marketing project. The project offers collection, transport and grading of vegetables and fruits. Numerous fenced plots (some of them quite big) can be seen around Mutoko.

There is also a Belgian NGO active in the area (construction of community buildings, etc.).

On one occasion, two women were met who sell small quantities of boiled cassava to travellers at the local bus station.

Village 1, Natural Region III/IV
12.10.1993

About 50 farmers (about half were women) were already gathered for training by local Agritex extension worker. The meeting was interrupted for discussion on cassava. A few women participated actively in the discussions.

The main crops grown in the village are as follows:

- Maize;
- Sorghum;
- Groundnuts;
- Cowpeas;
- Vegetables (Tomatoes, Onions, etc.);

Vegetables are the main cash crops.

According to the farmers, the main constraints to agricultural production are as follows:

- Money to buy fertilizer;
- Not enough draft power; this means there is a labour shortage during the planting season; to some extent labour is also hired in the village;
- Wildlife such as monkeys, and waterhogs;
- Shortage of water;
- Not enough land.

Originally the average acreage per farm was 10 - 12 acres but inheritance of land among children is leading to smaller farms.

Farmers stated their motivations to grow cassava as follows:

- Food (both men and women);
- Cash;
- Animal fodder.

The farmers only knew cassava as a food crop (boiled or chipped, dried and pounded into meal). They were not aware that there was a market although in the past (1990) a few 20 litre tins filled with tubers were locally sold by villagers at a price of Z\$12 per tin. Farmers did not know that cassava also could be used as animal feed.

At present, about 10 farmers of the group have cassava planted in their fenced gardens. The number of plants per farmer varies between 4 and 30; the average being of the order of 12.

Cassava is mostly consumed in June and July during the dry season. Cuttings are planted during the same months in moisture-retaining soil. The tubers are eaten after one year. According to the farmers, cassava needs fencing against donkeys, cattle and goats.

The farmers said that they received the planting material from communal areas and on one occasion Malawi was stated

as origin. Asked for specific cassava diseases farmers said that sometimes they have problems with leaves, hoppers and tubers.

Mushani, Natural Region III/IV
12.10.1993

25 men and 13 women participated in the meeting; the villagers were already engaged in a meeting to discuss water supply problems in the local school. The meeting was interrupted for about one hour to discuss cassava issues.

About one third to one half of the villagers present knew cassava. A few people have been growing it in the past. This year there was almost no production because most of the planting material was lost during the last drought when plants were up-rooted for consumption and cuttings dried out in the moisture-less soil.

At present, food is the farmers' main reason to grow cassava. Cassava is boiled before consumption (like sweet potatoes). Leaves are eaten as well as fresh vegetables, sometimes with oca and sometimes with peanut butter.

The farmers did not have any major pest or disease problems with cassava. However, termites and moles occasionally cause damage.

The cuttings are almost vertically planted. According to the farmers the main variety is of the white type.

On average, farmers have less than 10 cassava plants in their gardens. One farmer said he had about half an acre of cassava but it turned out that on this area he only had about 20 plants and the rest of the cuttings were dry. Nevertheless, in 1990/91 he had a cassava production which he could sell in Harare for Z\$400 (Z\$2/bundle of 6 roots).

The farmers gave the following reasons to expand cassava production:

- Cash
- Food
- Stockfeed

There was no serious lack of stockfeed this year since the last rainy season was favourable. However, in "normal" years there may be a shortage of pastures between September and November before the rainy season starts. The farmers possess the following animals: Cattle, pigs, goats, rabbits and poultry.

In general, farmers asked for more training to produce and utilise cassava in its different forms (including

stockfeed).

The main crops produced by the farmers are:

- Maize;
- Mhunga;
- Sunflower;
- Vegetables;
- Rapoko;
- Groundnuts;
- Rice.

Vegetables (tomatoes, onions, ocra, etc.), sunflowers, and groundnuts are the main cash crops.

The main constraints to agricultural production are as follows:

- Cash to buy fertilizer;
- Draught power;
- Poor soil fertility;
- Transport;
- Labour, where soils are relatively more fertile;
- Termites.

Transport of vegetables is a problem although there is an ARDA - based vegetable marketing project. The demand for the few ARDA trucks is too big.

The use of compost and manure was discussed in relation to increased soil fertility.

Makosa, Natural Region III/IV

13.10.1993

7 women and about 15 men participated in the meeting; Supposedly there were about 25 cassava growers in the village; but only 6 were present;

Those who grow the crop have between 4 and 20 cassava plants in their gardens for home consumption;

More cassava was planted before the drought but planting material got lost; those who have planting material do not give it away; farmers think they could sell small quantities of cassava on the local market; Z\$1 for a small basket of about 500gr was suggested as a possible price.

None of the farmers has grown cassava on a larger scale and nobody has sold it in Harare. Cassava could also become a substitute for bread which is becoming more expensive.

The main reasons to expand cassava production were stated as follows:

- Food,
- Cash,
- Animal Fodder.

Farmers do not know the utilisation of cassava as stockfeed but could be interested in this option.

The main crops planted by the farmers are as follows:

- Maize;
- Sunflower;
- Sorghum;
- Groundnuts;
- Mhunga;
- Rapoko;
- Cowpeas;
- Garden vegetables (tomatoes, onions, ocra, beans, etc.);

The most profitable crops are maize, tomatoes and sunflowers.

According to the farmers the main constraints to agricultural production are as follows:

- Rainfall;
- Lack of cash for fertilizer;
- Lack of farm implements;
- Labour; sometimes they have to hire labour during the planting season;
- Not enough land;

Among the farmers present about 12 (or roughly 50%) have draught power.

The size of the vegetable gardens varies between 0.2 and 0.7 hectares. The gardens are fenced (mostly with locally available material but in some cases also with barbed wire). However, fencing is expensive and farmers are unlikely to have the cash to buy more fencing material.

Small-scale farmers around Mutoko

11 - 13.10.1993

3 small-scale farmers were visited to discuss their attitude towards cassava.

Among the farmers only the first one has a commercial approach to agricultural production. Besides maize and cotton he also produces fruits (oranges, etc.) for the Harare market. He has about one third of an acre planted with cassava; the plants (roughly 50 in total) are in their second year and inter-cropped with maize and trees (nuts, etc.). The plants apparently are free of diseases. Although his family eats boiled cassava for breakfast, cash would be the main motivation to expand cassava production. He would expect a gross income of at least Z\$2,000 to 3,000 per hectare. He is prepared to try out cassava on half a hectare. At the same time, he could also be approached by Agritex for planting material, although it is recommended to analyse the

quality of the material prior to distribution. The farmer has a concrete drying floor which could be used for trials. Although the farmer has a large cattle herd, he does not face major feeding problems during the dry season since he has enough land (about 150ha in total).

The agricultural production of the other two small-scale farmers is more based on traditional farming methods. Although they have about 100 ha of land each, they face similar constraints to communal farmers: lack of cash to purchase inputs, labour shortages during the planting season, etc. Both of them have about 10 to 20 cassava plants which are either very young or in poor condition due to browsing goats. Both families eat cassava and would require more planting material to increase their home consumption. They see it to some extent, as a substitute for bread. The farmers are aware of the fencing problem regarding an increase in production. One farmer mentioned that his family used to feed pigs with boiled cassava tubers when he was young (about 30 years ago).

Mudzi District

14.10.1993

Mudzi District is also located on the road Harare - Nyamapanda (Border with Mozambique) at about 200 km from the Zimbabwean capital. The Mozambiquan border is about 20 km to the East of the District capital.

Mudzi's agricultural production is disadvantaged compared to Mutotko insofar as rainfall patterns are less favourable (about 450 - 550mm p.a.), farmers are less organised and the capital's markets are more distant. ARDA's vegetable marketing project does not cover this District.

On average, about 55% of the farmers have their own draught power although in areas close to the border it is only around 40 to 50%.

The food market of Mudzi was visited but there was no evidence of cassava.

Two meetings were held but the results of the discussions are summarised since the two groups belonged to the same village.

Village Meetings

The village is located about 30 km off the main road (right hand side) to the Mozambiquan border. There is quite a large dam (water surface roughly estimated at 10 ha) close to the village but the water is not well-utilised as yet. A small-scale irrigation system for 30 to 50 vegetable gardens (0.1ha each) is under

construction. The village also has a small hospital.

18 farmers (12 men and 6 women) participated in the first meeting. Here farmers were already gathered for training in manufacturing yokes. 19 farmers (12 women and 7 men) participated in the second meeting which took place close to the dam next to the construction site of the irrigation channels.

Farmers have about 3 ha of land on average.

The main crops are as follows:

- Maize;
- Mhunga;
- Rapoko;
- Sorghum;
- Sunflower;
- Groundnuts;
- Vegetables (tomatoes, cabbage, onions, etc.);

The cash crops are maize, vegetables, groundnuts and sunflower.

The main constraints to agricultural production were stated as follows:

- Inputs too expensive;
- Lack of draught power;
- Labour shortage during the rainy season;
- Lack of implements;
- Erratic rainfall patterns.

Most of the farmers have already eaten cassava in the past. At present, they do not have enough planting material since a lot of cuttings dried out during the last drought. The very few farmers who actually grow it this year have only between 5 and 20 plants.

Farmers said they would prefer the "white" variety to the "red" one.

The farmers gave their motivations to grow cassava in the following order:

- Food;
- Cash;
- Stockfeed.

Some farmers would like to expand cassava production (up to one acre per farmer) if there was a market.

With regard to stockfeed, farmers indicated some interest to use it for poultry and pig feed, however there is enough grazing available for cattle.

The main constraints to an increased cassava production were stated as follows:

- Lack of planting material;
- No fenced land available;
- Lack of knowledge regarding production and

- utilisation of the crop;
- Absence of markets and transport.

The farmers indicated that an outside donor would have to pay for the fencing material since they would not have the necessary means.

Concerning a co-operative type approach to start a cassava production, it was said that a group of 25 to 30 farmers could work together without problems.

Manicaland

Chipinge District

4 villages were visited in Chipinge District.

Madhuku, Natural Region V
18.10.1993

The village is located next to the main road to Chisumbanje.

Only 5 farmers came to the meeting (3 women and 2 men). They all produce cassava. The farmers started to grow the crop 4 years ago and, according to them, "hunger taught them to prepare it". Usually they plant cassava in November and harvest it after one year.

The farmers presented cassava in four different forms to the RRA team:

- Boiled;
- Dried;
- Flour;
- Prepared as *sadza*.

The farmers prioritised their motivations to grow cassava as follows:

- Food;
- Cash;
- Animal feed.

Regarding cassava based animal feed, farmers said that could be an option once the depleted herds were restocked again.

The main existing crops produced by the farmers are as follows:

- Maize;
- Mhunga;
- Rapoko;
- Sunflower;
- Cotton.

Cotton (sold to Triangle Ltd.), Sunflowers and maize (both sold to GMB) are the main cash crops.

The constraints to agricultural production were given as follows:

- Lack of draught power;
- Lack of funds to purchase inputs such as seeds, etc.

These are the main constraints besides the general problem of low rainfalls (about 400mm p.a. on average). Fertilizer is not used in the village; the soils are very fertile.

According to the farmers, rainfed cotton yields are quite good under normal conditions: 1,600 to 2,000 kg per hectare. However, the extension officers stated that the average yield over the last five years was far below this figure due to the drought.

According to the farmers, fencing is necessary to protect cassava from goats, donkeys, etc. An NGO (Lutheran World Federation) who is active in the village could perhaps assist in the construction of fences.

Concerning future processing technologies, farmers said they first want to start production before they consider processing.

One farmer who has about 20 plants was visited at his homestead. The plants were planted in November 1992 and almost one year old. The stems were about 1.70 - 2m high but foliage was not dense due to goats or donkeys browsing on the lower parts of the plants. One plant was up-rooted and the tuber weight was estimated at 0.5 - 1 Kg.

No evidence of diseases could be seen on the cassava plants.

Rimai, Natural Region V
19.10.1993

The village is approximately 20 km off the road to Chisumbanje.

20 farmers (14 male) and (6 female) participated in the meeting which took place next to the primary school. Among the villagers present, there was only one woman who has a plant in her garden. Farmers lost "a lot" of planting material during the recent drought. The are used to the consumption of boiled cassava.

The farmers' main motivations to grow cassava would be as follows:

- Money;
- Food;
- Animal feed.

The main crops planted by the villagers are as follows:

- Maize;
- Sorghum;
- Millets;
- Cotton;
- Sunflower.

Cotton (sold to Triangle Ltd.) and Sunflower are the main cash crops, whereas maize is only sold if there are any surpluses left after household consumption.

The main constraints stated by the farmers are as follows:

- Lack of draught power;
- Lack of cash to buy seeds;
- Erratic rainfall;
- Transport of produce.

GMB and Triangle (who are the main buyers of cash crops) charge the villagers for transport to the depots (Z\$7/bag and Z\$8/bail). GMB and Triangle collect the produce at the village centre next to the school.

According to the farmers there would be enough land for cassava; however, the lack of draught power is a constraint which leads to seasonal labour shortages.

There should be enough labour available for harvesting and processing. Farmers said chipping could be done by hand in an initial phase before using machines. There are traditional drying floors but it is doubtful whether these can be used for cassava as well because the existing floors are constructed with cow dung which may lead to the contamination of processed tubers.

According to the local extension supervisor, the average farm size is about 3 hectares; usually about 2 ha are planted with cereals (sorghum and maize 1 hectare each) and the rest with sunflower and cotton (half a hectare each).

About 60% of the farmers grow cotton; especially the masterfarmer trainees. Cotton was introduced about 10 years ago. The farmers who plant cotton have usually more land available. Not every cotton grower also has draught power.

The farmers are organised in rather large groups (clubs of about 100 members).

One farmer who has two pairs of oxen showed more interest in cassava as stockfeed - contrary to most of the other villagers. He has 16 acres of land and is, thus, better endowed to grow cassava. He said he could plant it on up to one hectare but would like to try it out first.

Village: Musilizwi, Natural Region IIb
20.10.1993

58 farmers (30 women and 28 men) participated in the meeting.

The village belongs to a resettlement area where about 1,600 families live. Chipinge is 35km by dirt or paved roads.

The main crops are:

- Maize;
- Burley tobacco;
- Rapoko;
- Sunflower.

Maize, tobacco and sunflower are the two main cash crops; however tobacco is only grown by a few farmers (about 5%) and on small plots.

The main constraints mentioned by farmers are as follows:

- lack of draught power;
- lack of rainfall;
- cash for inputs.

Approximately 20% of farmers have scotchcarts and 40% have draught power.

Basically all farmers know cassava. 10 (7 men and 3 women) among the 58 villagers present have cassava in their gardens. Another 9 farmers grew it in the past but don't have it now.

The number of plants grown by the 10 farmers varied between 7 and 35 with an average of 11. The villagers mentioned the lack of planting material as a constraint to expanded production.

According to the farmers cassava has a long tradition in the region; problems with the crop include mosaic virus, termites, crabs, moles.

The farmers' main motivations to grow cassava on a larger scale were given in the following order:

- Cash;
- Food;
- Animal feed.

It was said that labour could be made available to grow more cassava. A few farmers mentioned that they have sold small quantities of cassava to neighbours in the past.

Farmers who have some experience in drying cassava said it would not be easy to obtain one tonne of dried chips and therefore consider the proposed price of Z\$500 as low.

Concerning a larger cassava production for cash, transport appears to be a major constraint since the lorries of Triangle Ltd. do not come close to the village. Thus, expensive transport (RMS, or DDF) would have to be hired.

**Muzite, Natural Region III
20.10.1993**

Access to the village is a serious problem due to bad road conditions. The village is located in mountainous terrain very close to the Mozambiquan border.

About 20 farmers (3 women) came to the meeting. Basically all participants in the meeting were cassava growers. Besides cassava, the main crops grown by the farmers are:

- Maize;
- Rapoko;
- Sorghum;
- Groundnuts;
- Beans;
- Sunflower;
- Sweet potatoes;

Maize is the major food and cash crop. The other cash crops are: groundnuts, sunflower and sweet potatoes.

The main constraints to agricultural production are:

- transport;
- seed prices;
- tractors do not come.

Rainfall (600 - 800mm) is not considered a major problem. The land size per farm is small (1 - 2 has).

The number of cassava plants per farmer is of the order of 1 to 30. Constraints mentioned in relation to cassava: moles and lack of planting material.

The farmers prioritised their motivations to grow cassava as follows:

- Cash;
- Food;
- Animal feed.

However, the survey team pointed out that the villagers would face serious transport problems regarding an expanded cassava production for cash.

On the other hand, farmers do not have cattle to use cassava as stockfeed.

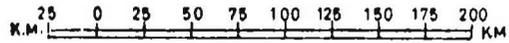
Thus, there only remained the food security issue. However, the farmers said they already eat cassava and, in addition, they already have enough to eat. They are more interested in cash crops.

At the end, villagers were not very happy with the outcome of the discussion. They expressed their unhappiness with a meeting that did not give them new hope.

APPENDIX 4
MAPS OF RRA SITES

ZIMBABWE

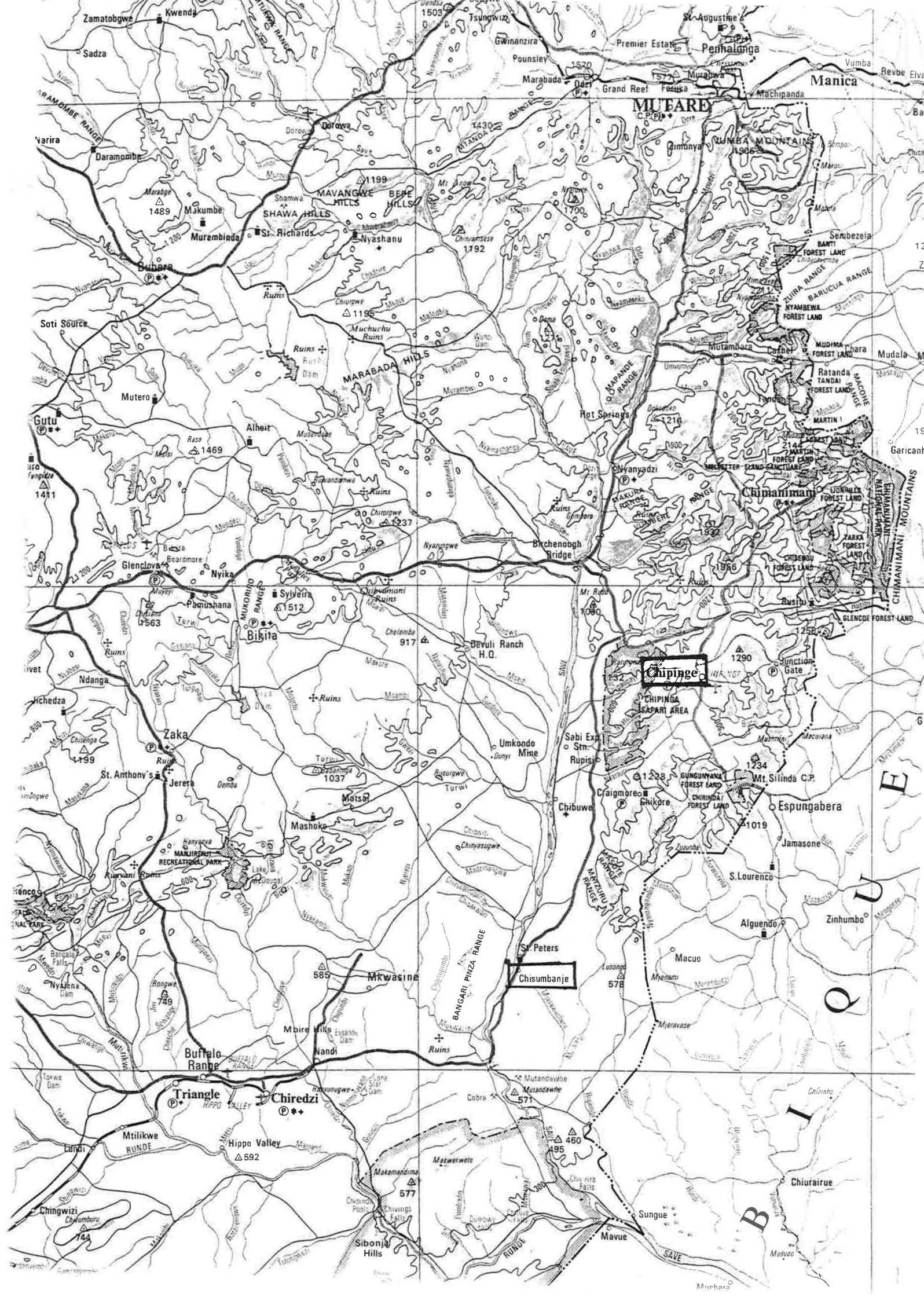
NATURAL REGIONS & FARMING AREAS



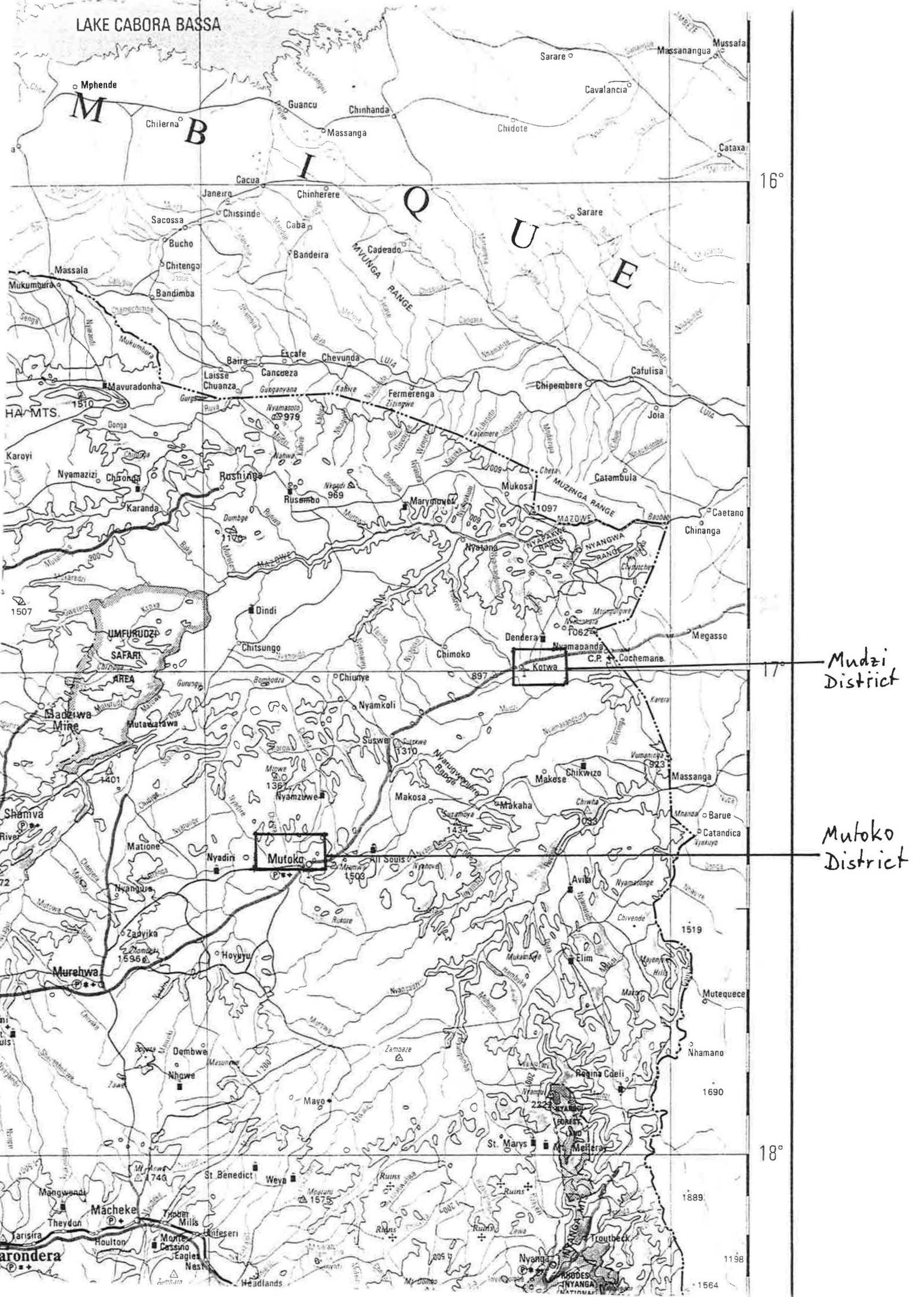
KEY

RELATED FARMING REGIONS

- I SPECIALIZED DIVERSIFIED FARMING REGION
- II INTENSIVE FARMING REGION
- III SEMI-INTENSIVE FARMING REGION
- IV SEMI-INTENSIVE FARMING REGION
- V EXTENSIVE FARMING REGION



LAKE CABORA BASSA



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Muzi District

Mutoko District

18°

Harare

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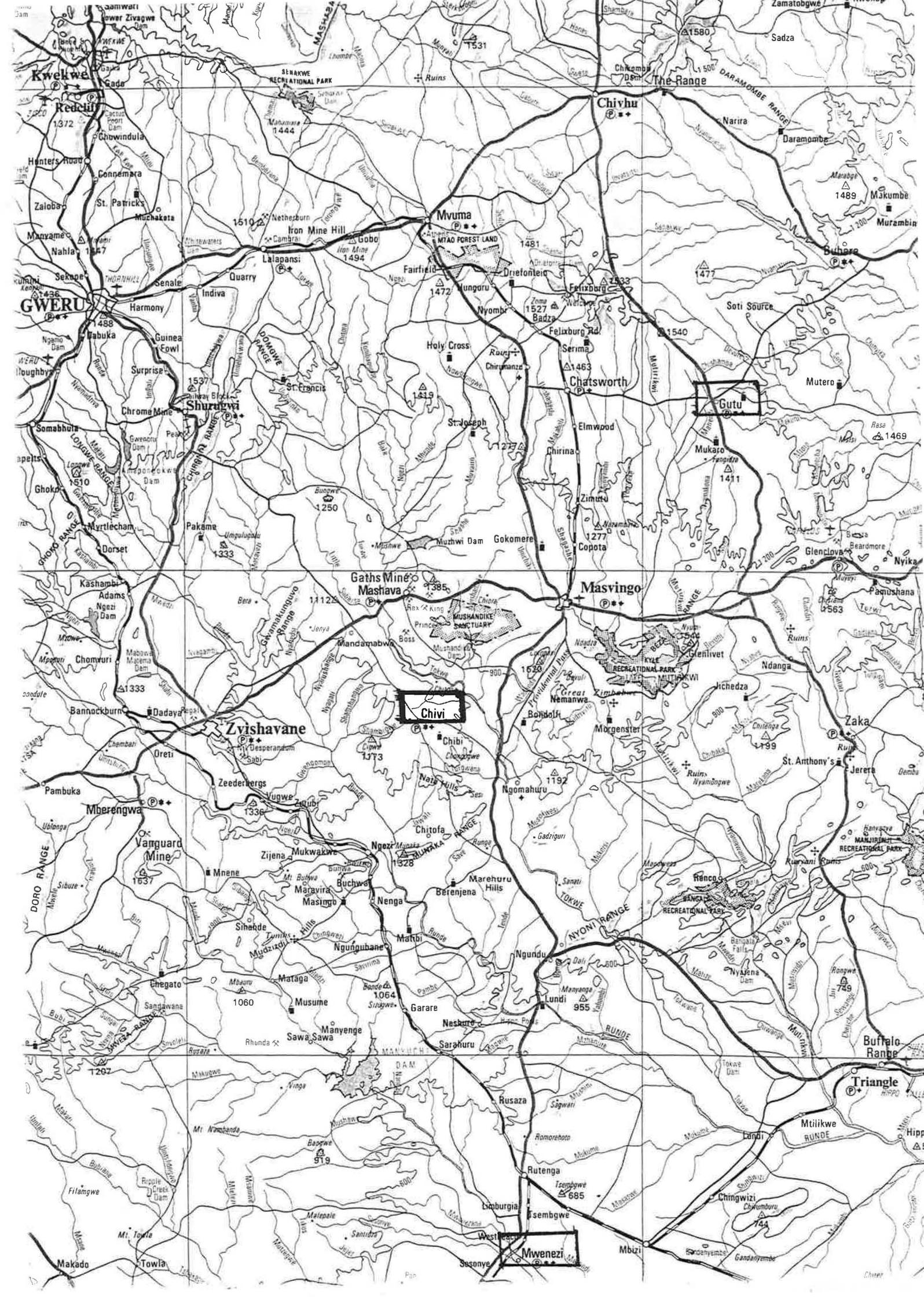
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APPENDIX 5
FENCING COSTS

Fencing costs

Real interest rate:	10.00%
Fence (1,500 m, or 14ha)	15,000 \$
Useful life:	10 years
Annualised capital cost:	2,441 \$
Annualised capital cost per ha:	174 \$
Maintenance (5% of construction cost):	750 \$
Maintenance per ha:	54 \$
Total annual cost for 14 hectares:	3,191 \$
Total annual cost per hectare:	228 \$

APPENDIX 6

**ESTIMATED CROP BUDGETS
MASVINGO, NATURAL REGIONS III AND V**

Appendix 6:
**Masvingo Province, Natural Region V
Estimated Crop Budgets (for 1 hectare)**

	Units	Crops					
		Cassava*	Maize	Small Grains	Cotton	Shelled *** Groundnuts	Sunflower
Income							
Yield	t / ha	12.00	0.45	0.50	0.60	0.45	0.50
Price	Z\$ / t	185	900	600	2,900	1,800	1,400
Gross income	Z\$	2,220	405	300	1,740	810	700
Production costs							
Fencing**	Z\$	456					
Soil preparation (hired animal draught power)	Z\$	75	75	75	75	75	75
Small tools	Z\$	20	20	20	20	20	20
Seeds	Z\$	0	82	30	58	90	43
Fertilizer	Z\$	0	154	0	154	88	61
Chemicals	Z\$	0	20	0	500	0	0
Transport of inputs (\$3/bag)	Z\$	0	9	0	9	6	3
Transport of fresh roots (\$10/tonne)	Z\$	120					
Chipping and drying, fixed costs	Z\$	124					
Chipping and drying, variable costs	Z\$	110					
Packing of produce	Z\$	30	4	4	10	4	4
Transport of output (\$2-4/bag)	Z\$	178	20	20	24	20	20
Seasonal interest on variable costs (10% real)	Z\$	53	38	15	85	30	23
Contingency allowance (5%)	Z\$	58	21	8	47	17	12
Total	Z\$	1,224	443	172	982	350	261
Net income****	Z\$	996	-38	128	758	460	439
Cropping seasons	Seasons	2	1	1	1	1	1
Net income/season	Z\$/season	498	-38	128	758	460	439
Labour requirements	Man-days	122	76	87	127	145	110
Net income/ labour day	Z\$/day	8.16	-0.50	1.47	5.97	3.17	3.99

Explanations:

* The price of cassava corresponds to Z\$500 per tonne of dried chips converted into fresh root equivalent by using a conversion factor of 2.7 (2.7 tonnes of fresh roots give 1 tonne of dried chips).

** Fencing costs are annualised (see also appendix 5).

*** It is assumed that farmers will use their own groundnut seeds, for which an opportunity cost is put.

**** The term "Gross Margin" was not used because part of the cassava production and processing costs are fixed costs.

Masvingo Province, Natural Region III
Estimated Crop Budgets (for 1 hectare)

	Units	Crops						
		Cassava*	Maize	Small Grains	Cotton	Shelled *** Groundnuts	Oriental Tobacco	Sunflower
Income								
Yield	t / ha	18.00	0.90	0.70	0.90	0.60	0.60	0.80
Price	Z\$ / t	185	900	600	2,900	1,800	7,500	1,400
Gross income	Z\$	3,330	810	420	2,610	1,080	4,500	1,120
Production costs								
Fencing**	Z\$	456						
Soil preparation (hired animal draught power)	Z\$	75	75	75	75	75	75	75
Small tools	Z\$	20	20	20	20	20	40	20
Seeds	Z\$	0	82	30	58	90	30	43
Fertilizer	Z\$	0	255	0	255	317	1,000	281
Chemicals	Z\$	0	20	0	500	0	2,000	0
Transport of inputs (\$3/bag)	Z\$	0	18	0	18	24	63	15
Transport of fresh roots (\$10/tonne)	Z\$	180						
Chipping and drying, fixed costs	Z\$	124						
Chipping and drying, variable costs	Z\$	140						
Packing of produce	Z\$	30	4	4	10	6	240	4
Transport of output (\$2-4/bag)	Z\$	266	40	32	40	24	100	32
Seasonal interest on variable costs (10% real)	Z\$	71	51	16	98	56	355	47
Contingency allowance (5%)	Z\$	68	28	9	54	31	195	26
Total	Z\$	1,430	594	186	1,127	642	4,098	542
Net income	Z\$	1,900	216	234	1,483	438	402	578
Cropping seasons	Seasons	2	1	1	1	1	1	1
Net income/season	Z\$/season	950	216	234	1,483	438	402	578
Labour requirements	Man-days	157	82	90	140	150	886	115
Net income/ labour day	Z\$/day	12.10	2.64	2.60	10.59	2.92	0.45	5.02

APPENDIX 7
PROCESSING COSTS

APPENDIX 7

Page 1

Investments for processing unit and annualised capital costs (Motorized chipper and concrete floor)

All values are in Zimbabwean Dollars

Real interest rate:		10.00%
Chipper (including 4hp motor, cap: 4 tonnes / hour):		6,000 \$
Useful life:		5 years
Annualised capital cost:		1,583 \$
Concrete floor (500 sqm):		12,000 \$
Useful life:		20 years
Annualised capital cost:		1,410 \$
Shed for chipper:		1,000 \$
Useful life:		10 years
Annualised capital cost:		163 \$
Tools:		2370 \$
3 wheelbarrows:	1,500 \$	
10 metal shovels:	720 \$	
10 wooden rakes:	150 \$	
Useful life:		3 years
Annualised capital cost:		953 \$
Working capital:		10,000 \$
Interest on working capital :		1,000 \$

Explanations concerning investments

Concrete drying floor:

40 m³ of concrete are required for a 500 sqm floor; this corresponds to 10.4 tonnes of cement plus 25 m³ of sand and 33.4 m³ of gravel, assuming that the drying floor will be built on sandy soils; the cost of cement is \$37 per 50kg bag or \$7,700 for the entire floor; it is assumed that the costs for sand, gravel and labour will bring the total construction cost of the floor to \$12,000. The information is taken from: Natural drying of cassava roots on concrete floors; CIAT, 1989.

Interest rate:

In mid-1993, the difference between commercial interest rates (around 35%) and the inflation rate (around 25%) is about 10%.

AFC (Agricultural Finance Corporation) usually applies interest rates close to market conditions, except in the case where developmental rates are applied. This involves donor money earmarked for certain credit schemes administered by AFC. In this case, the interest rate is usually 21%.

**Costs of chipping and sun-drying 350 tonnes of fresh cassava;
Motorised chipper; Private entrepreneur.**

All values are in Zimbabwean Dollars

Fixed costs	
Total annualised capital costs:	4,108 \$
Interest on working capital:	1,000 \$
Maintenance (5% of Chipper):	300 \$
Management (5 months, \$800 per month):	4,000 \$
Total fixed costs:	9,408 \$
Variable costs	
Labour, chipping (36 days, \$12/day):	432 \$
Labour, drying (350 days, \$8/day):	2,800 \$
20 blades	200 \$
Fuel (90 hours, 1.3l/h, \$3/l):	351 \$
Packaging bags (1,000 bags, \$3 / bag)	3,000 \$
Total variable costs:	6,783 \$
Contingencies (5% of fixed and variable costs):	810 \$
Total processing costs:	17,001 \$
Throughput of fresh cassava:	350 tonnes
Processing costs per tonne of fresh cassava:	49 \$
Throughput of sun-dried chips:	130 tonnes
Processing costs per tonne of dried chips:	131 \$

**Costs of chipping and sun-drying of 5 tonnes of fresh cassava;
Manually operated chipper.**

Fixed costs	
Total annualised capital costs:	56.2 \$
Maintenance (5% of price of chipper, shared by 7 farmers):	5.7 \$
Total fixed costs:	61.9 \$
Variable costs	
2 blades for chipper:	20.0 \$
Opportunity cost, family labour, chipping (12.5 days, \$8/day):	100.0 \$
Opportunity cost for family labour for drying (5 days, \$8/day):	40.0 \$
Small tools for drying:	30.0 \$
Packaging bags (10 bags, \$3 / bag):	30.0 \$
Total variable costs:	220.0 \$
Contingencies (5% of fixed and variable costs):	14.1 \$
Total processing costs:	296.0 \$
Throughput of fresh cassava:	5.0 tonnes
Processing costs per tonne of fresh cassava:	59.2 \$
Throughput of sun-dried chips:	1.85 tonnes
Processing costs per tonne of dried chips:	159.8 \$

It is assumed that the chipper has a capacity of 50 kg per hour which means that chipping 5 tonnes of cassava would require 100 hours or about 12.5 days. Drying of one tonne of fresh cassava requires about 1 man-day. It is also assumed that chipping and drying is entirely executed by family labour.

**Investments for on-farm chipping and annualised capital costs
(Manually operated chipper)**

Real interest rate:	10.00%
Manual chipper shared by 7 farmers:	800.0 \$
Useful life:	4.0 years
Annualised capital cost:	252.4 \$
Annualised capital cost per farmer:	36.1 \$
Concrete floor (50 sqm, shared by 7 farmers):	1,200.0 \$
Useful life:	20.0 years
Annualised capital cost:	141.0 \$
Annualised capital cost per farmer:	20.1 \$

APPENDIX 8

THE ZIMBABWEAN STOCKFEED MARKET 1980 - 1985

APPENDIX 8

The Zimbabwean Stockfeed Market 1980 - 1985

(in tonnes)

	1980	1981	1982	1983	1984	1985
Dairy Feeds						
Total used on farms	109,849	117,540	131,218	133,891	134,199	123,066
Purchased from Manufacturers	98,739	104,060	114,081	128,092	121,555	108,644
Pig Feeds						
Total used on farms	36,788	42,918	48,722	45,875	35,153	30,881
Purchased from Manufacturers	24,585	26,753	29,042	29,746	20,631	18,041
Poultry Feeds						
Total used on farms	101,485	133,585	161,714	153,637	137,651	141,890
Home mixed	45,165	56,520	57,258	59,870	60,470	63,801
Purchased from Manufacturers	47,442	64,249	76,428	80,466	64,725	61,709
Beef feeds						
Total used on farms	209,774	167,304	254,671	269,030	220,905	122,021
Purchased from Manufacturers	104,720	92,296	130,257	143,797	161,446	77,171
Blocks and Licks						
Purchased from Manufacturers	35,966	29,989	36,789	40,703	29,695	22,138
Sheep Feeds						
Total used on farms	1,789	2,124	2,015	2,205	1,065	844
Sundries						
	10,390	10,722	11,766	14,233	11,804	10,597
Total Stockfeed Market	506,041	504,182	646,895	659,574	570,472	451,437
Total Purchased from Manufacturers	323,631	330,193	400,378	439,242	410,921	299,144
Farm Maize and Roughage	182,410	173,989	246,517	220,332	159,551	152,293

Source: de la Hunt (1986)

