Potential For Increased Cassava Flour Utilisation In Africa

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SUMMARY

(i) High grade cassava flour developed in small scale factories in Colombia by CIAT and NRI has had promising trials by the confectionery and meat processing industries as a replacement for wheat flour. Duplication in Africa might help save foreign exchange and provide rural producers with larger market for their crop.

(ii) Cassava is a major staple crop for over 160 million people in Africa. Most cassava is grown in a humid tropical belt 15° either side of the Equator. There are four main areas of cassava concentration: coastal West Africa; central Zaire; the area surrounding Lake Victoria; and the east African coast including Madagascar.

(iii) Cassava is usually grown by small-holder farmers as an intercrop. It is an important food security crop because of its drought tolerance . There are a wide variety of traditional processing techniques. Generally bitter varieties undergo the most processing.

(iv) The *International Institute for Tropical Agriculture* based in Nigeria is the most important centre which conducts research on cassava in Africa. Many African countries have national research programmes which include research on cassava. However the operation of these programmes has been limited by a lack of funds.

(v) Sub-Saharan Africa produces a variety of cereals; wheat is only produced in significant quantities in Zimbabwe. Throughout the continent there has been a trend toward increasing urbanisation. This in turn has been associated with root crops being replaced by bread made from imported wheat, encouraged by overvalued exchange rates.

(vi) Many cassava producing countries are in the process of market liberalisation. Nigeria unsuccessfully tried to stimulate domestic wheat production by curtailing imports between 1987 and 1992. No import bans now apply in Africa, although there are import taxes on wheat products.

(vii) The prospects for dried cassava exports from Africa are minimal because of competition from South-East Asian producers who have saturated the world market. Although cassava derivatives have wide potential industrial uses high production costs make them unprofitable in Africa. Cassava composite flour in Africa has failed in the baking industry because of a lack of consumer acceptance.

(viii) Central and West Africa have high cassava production, high wheat import dependence and high urbanisation. No African country would appear to have the exact combination of factors which has made cassava flour promising in Latin America. Taking into account ODA policies regarding the use of technical cooperation funds and the strength of host institutions, Ghana is recommended as the most promising country for a more detailed analysis.

BACKGROUND

1. Cassava is grown in many Latin American, African and Asian countries mainly by small-scale farmers, both as a source of household food security, and as a means of earning income. Although cassava is well adapted to the tropics, including drought prone marginal areas, its perishability and bulkiness render the crop difficult to transport and expensive to purchase in urban centres.

2. The trend toward urbanization in Africa has led to a change in eating habits; urban per capita consumption of starchy staples, including cassava, in urban areas has given way to the consumption of imported produce such as bread and rice. Due to these limitations on urban demand for fresh roots the impact of improved production technology on small-scale farmers is restricted unless new markets for cassava products are identified and appropriate processing technology developed for such products.

3. An integrated cassava development project in Colombia, managed by CIAT and financially supported by IDRC, has developed a prototype flour production process. NRI has provided advisory inputs into a pilot plant. CIAT has undertaken encouraging trials using cassava flour in the confectionery and meat processing industries.

4. The purpose of this desk study is to assess whether there are African cassava producing countries where the processing technology developed by CIAT may be applicable. (The *Terms Of Reference* for this study are included in Appendix 1).

THE IMPORTANCE OF CASSAVA IN SUB-SAHARAN AFRICA

Introduction

5. Cassava is a major staple for over 160 million people of Sub-Saharan Africa, 40 per cent of the population. Even in areas where it is a secondary staple, it often plays an important role in household food security because of its resistance to drought and pests. (Dorosh, 1989, p56).

6. Cassava is the most important root crop in Africa as a whole; production is estimated to be twice that of yams and more than ten times that of sweet potatoes or cocoyams. (Dorosh, 1989, p57).

7. Cassava is of greatest dietary importance in Zaire where it is estimated to provide 1,200 calories per person per day, half the total. In the Congo and Central African Republic, it accounts for more than 900 calories per day. In coastal West Africa as a whole, cassava is of less dietary importance as the yam is a major calorie alternative. Per capita consumption of cassava is also high in Angola, Madagascar, Mozambique and Tanzania. However, because consumption is mainly concentrated in regions of these countries, national averages probably underestimate the importance of cassava to particular communities.

8. Traditional cassava products are among the cheapest sources of calories available in many African countries. The crop therefore is believed to have "a major role in mitigating chronic food insecurity for the poor." (Dorosh, p68, 1989).

Reliability of information sources

9. There is no doubt that cassava is a central part of food production systems throughout much of Sub-saharan

Africa. However estimating exact production patterns is exceedingly difficult because few reliable data are available.

10. Most data on cultivated area and production volume come from The Food and Agricultural Organisation (FAO) of the United Nations. These data must be used cautiously because in most countries data collection systems for small-holders are poorly developed. Estimates from different data sources for the same country can vary by a factor of 2 or even 10! (Dorosh, 1989, p56-7).

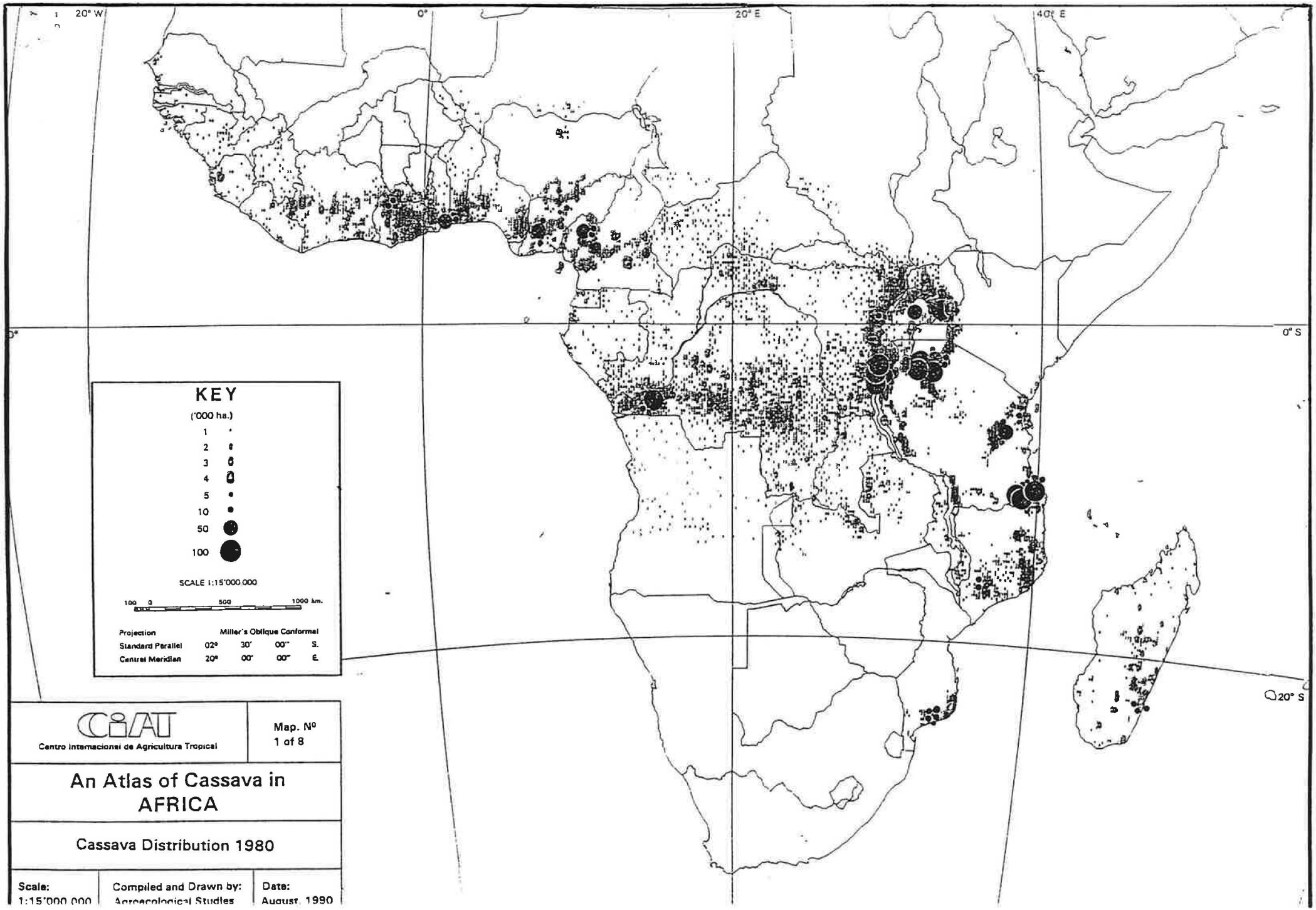
11. National level production data may mask important highly concentrated areas of production. Coastal West Africa is an example of where production is generally found in the more humid and highly populated southern parts of these countries. Its relative importance may be reduced when aggregated at country level.

Areas of cassava production in Africa

12. Map 1 of the distribution of cassava producing areas in Africa is the culmination of a major research effort by the Centro Internacional de Agricultura Tropical (CIAT) this organisation has a global mandate for cassava research under the Consultative Group for International Agricultural Research. (CIAT, 1992, *An Atlas of Cassava in Africa*).

13. The map was compiled from secondary sources as outlined in Appendix 2. It was noted by the authors that the most recent data were not necessarily the most reliable. Because only a small number of sources differentiated between monocropped and intercropped cassava the map is based on the assumption that all cassava is intercropped. (CIAT, 1992, p16). No data were available for Namibia, Botswana or Zimbabwe.

MAP 1: THE DISTRIBUTION OF CASSAVA IN SUB-SAHARAN AFRICA



14. Cassava is generally concentrated in a humid tropical belt 15° either side of the Equator. Within this belt there are four areas where cultivation appears to be most concentrated:

(a) the coastal belt of West Africa particularly from the Ivory Coast to Cameroon;

(b) Central Zaire, from the mouth of the Congo River to Lake Tanganyika;

(c) the Lake Victoria region, with very strong concentrations in Rwanda and Burundi, eastern Kiru in Zaire, Southern Uganda, northern Tanzania and south west Kenya; and

(d) Morogoro, Dar es Salaam and Mtwara in eastern Tanzania and north-east Mozambique.

15. Other important, but less concentrated regions are the Central African Republic, southern Zaire, southern Mozambique and central Madagascar, (CIAT, 1992, p17).

16. A lack of data makes the southern limit of cassava difficult to assess. Although cassava is grown in Namibia, Angola, Botswana, Zimbabwe and South Africa, it is not a major crop (CIAT, 1992, p17).

17. The usefulness of this map is that it highlights production concentrations within countries which might be less apparent when presented in terms of an average for the whole country.

18. The distribution map complements the production data which follow. The area surrounding the Lake Victoria is evidently an important growing area from the map. However, it would not be possible to make such an inference from national level data of the six countries which it covers.

19. In the last three decades evidence suggests that cassava has become increasingly cultivated outside the humid forest zone. Cassava has become a more important part of farming systems in the East African highlands in response to

increasing population pressure. Planted area has also increased in the drier areas in southern Africa because of the need to stabilize seasonal subsistence requirements. (Lynam, 1991, p8).

FAO production data for Africa

20. FAO cassava production data has been used to calculate per capita production in Appendix 3. The production data confirm the broad distribution pattern of Map 1. Humid central Africa, particularly Zaire, Congo and Gabon, is where cassava has greatest relative importance.

21. Per capita production is also high in humid West Africa (Ghana, Nigeria, Benin, Togo and Cote D'Ivoire) and humid coastal east Africa (Tanzania, Mozambique, and Madagascar).

22. Cassava production is also important, though to a lesser degree, in sub-humid East Africa (Uganda and Burundi) and in humid south west Africa (Angola).

ASPECTS OF CASSAVA PRODUCTION IN SELECTED COUNTRIES

Cassava in farming systems

23. Since cassava is well suited to diverse soil and agro-ecological conditions it is found in a large number of different farming systems in Africa. Cassava is usually grown by small-scale farmers as the last crop in a rotation before the land is returned to bush fallow (Adamu, 1989, p20). Very little cassava in Africa is produced as a mono-crop by commercial farmers.

24. In West Africa cassava is usually intercropped in Nigeria with vegetables, plantation crops, yams, sweet potatoes, maize, rice and legumes.

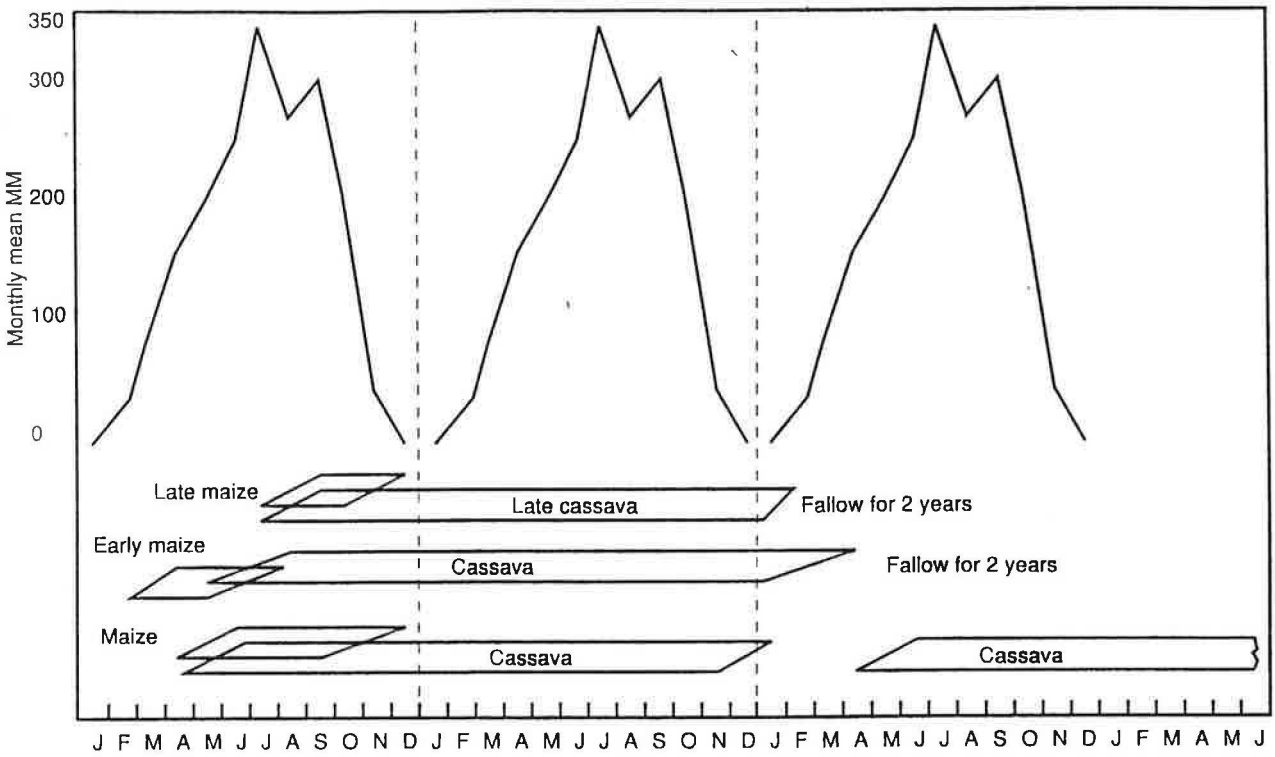
25. Women play major roles in all stages of cassava production, processing, utilisation and storage. (Adamu, 1989, p21).

26. Throughout Sub-Saharan Africa cassava is considered a "security crop" providing low-income people with a basic food staple. It produces more calories per unit area than any other food crop and can survive dry spells in excess of six months. It generally requires less labour and capital inputs than cereal crops and can survive in many conditions not suited to other crops (Adamu, 1992, p24).

Seasonality

27. Cassava is usually planted just before, or as early as possible after the rains begin. (IITA/UNICEF, 1989, p58). In Nigeria the usual planting time is in April or May. Figure 1 shows a cassava-based cropping system from Bendel State, Nigeria.

Figure 1 The major cassava-based systems and associated mean rainfall distribution in Ohosu area, Bendel State, Nigeria.



(Source: International Institute of Tropical Agriculture, 1990, p154)

28. Harvesting depends greatly on the cultivar, rainfall, soil conditions and temperature regime. The optimum fresh weight is achieved after 18 months, but harvesting in Africa often varies between 10 months and two years. The reason for the variations in harvest time reflects the usage of cassava when other foodstuffs are unavailable. (IITA/UNICEF, p67, 1990 and CTA, p4, 1989).

Cultivar differences

29. In Africa there are hundreds of different cassava cultivars which have a wide range of cyanide content. Mapping the distribution of "sweet" (low cyanide) and

"bitter" (high cyanide) varieties is difficult because farmers often cultivate many different cultivars. Moreover, there is a continuum between "sweet" and "bitter" and cultivars change their cyanide content through successive generations.

The CIAT atlas project was forced to conclude:

> "The major issue concerning varieties, namely the glucoside content of 'sweet' and 'bitter' varieties, remains unresolved on a continental scale, the distribution of 'sweet' and 'bitter' varieties is still unknown, as are changes in their relative importance." (CIAT, 1992, p44).

30. However, NRI was able to draw some general observations from its participation in the Collaborative Study of Cassava in Africa (COSCA). This study involved the collection of information on cassava in 233 villages in six countries over a four year time frame (1988-1992). High cyanide varieties were found to be most prevalent in Nigeria and Zaire. Low cyanide varieties were most common in Ghana, Cote d'Ivoire and Uganda. Varieties in Tanzania generally had a medium high cyanide content.

31. The more bitter a cassava cultivar the more prolonged the form of traditional processing. Consumer varietal preferences vary throughout the cassava growing regions of Africa. In Nigeria for example sweet cassava is preferred in the north, there is no preference in the east, while in the southwest preferences are equally divided between sweet and bitter varieties.

Yields

32. The average cassava yield in Africa is 6.8 tonnes per hectare but very wide variations have been reported between and within countries. (Appendix 3) Different planting densities due to intercropping explain much of the variation. Other factors include the incidence of pests and

diseases, soil types, the length of the growing season (years) and the variety of cassava cultivated. (Dorosh, 1989, p59).

33. Improved varieties developed by the International Institute of Tropical Agriculture (IITA) have yielded 15-25 tonnes per hectare under experimental test plots without fertilizer.

34. Improved disease resistant varieties are believed to account for less than 1 per cent of cassava in all major cassava-producing countries. Improved varieties have been most adopted in Nigeria particularly near Ibadan and along surrounding roads. Up to one fifth of Nigerian cassava may be of improved varieties. (Dorosh, p60, 1989).

35. The Delphi Survey was conducted by IFPRI to ascertain the factors limiting cassava yields in Africa. According to this survey the first constraint was disease, the second low yields and the third a lack of incentives for farmers to produce higher outputs. The main diseases affecting cassava in Africa are: cassava mosaic virus, bacterial blight, mealy bugs, and green spiders. (Sarma and Kunchai, 1989, p31-35).

36. No information is currently available on the average production levels per farmer. This information has been collected as part of phase two of the COSCA study but the results were still being processed in 1993.

Traditional cassava utilization

37. Although world-wide more than 10 per cent of cassava is used as animal feed, in Africa over 98 per cent of cassava is traditionaly processed and used for human consumption. (Dorosh, 1989, p61).

38. The type of processing is broadly related to the cyanide level of the variety. Low-cyanide varieties are usually the least bitter and undergo least processing. Peeling and boiling may be sufficient. High-cyanide varieties require more processing to remove the cyanide such as prolonged soaking of the root in water, grating, pounding, drying or roasting.

39. Appendix 4 diagrammatically illustrates some of the most important processed cassava forms recorded by the COSCA study. A list of some local product names and brief descriptions of their production is included in Appendix 5. The relative importance of different types of processing in the seven COSCA countries is recorded in Appendix 6.

40. Generally speaking traditional flours are most common in east Africa, Tanzania and Uganda. Flour made from bitter varieties is reported to be liked less than that from less bitter varieties in urban areas. (Dorosh, 1898, p64).

41. Products made after cassava has been soaked in water are most common in Central humid Africa: Zaire; Congo; Central African Republic and parts of Nigeria. Products which involve a stage of fermentation are most important in West Africa: Ghana, Togo, Benin, Cote d'Ivoire and Nigeria. The most important product in this category is *gari* which accounts for about 60 per cent of cassava consumption in West Africa.

42. The COSCA study has also shown that processing activities have seasonal characteristics. Most processing of cassava into flour occurs between June and September when labour is available. This trend is most apparent in Zaire. (Appendix 7).

43. The degree of mechanisation in processing varied greatly between the seven countries studied. Simple village based milling equipment was the most common processing

machinery. Mills were in use in the majority of villages in Nigeria, Tanzania, and Ghana but were only in minor use in Uganda and Cote d'Ivoire. No processing equipment was recorded by COSCA in Zaire. (Appendix 8).

NATIONAL AGRICULTURAL RESEARCH ORGANISATION INVOLVED WITH ASPECTS OF CASSAVA PRODUCTION AND UTILIZATION

44. National agricultural research systems (NARS) in Africa generally experienced a curtailment of resources in the 1980's. Many research centres experienced high staff turnover, low morale and reductions in funding. There is a general consensus that in the past roots and tubers have been neglected compared to plantation crops and cereals. In the last five to ten years African governments have begun to give root and tuber crops a higher profile, though resources are not always available to translate this policy into action.

45. It has proved difficult from a desk study to obtain up to date information on the relative size of institutions and their cassava research programmes.

Cameroon

Mission on Seeds and Staple Food Development

46. Although this organization has a mandate to oversee the marketing of root-crops, its activities with regard to cassava are reported to be small. (Aviles, 1987, p4).

USAID

47. USAID is supporting research on root crops through their involvement with the ROTREP project in collaboration with the *Agronomic Research Institute*.

Cote D'ivoire

Office of Assistance to the Marketing of Staple Production Foodcrops

48. Collects market information, has credit schemes for producers, has training for commercial operators, assists in the development of commercial infrastructure.

Ivorian Centre for Economic and Social Research (ITRES) a dependent agency of the University of Abidjan.

49. This Centre has carried out surveys on the price and marketing channels of root crops.

Societe Ivoirienne de Technologie Tropicale

50. As part of the Ministry of Agriculture the *Societe Ivoirienne de Technologie Tropicale* has been involved in the industrial production of dehydrated *attieke* and cassava flour as a substitute for wheat in the baking industry. The high production cost of cassava flour in relation to imported wheat flour is reported to limit demand at national level. (COSCA, 1989b, p10).

Ghana

Ghana Food Research Institute

51. The Ghana Food Research Institute has developed flours from cassava for use in the preparation of fufu. The processed flours are easier to transport and store than fresh roots or dough. One of these flours, instant fufu flour is marketed under the trade name of "*Lukapap*". Consumer acceptance of the product has yet to be assessed (COSCA, 1989a, p16).

52. Research was conducted in the 1970's by the University of Ghana (Legon) into the use of cassava starch to fortify locally milled wheat flour for biscuits and cakes.

Nigeria

53. Several research institutes are involved with aspects of cassava production and utilization.

The International Institute of Tropical Agriculture (ITTA).

54. The IITA has been responsible for improved cassava processing technology for gari and cassava chips and flour, and cassava starch. Relatively simple machinery has been developed for washing and grating cassava, pressing, fermenting, sifting, slicing and frying cassava. Most of the machinery uses small diesel engines. The *Brook* dryer is a simple device which consists of three 200-litre drums and a screen which is used in the manufacture of cassava starch. (IITA, 1990, p98-109).

55. IITA report that good quality breads have been produced using between 10 and 100% cassava flour in place of wheat. Cassava flour has also been used as a total replacement for wheat in cakes and biscuits. (IITA, 1990, p119).

National Root Crops Research Institute (NRCRI)

56. Based in Umudihe in eastern Nigeria the NRCRI is mandated by the Federal Government to conduct research on cassava. Most work has been concerned with new varieties and improved cultivation techniques. Some research has been conducted on the use of cassava meal and peel meal as a carbohydrate base for the poultry industry to substitute for maize. Techniques have also been developed for processing cassava into powdered starch and for further processing the

powder into cold water starch for textile finishing, home laundry purposes, and adhesives. (COSCA, 1989b, p21).

Tanzania

The National Root and Tuber Crops Improvement Program

57. This organisation includes a small cassava programme. Research to date appears to have been restricted to agronomic aspects of cultivation. (COSCA, 1989b, p26).

Uganda

The Uganda Root Crop Improvement Programme

58. This government programme has conducted research on improved production techniques. No work is reported to have been conducted on post-harvest technologies. Industrial starch is manufactured from cassava by the Lira Starch Factory, 200 miles north of Kampala. (COSCA, no.3, p31-32).

Zaire

Program National du Manioc (PRONAM)

59. Cassava research in Zaire has been conducted since 1974 by the *Program National du Manioc*. (COSCA, 1989b, p33). The objectives are to: select and multiply new varieties; introduce biological control against pests and diseases; manage an applied agronomic research programme. (Aviles, 1987, p18).

Other organisations involved with cassava production and processing.

60. There appear to be relatively few documented accounts of NGO involvements with cassava activities. The noticeable exception is the two million dollar support of the COSCA programme by the Rockefeller organisation.

61. Industrial processing plants have been too large for interests of NGO's in the past. There is currently much interest among the local NGO's and the international donor community in small scale technology which reduce the drudgery of women's work. CARE has a project in Sierra Leone, which is helping to introduce improved varieties to farmers. Action Aid is conducting participatory with farmers in Uganda in order to help combat the threat of the cassava mosaic virus.

CEREAL IMPORTS AND URBANISATION

62. Sub-Saharan Africa imports high volumes of cereals, its global share of cereal food aid has also increased from 5 percent in 1970-71 to almost 50 per cent in 1984-85. (Lynam, 1991, p10). The table below outlines the increase in the value of cereal imports between 1985 and 1990.

Table 1 Value of wheat imports 1985-90

	1985 US $ 10,000	1990 US $ 10,000	% change
Ghana	1355	3460	+ 255
Cote d'Ivoire	3652	4560	+ 25
Gabon	760	840	+ 11
Togo	503	1570	+ 312
Zaire	3320	4000	+ 20
Uganda	215	110	- 48
Tanzania	1336	1200	- 10
Kenya	2431	2400	- 1

(Source: FAO Trade Yearbook 1990 and 1987)

63. Appendix 10 shows the level of per capita cereal production in Sub-Saharan African countries. Cereal production is of least importance in humid central Africa. Elsewhere in Africa the picture is complicated by the importance of particular cereals in agro-ecological areas. Rice is widely cultivated in Madagascar, Cote d'Ivoire and Guinea: sorghum and millet are important in the West African Sahel; in southern and eastern Africa maize is widespread.

64. Wheat production is only of major significance in Zimbabwe, smaller quantities are grown by Kenya and Zambia. (Appendix 11). No developing African country exports significant quantities of wheat. Despite being the

continent's largest producer, Zimbabwe, is also a wheat and wheat flour importer. (FAO Trade Yearbook, 1990, Table 39).

65. West Africa has historically had higher imports than other regions because of low shipping costs from the USA to the major urban concentrations on the coast.

66. In Francophone West Africa the exchange rate has persistently been overvalued having been pegged to the French franc since 1948. A similar valuation characterised Nigeria during the oil boom. Under such conditions imports appeared relatively cheap when expressed in local currency. (Lynam, 1991, p10).

67. Wheat and wheat flour are often given to African countries as part of food aid programmes. The per capita volume of such aid varies greatly between countries and from one year to another, depending on the domestic food security situation. Wheat food aid was of greatest relative importance during 1988-90 in Equatorial Guinea, Mozambique, and Malawi due to a combination of unfavourable climatic conditions, internal strife and regional conflicts. (Appendix 12).

68. Total wheat and wheat flour availability has been calculated in Appendix 13. Wheat production, imports and aid donations have been added and exports subtracted. The Congo and Gabon have the greatest wheat and wheat flour availability per head on account of large imports. Zimbabwe has high availability on account of its local production. Inland eastern Africa and most Sahelian countries have least wheat availability. Central and West Africa import the highest quantities per capita.

Urbanisation And Food Consumption Trends

69. With the exception of population growth, the most important factor influencing the level and form of cassava consumption in Africa is urbanization. (Dorosh, 1989, p65). Appendix 14 lists the current urban population rates for the main cassava producing countries in Africa.

70. The perishability of fresh cassava makes it a high risk food to transport to urban markets. The high wastage levels contribute to high prices in urban markets and lead to the perception of fresh cassava as a luxury food rather than a staple. It is likely that the forms of cassava which can be most easily transported, stored and processed will be most important in the 1990's and beyond. (Dorosh, 1989, p65).

> " Women in urban areas often have a greater opportunity cost on their time because of employment opportunities. Women thus substitute reduction in food preparation time for increased cost of the food item. The result is a shift to such items as bread and away from staples requiring long cooking times. Increased rice and wheat imports are thus due as much to improved convenience as to "cheap" import prices. Cassava currently has the advantage in that it is normally traded as a processed product."
> (Lynam, 1991, p10).

71. Evidence from Asia also suggests that most traditional cassava products have negative income elasticity of demand - that is, as per capita income increases, per capita consumption decreases. (Sarma and Kunchai, 1991, p23-27).

72. Data from the Congo for 1984 suggest that rural cassava consumption (form not specified) was 400 kg per person per year. In the capital, Brazzaville, cassava consumption was lower, estimated at 175 kg per person a year. (Aviles, 1987, p5).

73. Although well adapted to rural consumption, cassava appears to be out performed by almost all other foodstuffs

in urban areas. (Janssen and Wheatley, 1985, p271). If the trends observed in Latin America and Asia are an indication of the future of root crops in African countries, much will depend on their ability to adapt from a subsistence to a market orientated form of production. (Lynam, 1991, p9).

GOVERNMENT POLICIES INFLUENCING CASSAVA PRODUCTION AND UTILISATION

74. Until recently, in most Africa countries, the price of imported cereals has been kept relatively low through overvalued exchange rates, food aid concessional sales and sometimes direct subsidies. (COSCA, 1988, p1). Structural adjustment programmes in many Sub-Saharan African countries have resulted in cereal markets being totally or partially liberalised.

75. The effect of free market exchange rates should have the result of raising the real costs of cereal imports, (leaving aside the controversial issue of whether cereal products are being "dumped" on developing countries). This places domestic producers in a better environment in which to compete in the 1990's than they were a decade ago.

76. Maintaining and expanding the use of cassava in Africa will require much more than just "getting the prices right". Full government support is required in extension, input supplies, credit provision, extension services, and markets. (Sarma and Kunchai, 1991, p4).

Cereal policies in Sub-Saharan African with particular reference to import duties and tariffs on wheat.

77. The situation regarding wheat markets and liberalisation is in a state of flux. Conversations with several commercial attaches of African embassies in London confirmed the view that there is currently a lack of clarity regarding the regulations and tariffs, if any, of cereal imports. All commercial attaches stated that the substantial majority of wheat and wheat flour imports is for use in the baking industry.

78. It is too early to judge whether the attention now being given to internal market constraints will have the desired effect of stimulating domestic production. In Zambia it is reported that higher prices for wheat are being passed on to urban consumers and that bread consumption is declining. However, the experience of Nigeria demonstrates that policies to prohibit imports are not a guarantee that domestic production of cereals or cereal flours will become established.

Table 2 Import taxes on wheat and flour (percent)

	Burundi[1]	Cote d'Ivoire[2]	Ghana[3]	Zaire[4]
Wheat (durum)	40	2.5	27.5	23
Wheat flour	50	5	37.5	18
Starch (cereal)	15	15	37.5	18
(cassava)	50	15	37.5	33

Tanzania - Raw materials (ie wheat) have been exempted from duty since July 1992. A duty on consumer goods is likely to apply to wheat flour but this rate could not be ascertained. (personal communication Tanzania High Commission).

Uganda - An import tax on wheat and wheat flour in the region of 40 to 50 percent exists. (personal communication Uganda High Commission).

Zambia - Import taxes (unspecified) only apply to cereal imports when there is no domestic shortage. (personal communication High Commission of Zambia).

[1] import duty 1987/1988, source: *International Customs Tariffs Bureau*, 1987).

[2] import duties as of 1986/7 includes revenue tax and customs duty, (source: International Customs Tariffs Bureau, 1986).

[3] This figure is a customs tax and a 17.5 percent value added tax (also applicable to the domestic formal sector) (Personal communication, Ghana High Commission).

[4] import tax and turnover tax of 3 percent as of 1991/92. (Source: *International Customs Tariffs Bureau*, 1991)

79. The table above lists import taxes for wheat and flour for African countries where information is available. It is probable that similar taxes exist for most African countries. An important first step in assessing the economic feasibility of a high grade cassava flour processing facility would be to ascertain exactly what import duties apply on competing products.

80. Most African governments now have a non-interventionist approach towards cereal markets. The importation of wheat and wheat flours used to be limited to the state is now conducted by the private sector. Many bakeries are thus involved with ordering their supplies directly from private importers of cereal.

81. African governments have declared varying degrees of support for root and tuber programmes. It is difficult, however, to know how much of the rhetoric of support for root crops has been translated into increased research budgets for these crops. In Cote d'Ivoire, Ghana and Zaire the development of the non-grain starch staples has been declared a national priority. Cote d'Ivoire and Ghana also have a stated emphasis on industrial processing technology. (Aviles, 1987, p4).

Government intervention in Nigeria

82. Nigeria provides a special case of government intervention in the wheat market. In January 1987 the Nigerian government banned the import of wheat in an attempt to save foreign exchange and promote local wheat production.

83. The National Accelerated Wheat Production Programme launched in 1988 to make Nigeria wheat self-sufficient failed to provide even one percent of the volume of wheat required by millers. The effects were disastrous to the milling and baking industries most of which were forced to

close. Wheat was smuggled into Nigeria from neighbouring countries and some Nigerian bakeries continued to supply the domestic market by relocating outside the country. (*Public Ledger*, November 20th 1992, p1 and p12.)

84. Since November 1992 the ban has been lifted "temporarily" although it is widely believed it will not be re-imposed. Imports for 1993 are expected to be 600,000 tonnes. (USDA, 1992, p11).

85. Import taxes are believed to apply for wheat but the present levels could not be ascertained by the Nigerian High Commission or the International Wheat Council.

CURRENT AND POTENTIAL MARKETS FOR CASSAVA OTHER THAN AS A FRESH ROOT

International Cassava Markets

86. Cassava has had a long but unsuccessful history as an export crop in Africa. Cassava starch exports started from Reunion and Madagascar at the turn of the century and later from Togo in the 1920's. After independence these industries went into decline due to the loss of privileged access to colonial markets and competition from south east Asia. Exports of dried cassava feed stuffs from Africa began in the 1930's from Zaire, Malawi, Tanzania, Togo, Mozambique and Angola. Since independence only small exports of cassava chips have been produced by Tanzanian when production has been surplus to the local market. (Lynam, 1991, p9).

Cassava as an animal feed

87. A potential use of cassava is in pellet form as animal feed. In Europe over 6 million tonnes of dried cassava are imported mainly from Thailand, a highly competitive low cost producer. Tanzania disposed of some deteriorating storage stocks of cassava to Europe but this has been conducted at a loss. (Dorosh, 1989, p67). The export potential for Africa must be considered minimal in light of such a saturated and competitive market.

Cassava starch

88. The world market for industrial starch is also unpromising. Although the process uses relatively simple technology profitability has been reduced by lower cost alternatives from potato and starch in developed countries.

Other industrial uses

89. Cassava has a wide industrial uses; world-wide over 100 cassava starch derivatives have been identified. Despite this potential, high capital investments have made the exploitation of cassava products in African industries very minor.

90. Cassava starch has uses in the food industry as a component in sauces, gravies, baby foods, confectionery and bakery products. It is also used as a jelly or thickening agent. It also has extensive uses in the manufacture of adhesives, dextrins, pastes and paints. In the textile industry, it is used for warp sizing, cloth and felt finishing. (IITA, 1990, p120).

91. Cassava also has the potential to be used as a high fructose syrup (sugar substitute). But although many cassava producing countries are also large sugar importers the production of fructose from cassava is almost twice as expensive as the world market price for sugar. Ethanol can also be produced from cassava but only a substantial increase in world oil prices would make this an economically viable option.

92. The contribution of cassava to the trade balance improvements in Africa will come through the extent it can be used in the place of imports and not as a source of foreign exchange. (Lynam, 1991, p9).

93. Despite the wide range of uses for cassava derivatives they have no known industrial applications in Africa. Cassava flour is not believed to be used in modern breweries, meat processing or brewing in Africa.

Cassava in bread making

94. In the 1960's and 1970's there was much optimism regarding the use of composite flours in bread making. (FAO Composite Flour Programme, 1973). However bread made using cassava flour has not met with consumer acceptance in Africa. Part of the problem has been the poor rising qualities of cassava flour. Cassava starch has better baking quality but suffers from a lack of flavour. It is generally considered that cassava composite flour has little future prospects in Africa. (D.Dendy personal communication).

95. Part of the lack of success in composite flour products may have been associated with poor marketing in the past. It has been suggested that cassava products would be better marketed as new "convenience" products rather than as a cheap alternative to wheat bread. (Eggleston, 1992, p8). Some evidence of the success of this strategy is found in the marketing of millet composite bread in Senegal. Under the brand name *Pain Nourissant* millet bread has been successfully promoted through advertising campaigns as a middle-class consumer product and sells for a higher price than wheat bread of the same size. (D.Dendy personal communication).

Cassava in the confectionery industry

96. According to CIAT their research has identified some "highly encouraging" uses for cassava flour in the confectionery industry. The results of food industry trials are shown in the following table.

Table 3 Results of CIAT cassava flour trials

Product category	No. of industry trials	No. of positive results	% substitution of wheat flour	Comments on product made with cassava flour
Processed meats	9	9	100	Better consistency, water absorption, good color
Biscuits/cookies	37	32	5–50	Firmer texture, good taste, crisper
Cakes	15	11	5–30	Good taste, good volume
Pastas/noodles	8	4	20–35	Good quality
Ice-cream cone	5	4	5–100	Firmer, maintains texture well
Packet soups	2	2	20–100	Good taste

(Source: Wheatley and Best, 1991, p16)

97. In general cassava flour was found to be acceptable at levels of up to 50 percent substitution in biscuits. As a result of the trials there has been commercial interest from Colombian biscuits manufacturers. Promising results were also obtained using amounts of cassava in cakes and ice-cream cones. Similar trials in the Philippines have found a high level of consumer acceptance for coconut cookies, doughnuts, cheese sticks and cinnamon rolls. (Van Den, 1985, p2).

Cassava in the meat industry

98. The CIAT trials also revealed a very favourable response when used in processed meats, noodles, and packet soups. Cassava flour in sausage production was found to have better qualities than wheat flour in terms of water absorption, colour and flavour. (Source: Wheatley and Best, 1991, p16).

Food Standards

99. Rules and food standard regulations may be important in determining the extent to which a composite flour (in this case cassava) can be used in place of wheat flour by food processors. The most important regulations relevant to cassava are those governing microbial requirements in wheat flour. Regulations may vary between one country and another, Appendix 15 lists the hygiene standard for Tanzania believed to be typical of those for East Africa.

100. International standards for edible cassava flour have been drafted by the Food and Agricultural Organisation. (Appendix 16, FAO Codex Alimentarius 1989).

Experiences of industrial cassava processing in Africa

101. This section reproduces sections from an FAO Working paper on the *Marketing Development of Roots, Tubers and Plantains (A report based on studies in eight West and Central African Countries)* (Aviles, 1987).

Cote D'ivoire

102. Industrial processing of cassava to flour, is reported to have provided 5,000 jobs in Cote d Ivoire. This new development has had positive spillovers: constraints at the producer level have been alleviated, technology has been diffused, urban employment has been created, and value added has been increased to a degree superior to that of rural processed cassava.

103. A pre-industrial processing chain to transform cassava into dry *attieke* in the area of Toumondi is technically functional, although the processing operation is still limited by fluctuations in the supply of cassava coming from

rural areas. (Aviles, 1987, p23-24). No further technical details are available.

Congo

104. In 1971 the Congolese Government developed an agro-industrial complex for the production of cassava fou-fou from a State farm. Since improvements to the factory were made in 1980 the factory has produced between 500 and 2000 metric tonnes of flour per year.

105. The finished product is sold in sacks to local wholesalers. Industrial fou-fou is less appreciated by the consumer than traditional fou-fou, however it is purchased because it is price competitive. (Aviles, 1987, Annex p6).

Gabon

106. An experimental FAO project to semi-industrialize cassava is reported to have succeeded at improving the rate of processing and reducing the labour time involved. The project has found difficulty in securing a regular supply of fresh cassava. (Aviles, 1987, p4, Annex p12).

Ghana and Nigeria

107. Small scale processing for *gari* production has been attempted by several commercial and co-operative ventures in Ghana and Nigeria. They have generally met with limited success because of the following common problems:

(a) failure to conduct financial viability studies.

(b) lack of credit facilities for the heavy investment in machinery.

(c) inadequate supplies of raw material, often connected to a lack of transportation facilities.

(d) a lack of management skills, record-keeping and marketing experience.

(Kwatia, 1991, p17-19).

108. Appendix 17 outlines several gari production and processing enterprises in Nigeria.

109. Table 4 which follows shows three indicators important in deciding where the production of high grade cassava flour will have applicability in Africa. The table is provided only as a simple means of bringing together more detailed data included in various appendices. Previous statements regarding the reliability of this information must be borne in mind. The table is not intended to be used as a hard and fast means of prioritizing one country over another.

110. Firstly, it is important that any country chosen for a feasibility study produces sufficient cassava to supply a processing plant. Further attention would need to be paid to how production areas are distributed within a country. It is possible that a country which has little cassava production per capita may nonetheless have a region where cassava is grown in sufficient quantities to justify a processing unit.

111. Secondly, wheat imports are considered to be important. The main justification for replacing wheat flour with cassava is that foreign exchange will be saved.

PRIORITIZATION OF COUNTRIES FOR MORE DETAILED RESEARCH

Table 4 Factors relevant to where cassava flour processing technology may have applicability in Africa.

Country	Cassava production	Wheat imports	Urban % of population
Humid & Sub-humid West Africa			
Ghana	High	Medium	Medium
Benin	High	Medium	Medium
Cote d'Ivoire	Medium	Medium	High
Togo	Medium	Medium	Medium
Liberia	Medium	Low	High
Nigeria	Medium	Low	Medium
Senegal	Low	Medium	Medium
Sierra Leone	Low	Medium	Medium
Sahelian West and Central Africa			
Guinea	Low	Medium	Medium
Chad	Low	Low	Medium
Niger	Low	Low	Medium
Mali	Low	Low	Low
Burkina Faso	Low	Low	Low
Humid Central Africa			
Congo	High	High	High
Gabon	High	High	High
Zaire	High	Low	High
Cameroon	Medium	Medium	High
CAR	Medium	Medium	High

(Key on following page)

Table 4 cont Factors relevant to where cassava flour processing technology may have applicability in Africa.

Country	Cassava[1] production	Wheat[2] imports	Urban % of[3] population
Sub-humid and mountainous East Africa			
Madagascar	Medium	Low	Medium
Kenya	Low	Low	Medium
Burundi	Medium	Low	Low
Uganda	Medium	Low	Low
Rwanda	Low	Low	Low
Sub-humid and semi-arid Southern Africa			
Mozambique	High	Medium	Medium
Tanzania	High	Low	Medium
Angola	Medium	Medium	Medium
Zambia	Low	Low	High
Zimbabwe	Low	Low	Medium
Malawi	Low	Low	Low

[1] Cassava production:

(see Appendix 3)

Kg / capita average 1988/90	
Low	0 - 99
Medium	100 - 199
High	> 200

[2] Wheat imports: trade and aid

(see Appendix 12)

Kg / capita average 1988/90	
Low	0 - 9
Medium	10 - 19
High	> 20

[3] Urban population: as % of total

(see Appendix 14)

Percentage	1990
Low	0 - 19
Medium	20 - 39
High	> 40

112. Thirdly, urbanisation was considered to be a proxy indicator of processed food eating habits. It is in towns rather than in rural areas that there is the effective demand for confectionery and processed meat products.

113. These three factors vary between the main regions of Africa. Cassava production is significant in all areas but the Sahel and southern central Africa. Wheat imports are of most importance in West and Central Africa. Urbanization is highest in Central Africa and West Africa.

114. Only two countries, Congo and Gabon, produce in excess of 200 kg of cassava per person per year, import more than 20 kg of wheat per head and have more than 40 percent of their population resident in towns. The pattern observed in the Congo and Gabon is replicated to almost the same extent by other central humid African countries. However the Francophone countries of West Africa are unlikely to be eligible for ODA technical cooperation assistance. This factor coupled with weak national research institutions and internal unrest means they are not recommended for further analysis.

115. West Africa is considered to be a more promising region for the establishment of high grade cassava processing plants. Cassava is of importance in the southern portions of these countries where the urban populations are most concentrated. Wheat imports are draining foreign exchange and urbanisation is increasing. The importance of West Africa has been highlighted by other researchers:

> " the real 'fight' between root crops and grains will primarily play itself out in West Africa. It is in these markets that the future potential of root and tuber crops in the agricultural sector will be determined. This is where cheap grain imports confront the traditions and production capacity of the root crop belt. This region thus sets the stage for the evolution of root and tuber crops in the rest of Africa ". (Lynam, 1991, p11).

116. Ghana is considered to be the most promising country in the region for further analysis when one takes into account the strength of government institutions such as the *Ghana Food Research Institute* and the expertise of the *University of Legon*. Ghana also has a declared national policy of support for root-crop development and processing. It is also the country which is believed to have made the soundest contribution to the COSCA study. If a successful project could be established in Ghana it may have replicability on a larger scale in nearby countries such as Nigeria.

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APPENDIX 1

TERMS OF REFERENCE

DESK STUDY OF THE POTENTIAL FOR INCREASED CASSAVA FLOUR UTILISATION IN AFRICA

(i) The study will identify in which African countries cassava production is of most importance.

(ii) Based on the countries identified in (i) production factors will be analysed in more detail according to: yields, utilisation, seasonality, cultivar differences (cyanide levels).

(iii) Identify where possible for the countries chosen, NARS or other organisations involved with aspects of cassava production or utilization.

(iv) Compile data on cereal production by African countries and imports of wheat and flour (including those which are part of food aid).

(v) Identify food preferences associated with urbanisation and the scale of food processing industries which utilise cereal (eg wheat) flours in their products.

(vi) Review government policies regarding cereal flours which may be of relevance to their partial substitution by cassava flour.

(vii) Assess current or potential markets for cassava utilization, other than as a fresh root.

(viii) Prioritize countries for a more detailed analysis of cassava flour utilisation.

Sources of information on cassava used by the CIAT in "An Atlas of Cassava in Africa"

Angola

Source: World Atlas of Agriculture (1976), volume 4: Africa[1]. Istituto Geografico De Agostini, Novara, Italy.

Data: 1964-1966. 90,000 ha.

Comments: These data replaced more recent data from the Anuário Estadístico 1973 (Instituto Nacional de Estadística, Delegação de Angola, Luanda, 1973). The latter were inconsistent, and it was likely that they were inaccurate because of contemporary civil disturbances.

Benin

Source: Annuaire 1969-1979. Ministère du Développement Rural et de l'Action Coopérative. Cotonou.

Data: 1979. 113,000 ha (1.3%). Department level.

Comments: FAO information was for 1976-1977 and was not used. Departments are very small at 1:5,000,000, enhancing accuracy of point location at this scale. WAA (1976) was used as a guide to population distribution. A 1967 cassava distribution map was used as a consistency check.

Burkina Faso

Source: Bulletin de Statistiques Agricoles Campagnes 1982-84 (1984). Service des Statistiques Agricoles, Ministère de l'Agriculture et de l'Elevage, Ouagadougou.

Data: 1984. 1000 ha (0.01%). ORD (Organisme Régional de Développement).

Burundi

Source: Annuaire Statistique, 1981. Ministère du Plan National des Etudes et Statistiques. Bujumbura.

Data: 1981. 394,000 ha (4.7%). District.

Comments: The FAO data were slightly more recent but for production in tons. There was no indication of yields, so hectarage could not be accurately deduced. The choice of scale (1:5,000,000) and dot size results in an impression of great concentration of cassava in all parts of the country apart from the escarpment of the Congo-Nile divide to the west of the country. This may give an exaggerated view, although it is consistent with the rest of the map.

Cape Verde

Source: Rapport de la Mission d'Étude Sectorielle Agricole. Missions de Programmation Intéressant le Secteur Alimentaire et Agricole (1969).

Data: 1969. 1000 ha (0.01%). Province.

Comments: 1000 ha, being the basic unit for mapping, could only be represented by one dot. It was placed in the most populated area.

Cameroon

Source: Annuaire de Statistiques Agricoles 1982-1983; Yearbook of Agricultural Statistics. Ministère de l'Agriculture. Yaoundé.

Data: 1983. 383,000 ha (4.7%). Province.

Comments: Within Provinces, apart from settlement locations, the names of 34 known locations of cassava concentrations were extracted from the WAA (1976) and used to aid in dot placement.

Central African Republic

Source: Recensement Agricole de la Republique Centrafricaine (1985): Résultats Définitifs. 1987. FAO Proj. PNUD/FAO/CAF/84/002. Bangui.

Data: 1985. 152,000 ha (1.8%). Prefecture level.

Comments: This was some of the most detailed information encountered. The WAA (1976) was also consulted to verify dot placement against its maps of population density, and percentage of total farms cultivating manioc.

Chad

Source: (1) Statistik des Auslandes (1984). Statistisches Bundesamt, Wiesbaden, Germany.

(2) Résultats du Recensement Agricole 1972/3 pour le Tchad. FAO, Rome, Italy. 1977.

(3) Recensement Agricole du Mali de 1984 Résultats preliminaires. Ministère du Plan Nov. N'Djamena. 1985.

Data: (1) 1982. 23,000 ha (0.03%). Country total.

Comments: Total production for the country in 1982 from (1) was converted to hectares by using the typical yields from Mali (3). For distribution amongst prefectures, older information (2) was used.

Comores

Source: Statistik des Auslandes (1983). Statistisches Bundesamt, Wiesbaden, Germany.

Data: 1983. 5000 ha (0.06%). Country total.

Congo

Source: Annuaire Statistique 1982. Ministère du Plan, Centre National de la Statistique et des Études Économiques. BP 2031. Brazzaville.

Data: 1972-1973. 160,000 ha (1.9%). Province.

Comments: WAA (1976) was used as a guide to locate points within provinces.

Equatorial Guinea

Source: Statistik des Auslandes (1986). Statistisches Bundesamt, Wiesbaden, Germany.

Data: 1984. 25,000 ha (0.3%). Country total.

Comments: Production was divided by average yield to get a hectarage figure for the whole of Equatorial Guinea. Between Río Muni and Fernando Po, hectarages were divided by the proportions of area of land available for arable production (WAA, 1976). Cassava was quoted as being important in both these areas.

Gabon

Source: Statistik des Auslandes (1985). Statistisches Bundesamt, Wiesbaden, Germany.

Data: 1983. 42,000 ha (0.5%). Country total.

Comments: The total hectarage of 42,000 ha was calculated from production, and a yield estimate from typical yields. Within provinces, a 1964 distribution map (WAA, 1976) was used as a guideline for dot placement.

Gambia

Source: Statistik des Auslandes (1987). Statistisches Bundesamt, Wiesbaden, Germany.

Data: 1984. 2000 ha (0.02%). Country total.

Comments: Total production was divided by yield to give a total hectare figure. The 2 dots were placed near the most populated areas. Note that the production and yield figures quoted did not change from 1981 to 1984, remaining at 6.0 MT/ha throughout the 4 years! The reliability of the data set was thus questioned.

Ghana

Source: Agricultural Statistics (Food Crops). (1986). The Statistics Section, Ministry of Agriculture. Accra.

Data: 1980. 380,000 ha (4.6%). Region.

Comments: A distribution map by A. Warren (personal communication) based on impressions of Ghanaian research staff was also available as a detailed guide to distribution of cassava.

Guinea

Source: United Nations 1981. Mémoire de la Guinée (Rome?).

Data: 1975. 79,000 ha (1.0%). Administrative region.

Comments: Accuracy of dot placement was facilitated by the small size of political divisions.

Guinea-Bissau

Source: (1) Agricultural Census 1960/61. Guinea-Bissau.

(2) Recenseamento Geral da População 1960. Resumo Geral. Serviços de Administração Cível, Secção de Estadística. Lisbon, Portugal, 1978.

Data: 1960-1966. 6000 ha (proportion unknown). Regions.

Comments: There were no more recent data than (1). A map of administrative divisions in (2) was used. Dots were not placed in tidal mangrove areas.

Ivory Coast (Côte d'Ivoire)

Source: Sous-direction des statistiques agricoles et forestières (1984). Ministère de l'Agriculture et des Faux et Forêts. Abidjan.

Data: 1984. 230,000 ha (2.8%). Département.

Kenya

Source: (1) Ministry of Agriculture, Kenya (1979).

(2) Integrated Rural Survey 1974-5. Basic Report of the Central Bureau of Statistics. Ministry of Finance and Planning. Nairobi. March 1977.

Data: 1977. 69,000 ha (0.6%). Province and district.

Comments: Basic data from (1) were used because they were organised by smaller political divisions. However, (2) showed consistently larger areas of cassava production (69,000 versus 52,000). While using (1) to indicate distribution among districts, the total cassava area was taken from (2).

Liberia

Source: Production estimates of major crops 1984 (1985). Ministry of Agriculture, Monrovia.

Data: 1984. 43,000 ha (0.5%). County.

Comments: A distribution map by A. Warren (personal communication), based on impressions of Liberian research staff, was also available.

Madagascar

Source: Statistiques Agricoles. Annuaire 1978/9 (1980). Ministère du Développement Rural et de la Réforme Agraire. Antananarivo.

Data: 1979. 238,000 ha (2.9%). Fartamin/Fivondronona.

Comments: The detailed nature of the information makes Madagascar the most accurately mapped.

Malawi

Source: National Sample Survey of Agriculture 1980/1 (1984). National Statistical Office. Zomba.

Data: 1981. 50,000 ha (0.6%). ADD (Agricultural Development Division).

1. Hereafter referred to as 'WAA, 1976'.

(Source: An Atlas of Cassava in Africa, CIAT, 1992)

Mozambique

Source: Programa de Investigação Agronómica em Moçambique. Propostas. Período 1977-80 (1977). Maputo.

Data: 1970. 449,000 ha (5.4%). Provincia.

Comments: WAA (1976) distribution map was used as a guide.

Niger

Source: Annuaire Statistique, édition 1985. (1985) Direction de la statistique et de l'informatique. Ministère du Plan.

Data: 1982. 34,000 ha (0.6%). Département.

Nigeria

Source: National Agricultural Sample Census of Nigeria, 1974-5.

Data: 1975. 415,000 ha. State.

Comments: For the case study (Chapter 7), the agricultural census data of 1951/52 were consulted, as well as various detailed reports. For a discussion of discrepancies between data sources, see Chapter 7.

Rwanda

Source: Résultats de l'enquête nationale agricole, 1984, vol. 1. Ministère de l'Agriculture de l'Élevage et des Forêts. Kigali. Septembre, 1985.

Data: 1984. 141,000 ha (1.7%). Préfecture.

Senegal

Source: Situation économique du Sénégal 1985. Direction de la Statistique, Ministère de l'Économique et des Finances. Dakar.

Data: 1984. 6000 ha (0.09%). Région.

Sierra Leone

Source: (1) Statistik des Auslandes, 1986; Sierra Leone. Statistisches Bundesamt, Wiesbaden, Germany.

(2) Agricultural Statistical Survey of Sierra 1970/71. Central Statistics Office, Freetown.

Data: 1984. 30,000 ha (0.4%). Country total.

Comments: The recent total in (1) was distributed to provinces according to proportions in 1970-1971, in (2).

Sudan

Source: (1) Statistik des Auslandes, 1987; Sudan. Statistisches Bundesamt, Wiesbaden, Germany.

(2) Current Agricultural Statistics. Khartoum, June 1979.

Data: 1985. 46,000 (0.6%). Country total.

Comments: Recent total figure from (1) was used, and proportional distribution by region (qtlm) was taken from (2).

Tanzania

Source: Regional and District Cassava Production in Tanzania 1985/6 (1986). Early Warning and Crop Monitoring Unit. Dar es Salaam.

Data: 1986. 1,286,000 ha (15.6%). Region.

Comments: Also available was 1:2,500,000 scale map of cassava distribution by A. Warren (personal communication). For the detailed case study (Chapter 7), pre-independence reports were consulted. National statistics presented marked inconsistencies (see Chapter 7).

Togo

Source: Enquête Agricole: Rendements des principales cultures vivrières campagne agricole 1985/6. (1986) Direction des enquêtes et statistiques agricoles. Ministère du Développement Rural. Lomé.

Data: 1985. 49,000 ha (0.6%). Circonscription.

Comments: Data for Togo were separated as monocrop cassava, cassava as the principal crop and as the secondary crop. So not to over-estimate the area of actual cassava, the area quoted for cassava as the secondary crop was not used. Hectarages were calculated from production figures and the yields of cassava as the main crop, for each political division.

Uganda

Source: A printout had been extracted from a database, with no source quoted. Most probably from the Ministry of Agriculture and Forestry, Uganda.

Data: 1984. 401,000 ha (4.9%). District level.

Comments: Data available for relatively small political divisions (36 Districts) and thus (spatially) accurately mapped, although the type of survey used to obtain the data was unknown.

Zaire

Source: Annuaire des Statistiques Agricoles 1979/85. (1986). Service d'Études et de Planification Agricole. Division de la Statistique Agricole, Kinshasa.

Data: 1985. 2,150,000 ha (26.1%). Région.

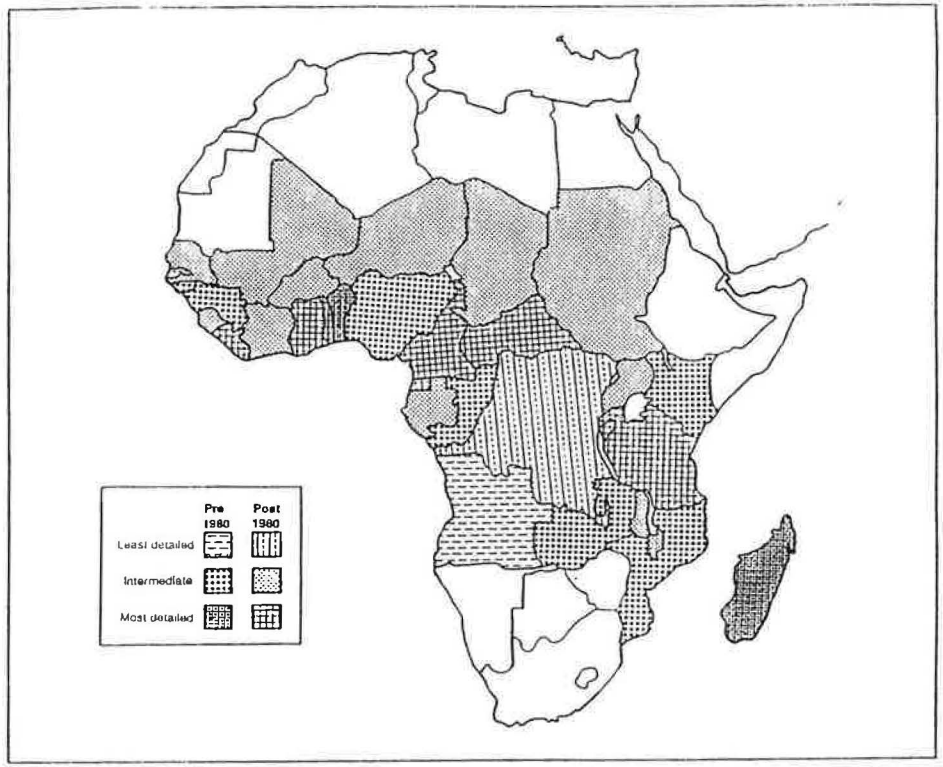
Comments: Regions in Zaire are enormous. Within regions dots were placed largely according to settlement patterns. The WAA (1976) provided a distribution map (albeit old, 1960) and an indication of those areas in which more than half of the cropped land was planted with cassava. For the case study, reports from the Ministère des Colonies, as well as from the Institut National d'Etudes Agronomiques au Congo Belge, were consulted.

Zambia

Source: Agricultural and Pastoral Production 1970 (1973). Central Statistics Office, Lusaka.

Data: 1970. 161,000 ha. Province.

Reliability and periodicity of data available on cassava in Africa.



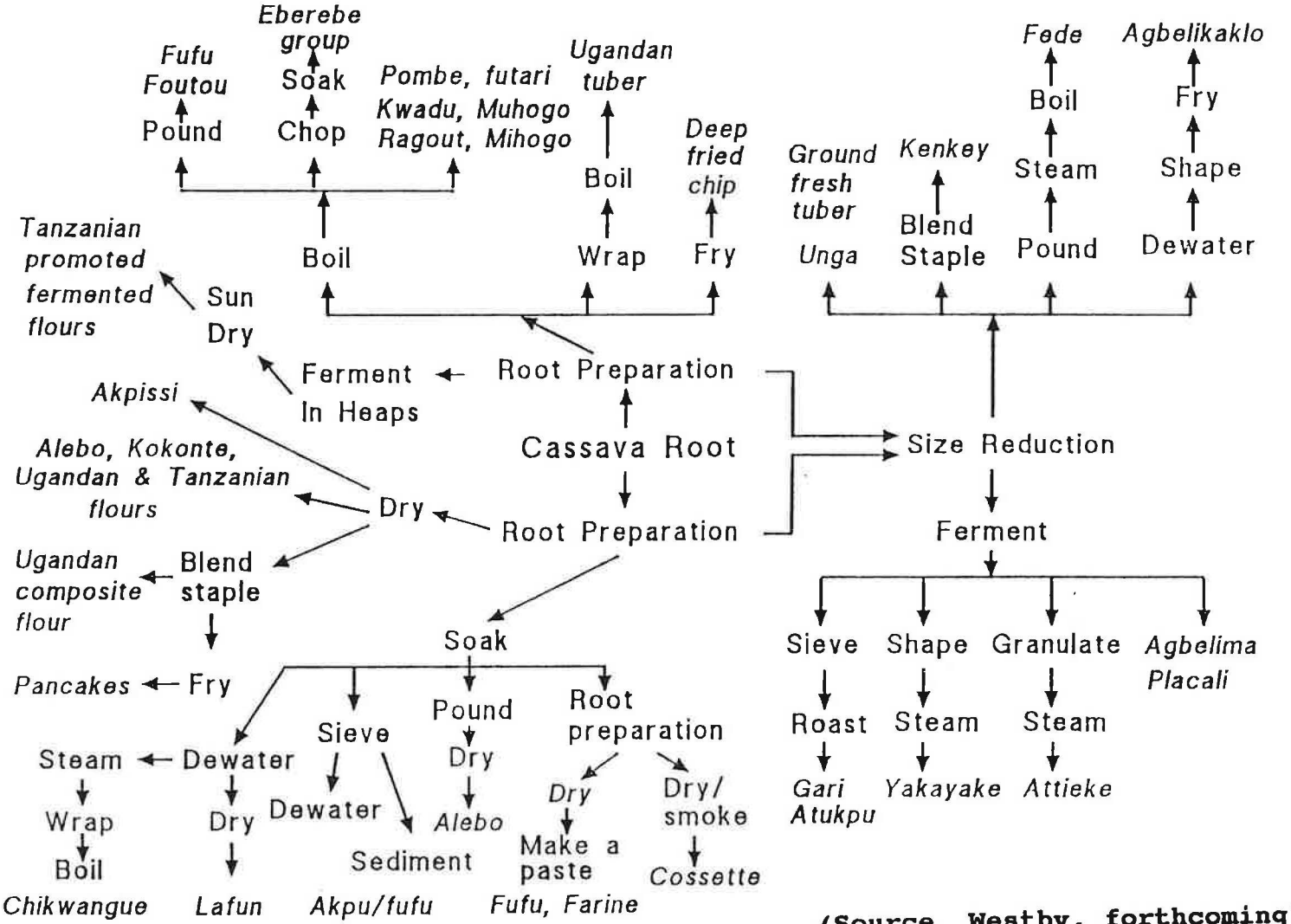
(Source: An Atlas of Cassava in Africa, CIAT, 1992)

Cassava production and yields in Sub Saharan Africa 1989-1991

	Cassava Production (kg per capita)				Cassava Production ('000 tonnes)				Yield (MT/Hectare)	Population millions			
	Av 89/91	1991	1990	1989	Av 89/91	1991	1990	1989	1991	Av 89/91	1991	1990	1989
Total	105	104	105	104	67187	68931	67584	65047		642	661	642	623
Humid/Sub-humid W. Africa:													
Ghana	211	228	181	225	3215	3600	2717	3327	6.7	15	16	15	15
Benin	200	217	208	178	941	889	957	977	7.4	5	5	5	5
Nigeria	168	147	176	179	18156	20000	19043	15425	11.8	108	112	108	105
Togo	138	120	169	125	501	500	593	409	7.7	4	4	4	3
Liberia	122	140	115	111	317	300	300	350	6.4	3	3	3	3
Cote d'Ivoire	120	126	116	120	1429	1435	1393	1460	5.6	12	12	12	12
Sierra Leone	26	30	29	21	110	90	123	118	4.1	4	4	4	4
Senegal	9	8	9	9	66	69	69	59	3.2	7	8	7	7
Gambia	7	7	7	7	6	6	6	6	5	1	1	1	1
Sahelian West and C. Africa													
Guinea	72	64	78	75	419	450	450	358	6.4	6	6	6	6
Chad	59	60	58	59	334	342	330	330	4.7	6	6	6	6
Niger	28	28	28	27	213	216	213	210	7.7	8	8	8	8
Mali	8	8	8	8	74	73	75	73	9	9	10	9	9
Burkina Faso	3	4	4	3	31	30	32	32	5	9	9	9	9
Humid Central Africa:													
Zaire	497	504	494	493	17742	18227	17600	17400	7.6	36	37	36	35
Congo	322	304	335	325	740	780	770	669	7.8	2	2	2	2
Gabon	203	188	214	208	237	250	250	212	5.6	1	1	1	1
CAR	170	175	173	163	519	520	520	516	3.1	3	3	3	3
Eq. Guinea	127	126	129	128	45	46	45	44	2.6	.35	.36	.35	.35
Cameroon	101	100	102	101	1189	1230	1200	1137		12	12	12	11
Sub-humid/mountain E. Africa:													
Madagascar	191	196	191	185	2286	2290	2292	2277	6.7	12	12	12	12
Uganda	182	197	178	172	3419	3350	3339	3568	8.8	19	20	19	18
Burundi	113	132	103	104	616	580	569	698	11.1	5	6	6	5
Rwanda	76	76	76	75	547	560	550	530	11.1	7	8	7	7
Kenya	27	27	27	26	643	650	650	630	9.7	24	25	24	23
Sub-humid/semi-arid S. Africa:													
Tanzania	256	296	254	221	6993	6266	6922	7792	10.3	27	28	27	26
Mozambique	250	263	258	229	3915	3690	4056	4000	3.8	16	16	16	15
Angola	185	185	190	180	1850	1850	1900	1800	3.7	10	10	10	10
Zambia	31	31	31	31	260	270	260	250	3.6	8	9	8	8
Malawi	18	18	17	18	156	168	145	155	2.3	9	9	9	8
Zimbabwe	9	10	9	9	89	90	90	88	3.9	10	10	10	9

SOURCE: FAO PRODUCTION YEARBOOK 1991

Processing techniques and traditional cassava products identified by the COSCA study.



(Source, Westby, forthcoming)

Gari (garri)	Grated, fermented, sieved and fried cassava mash; in its final form, it is a free-flowing granular meal; used in a variety of ways in main meals and as a snack (West Africa)
Garifoto	Combination of gari and fish or egg sauce to make a one-dish meal (Ghana)
Kokonte	Dried, unfermented cassava chips, milled into flour and made into a thick paste; eaten with soups (Ghana)
Kourou-kourou	Thin gruel made by adding some fermented cassava flour to boiling water (Cameroon)
Kumkum	Cassava flour prepared from fermented tubers by grating, forming into balls, and drying over the fireplace; the dried balls are stored until required and marketed as balls or flour (Cameroon)
Kpokpo gari	Peeled and soaked tubers which are then grated, washed, dried, roasted into large hard grains and then soaked in water again; eaten with side dishes (Nigeria)
Njambo	Dried, fermented cassava chips, milled into flour and made into a thick paste (Gambia)
Tapioca	Wet or partially dried sieved starch particles heated with continuous stirring, forming gelatinized, dried granules; eaten as breakfast porridge (West Africa)
Ugali	Dried cassava chips produced by sun-drying, or steeped and fermented prior to drying, and then made into a thick paste; eaten with soup (Tanzania)
Yakeyake	Steamed cassava dough (Ghana)

Abacha	Boiled, shredded and dried cassava slices (similar to noodles); eaten in salads (Nigeria)
Ampesi	Boiled cassava tubers; normally eaten with vegetable/meat soups or stews (Ghana)
Agbele kaklo	Deep-fried snack in the shape of croquettes or balls prepared from grated cassava mash; eaten as snacks (Ghana)
Akple	Thick porridge prepared from a mixture of maize and cassava dough; eaten with okra soup or stew (Ghana)
Attieke	Steeped, pounded, fermented cassava tubers which are pressed, crumbled and steamed; eaten with milk or meat and vegetables (Côte d'Ivoire)
Bâton du manioc	Wet cassava paste wrapped in leaves, shaped as a long stick (30 to 60cm) and cooked (Cameroon)
Chickwangue	Like bâton du manioc, but shaped into a ball (Cameroon)
Elubo lafun	Thick paste prepared from traditional cassava flour (lafun); eaten with vegetable/meat soup (Nigeria)
Fufu	Boiled cassava pounded with plantain or with cocoyam; eaten with various soups (Ghana)
Foofoo	Soaked, pounded and fermented mash which is then mixed with water, sieved, and cooked into a thick paste; eaten with stew (Sierra Leone)

Source: IITA, 1990, Cassava in Tropical Africa, p116-117

Frequency of cassava food products identified in the COSCA study.

Product type by country — first three ranked products

Product	Côte d'Ivoire	Ghana	Western Nigeria	Eastern Nigeria	Tanzania	Uganda	Zaire	Total	Per cent
Cooked roots	35	20		11	9	33		108	17
Roasted granules	7	19	18	24				68	11
Steamed granules	30	1					1	32	5
Flours/dry pieces	21	27	17	35	61	52	66	279	45
Fermented pastes	4	10	19	21	1		20	75	12
Leaves					1	3	2	6	1
Beers						6		6	1
Sedimented starch	22		3	3				28	4
Unclassified		5	4	4	2	2	4	21	3
							Total	623	100

Note: The figures in the columns indicate the number of times a particular product type was ranked in the first three most important in the 233 villages surveyed.

Product type by country — first ranked products

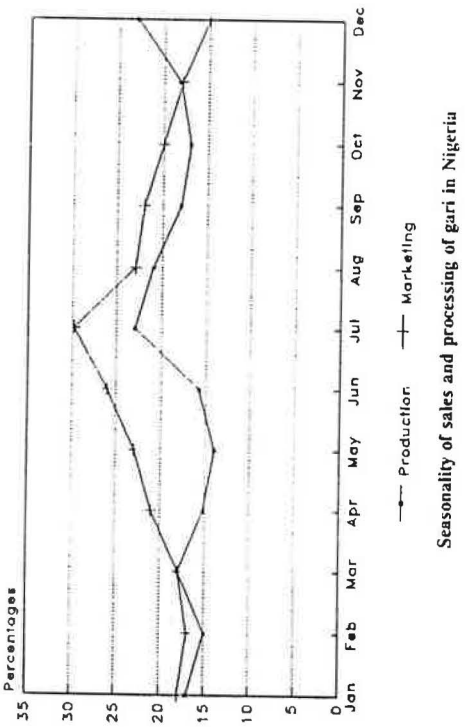
Product	Côte d'Ivoire	Ghana	Western Nigeria	Eastern Nigeria	Tanzania	Uganda	Zaire	Total	Per cent
Cooked roots	16	7			2	28		53	23
Roasted granules	1	12	14	8				35	15
Steamed granules	14						1	15	6
Flours/dry pieces	4	8	4	27	26	4	24	97	42
Fermented pastes	2	2		8	1		9	22	9
Leaves								0	0
Beers								0	0
Sedimented starch	3							3	1
Unclassified		1	3	1			2	7	3
							Total	232	100

Note: The figures in the columns indicate the number of villages where the products were ranked first in the 233 villages surveyed

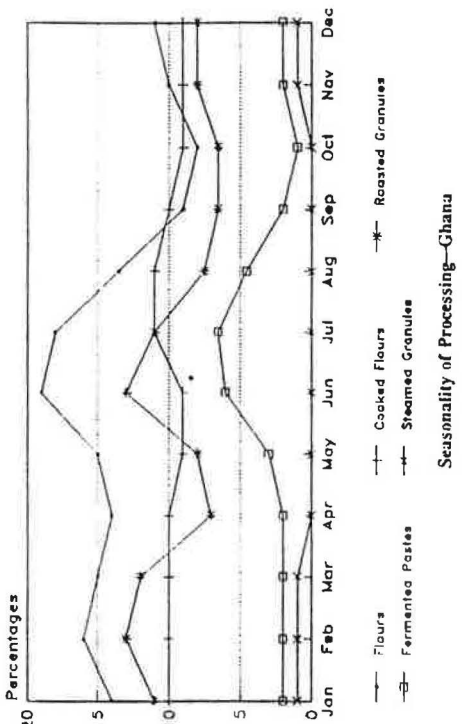
(Source, Collaborative Study of Cassava in Africa, Working Paper No 7, p3, 1992)

Seasonality of cassava processing activities

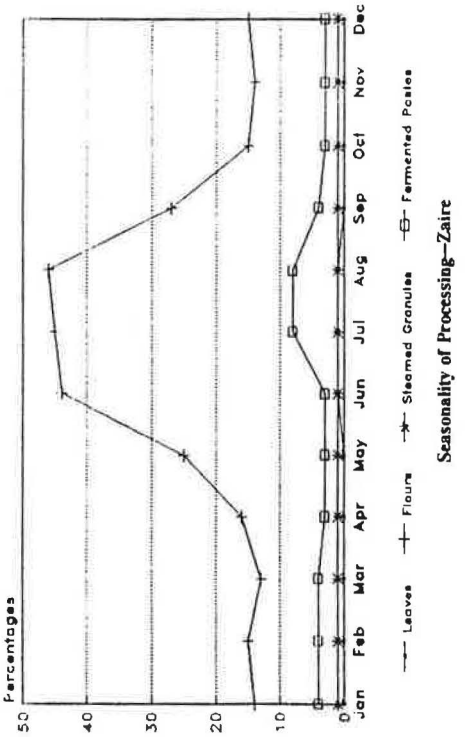
APPENDIX 7



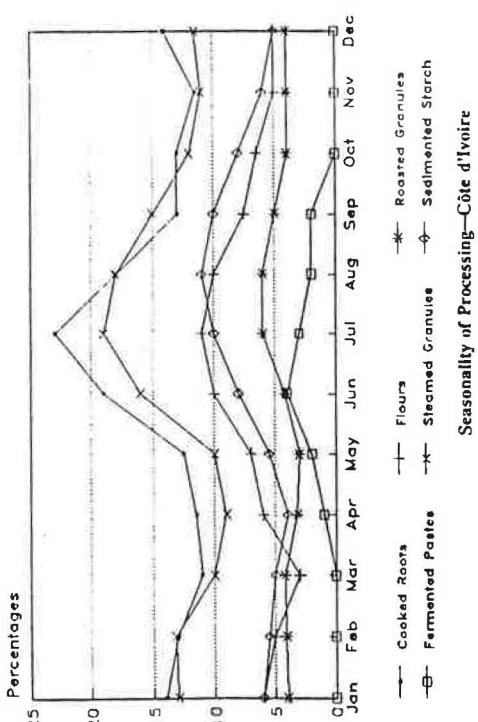
Seasonality of sales and processing of gari in Nigeria



Seasonality of Processing—Ghana



Seasonality of Processing—Zaire



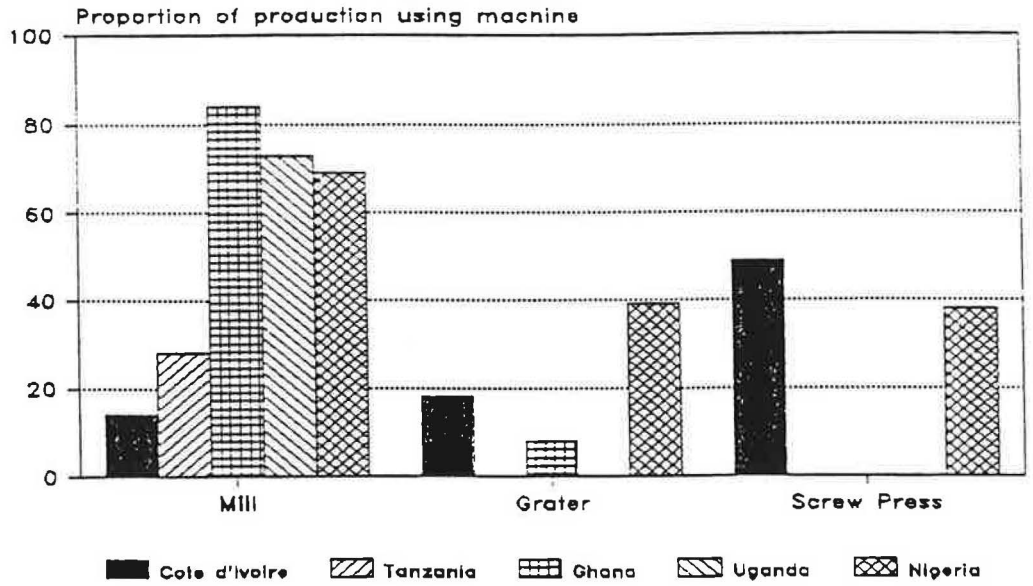
Seasonality of Processing—Côte d'Ivoire

(Source, Collaborative Study of Cassava in Africa, Working Paper No 7, p10-11, 1992)

Extent of mechanised processing in COSCA countries

Mechanization of processing — total and relative frequency of use

Product	Country	Total Product	Mill/ Grinder	Grater	Screw Press
Roasted granules	Côte d'Ivoire	7	1(14%)	1(14%)	7(100%)
	Ghana	19	14(74%)	4(21%)	0(0%)
	Nigeria	42	21(50%)	31(74%)	17(40%)
Steamed granules	Côte d'Ivoire	30	6(20%)	3(10%)	24(80%)
Flours	Côte d'Ivoire	21	3(14%)	4(19%)	10(48%)
	Ghana	27	23(85%)	2(7%)	0(0%)
	Nigeria	52	36(69%)	20(38%)	14(27%)
	Tanzania	61	16(26%)	0(0%)	0(0%)
	Uganda	52	37(71%)	0(0%)	0(0%)
	Zaire	66	0(0%)	0(0%)	0(0%)



Use of machines in the production of flours

(Source, Collaborative Study of Cassava in Africa, Working Paper No 7, p17-18, 1992)

APPENDIX 9

Addresses of some African reaearch oranisations involved with cassava.

Cote D'Ivoire

(COSCA contact)

CIRES
08 BP 1296
Abidjan 01

Centre Ivorien de Rescherches Technologiques
09 BP 922
Abidjan 09

Gabon

Laboratorie de Zoollogie et de Lutte Biologique,
Programme National de Lutte Biologique,
B.P. 1886
Liberville

Ghana

(COSCA contact)

Department of Agricultural Economics
University of Ghana (Legon)
Box 68
Accra Telex 2556 UGL GH

Crops Research Institute CSIR
& Food Research Institute CSIR

PO Box 3785
Kumasi
Ashanti

Ghana Standards Board

PO Box M.245
Accra

Nigeria

(COSCA contact)

National Root Crops Research Institute
Umudike
Imo State

International Institute of Tropical Agriculture
P.M.B. 5320
Ibadan

Tanzania

(COSCA contact)

c/o NCDP
Box 6226
Dar es-Salaam

Agricultural Research Institute
P.O. Box 1433
Ukirigur
Mwanza

Uganda

(COSCA contact)

Namalange Research Station
PO Box 7084
Kampala

Zaire

Projet de Researche Agronomique Appliquee et
Vulgarization PRONAM.
B.P. 11635
Kinshasa 1

Cereal production in Africa 1989-1991

	Cereal Production (kg per capita)				Cereal Production ('000 tonnes)				Population millions			
	Av 89/91	1991	1990	1989	Av 89/91	1991	1990	1989	Av 89/91	1991	1990	1989
Total	68	80	70	54	43503	35449	45056	50005	642	661	642	623
Humid/Sub-humid W. Africa:												
Ghana	77	83	56	90	1166	1436	844	1217	15	16	15	15
Benin	117	125	120	107	550	534	553	563	5	5	5	5
Nigeria	93	144	128	13	10105	1420	13773	15122	108	112	108	105
Togo	137	166	138	112	499	447	484	566	4	4	4	3
Liberia	63	112	38	41	163	110	100	280	3	3	3	3
Cote d'Ivoire	105	103	104	108	1244	1292	1247	1193	12	12	12	12
Sierra Leone	126	143	134	103	526	442	562	573	4	4	4	4
Senegal	134	150	130	122	977	914	950	1067	7	8	7	7
Gambia	115	114	108	121	99	108	93	96	1	1	1	1
Sahelian West and C. Africa												
Guinea	140	132	139	148	812	888	809	740	6	6	6	6
Chad	122	106	106	154	692	891	602	582	6	6	6	6
Niger	248	246	194	302	1916	2415	1490	1843	8	8	8	8
Mali	223	242	193	235	2054	2232	1772	2157	9	10	9	9
Burkina Faso	211	224	169	240	1902	2234	1519	1952	9	9	9	9
Humid Central Africa:												
Zaire	37	37	37	37	1311	1359	1303	1272	36	37	36	35
Congo	11	12	11	11	26	26	26	26	2	2	2	2
Gabon	18	19	18	18	21	21	21	21	1	1	1	1
CAR	50	42	55	52	152	165	166	124	3	3	3	3
Eq. Guinea	0	0	0	0	0	0	0	0	.35	.36	.35	.35
Cameroon	77	74	73	82	903	1003	865	841	12	12	12	11
Sub-humid/mountain E. Africa:												
Madagascar	208	219	215	190	2490	2352	2577	2542	12	12	12	12
Uganda	86	89	84	85	1616	1652	1578	1619	19	20	19	18
Burundi	55	50	53	61	300	342	293	265	5	6	6	5
Rwanda	41	40	39	44	296	330	282	277	7	8	7	7
Kenya	128	145	129	110	3072	2747	3105	3364	24	25	24	23
Sub-humid/semi-arid S. Africa:												
Tanzania	152	182	141	135	4154	3826	3842	4793	27	28	27	26
Mozambique	40	40	47	34	629	546	734	607	16	16	16	15
Angola	31	30	26	37	311	381	264	289	10	10	10	10
Zambia	188	243	143	182	1592	1603	1207	1967	8	9	8	8
Malawi	178	188	162	185	1561	1679	1415	1588	9	9	9	8
Zimbabwe	246	270	266	205	2364	2054	2580	2459	10	10	10	9

SOURCE: FAO PRODUCTION YEARBOOK 1991

Wheat production in Africa 1989-1991

	Wheat Production (kg per capita)				Wheat Production ('000 tonnes)				Population millions			
	Av 89/91	1991	1990	1989	Av 89/91	1991	1990	1989	Av 89/91	1991	1990	1989
Total	1.2	1.2	1.2	1.2	773	761	800	759	642	661	642	623
Humid/Sub-humid W. Africa:												
Nigeria	.7	.6	.8	.8	78	85	90	60	108	112	108	105
Sahelian West and C. Africa												
Chad	.4	.2	.4	.7	2	4	2	1	6	6	6	6
Niger	1.2	.3	1.7	1.5	9	12	13	2	8	8	8	8
Mali	.2	.2	.2	.2	2	2	2	2	9	10	9	9
Humid Central Africa:												
Zaire	.2	.2	.2	.2	7	7	7	7	36	37	36	35
Cameroon	.2	.2	.2	.2	2	2	2	2	12	12	12	11
Sub-humid/mountain E. Africa:												
Madagascar	.1	.1	.1	.1	1	1	1	1	12	12	12	12
Uganda	.5	.6	.4	.4	9	8	8	11	19	20	19	18
Burundi	1.9	1.5	1.6	2.5	10	14	9	8	5	6	6	5
Rwanda	1.4	1.4	1.4	1.3	10	10	10	10	7	8	7	7
Kenya	8.8	10.5	7.7	8.4	213	210	185	243	24	25	24	23
Sub-humid/semi-arid S. Africa:												
Tanzania	3.2	4.0	3.1	2.6	88	75	84	106	27	28	27	26
Mozambique	.3	.2	.3	.3	4	5	5	3	16	16	16	15
Angola	.3	.2	.3	.3	3	3	3	2	10	10	10	10
Zambia	6.6	5.8	6.2	7.7	56	68	52	47	8	9	8	8
Malawi	.2	.1	.2	.2	2	2	2	1	9	9	9	8
Zimbabwe	28.9	27.8	33.5	25.3	277	253	325	253	10	10	10	9

SOURCE: FAO PRODUCTION YEARBOOK 1991

No wheat production in, Ghana, Benin, Togo, Liberia, Cote d'Ivoire, Sierra Leone, Senegal, Gambia, Guinea, Burkina Faso, Congo, Gabon, CAR, Eq Guinea

Wheat and flour imports. Trade and Aid. Africa 1989-1991

	Wheat and flour imports trade and aid (kg per capita)								Wheat and flour imports trade and aid ('000 tonnes)							
	Total	Av 88/90 (Aid)	1990 Total	(Aid)	1989 Total	(Aid)	1988 Total	(Aid)	Total	Av 88/ (Aid)	1990 Total	(Aid)	1989 Total	(Aid)	1988 Total	(Aid)
Total	7.8	1.2	8	1.0	7	1.1	8	1.6	3011	476	3135	410	2790	439	3109	579
Humid/Sub-humid W. Africa:																
Ghana	16	2.8	18	2.9	13	2.8	14	1.7	219	36	269	44	195	41	194	24
Benin	15	.8	18	.0	11	1.6	20	.9	75	4	83	0	51	7	90	4
Nigeria	2	.0	2	.0	2	.0	2	.0	209	0	252	0	185	0	190	0
Togo	23	2.7	21	2.9	23	2.6	26	2.1	79	9	72	10	79	9	86	7
Liberia	7	.1	2	.0	11	.2	10	.2	19	0	5	0	28	.5	23	.5
Cote d'Ivoire	21	.0	19	.0	21	.0	22	.0	240	0	231	0	241	0	249	0
Sierra Leone	13	3.3	11	2.6	15	3.8	9	3.6	48	13	47	11	61	15	36	14
Senegal	23	1.9	23	1.5	24	2.3	17	1.6	153	13	167	11	172	16	119	11
Gambia	31	.6	34	.6	26	.6	33	.6	26	1	29	.5	22	.5	27	.5
Sahelian West and C. Afric																
Guinea	17	.1	17	.0	16	.0	19	1.3	95	2	98	0	88	0	100	7
Chad	6	.9	5	.5	7	1.3	8	.6	36	4	28	3	36	7	45	3
Niger	7	1.3	8	2.2	5	.0	9	3.0	55	13	62	17	36	0	67	22
Mali	6	1.6	6	2.1	6	1.1	5	1.5	52	14	59	19	49	10	47	13
Burkina Faso	5	1.2	4	.7	6	2.0	4	.4	42	9	40	6	49	17	37	3
Humid Central Africa:																
Zaire	8	1.8	8	1.6	8	2.0	9	1.3	284	56	284	58	261	68	308	43
Congo	36	.0	34	.0	34	.0	49	.0	85	0	79	0	74	0	102	0
Gabon	36	.0	38	.0	32	.0	41	.0	42	0	45	0	36	0	45	0
CAR	10	.0	11	.0	8	.0	13	.0	31	0	34	0	24	0	36	0
Eq. Guinea	21	5.8	20	8.6	20	2.9	24	5.9	7	2	7	3	7	1	8	2
Cameroon	26	.0	25	.0	26	.0	27	.0	300	0	298	0	301	0	300	0
Sub-humid/mountain E. Afri																
Madagascar	7	2.1	9	2.2	4	1.7	7	2.7	79	26	106	26	50	20	80	31
Uganda	1	.7	1	.7	1	.8	2	.6	26	13	21	14	24	14	32	10
Burundi	3	.3	3	.4	1	.2	4	.8	15	2	19	2	7	1	19	4
Rwanda	2	.6	3	.8	1	.4	1	.0	13	3	23	6	8	3	7	0
Kenya	8	2.9	9	2.6	8	2.7	8	5.0	192	79	205	62	182	62	188	112
Sub-humid/semi-arid S. Afr																
Tanzania	2	.3	2	.3	2	.0	5	1.5	77	15	64	8	42	0	126	38
Mozambique	15	7.2	15	6.4	13	7.0	22	10.8	252	122	231	100	197	107	328	160
Angola	16	1.5	15	.9	18	2.1	11	2.0	143	16	151	9	175	20	103	19
Zambia	4	.5	4	.0	4	.0	4	4.6	32	12	33	0	33	0	29	36
Malawi	4	1.3	3	.0	5	2.4	2	1.9	28	12	30	0	40	20	13	15
Zimbabwe	6	.0	6	.0	4	.0	8	.0	58	0	63	0	37	0	75	0

* Expressed in wheat equiv

Total = trade + aid

SOURCE: FAO PRODUCTION YEARBOOK 1991

Total wheat and wheat flour availability. Africa 1989-1991

Wheat and flour (production + imports + aid - exports)

	Total wheat and wheat flour availability. (kg per capita)				Total wheat and wheat flour availability. ('000 tonnes)			
	Av 88/90	1990	1989	1988	Av 88/90	1990	1989	1988
Total	10	10	9	10	3833	3905	3514	3795
Humid/Sub-humid W. Africa:								
Ghana	15	18	13	14	219	269	195	194
Benin	17	18	11	20	75	83	51	90
Nigeria	3	3	2	2	276	342	245	240
Togo	16	15	16	18	54	51	54	58
Liberia	7	2	11	10	19	5	28	23
Cote d'Ivoire	21	19	21	22	240	231	241	249
Sierra Leone	12	11	15	9	48	47	61	36
Senegal	22	23	24	17	153	167	172	119
Gambia	31	34	26	33	26	29	22	27
Sahelian West and C. Afric								
Guinea	17	17	16	19	95	98	88	100
Chad	7	5	7	9	38	30	37	47
Niger	8	10	5	10	62	75	38	73
Mali	6	7	6	6	54	61	51	49
Burkina Faso	5	4	6	4	42	40	49	37
Humid Central Africa:								
Zaire	8	8	8	9	291	291	268	315
Congo	39	34	34	49	85	79	74	102
Gabon	37	38	32	41	42	45	36	45
CAR	11	11	8	13	31	34	24	36
Eq. Guinea	21	20	20	24	7	7	7	8
Cameroon	25	25	26	26	291	291	293	289
Sub-humid/mountain E. Afri								
Madagascar	7	9	4	7	80	107	51	81
Uganda	2	2	2	3	36	29	35	45
Burundi	4	5	3	5	24	28	15	28
Rwanda	3	5	3	2	22	33	18	15
Kenya	18	16	18	19	415	390	425	431
Sub-humid/semi-arid S. Afr								
Tanzania	6	5	6	8	168	148	148	207
Mozambique	17	15	13	23	256	236	200	333
Angola	15	15	18	11	145	154	177	105
Zambia	9	10	10	8	77	85	80	66
Malawi	3	4	5	2	29	32	41	15
Zimbabwe	36	40	32	36	337	388	290	332

* Expressed in wheat equivalence

Urbanisation rates for African counties where cassava is produced

	Urban population as a percentage of total 1990	Urban average annual % growth rate 1980-90	Percentage of urban population in capital 1990	Population millions 1991
Humid/Sub-humid W. Africa:				
Ghana	33	4.2	22	16
Benin	38	5.1	12	5
Nigeria	35	6	19	112
Togo	26	6.9	55	4
Liberia	46	6.1	57	3
Cote d'Ivoire	40	4.5	45	12
Sierra Leone	32	5.3	52	4
Senegal	38	4	52	8
Sahelian West and C. Africa				
Guinea	26	5.7	89	6
Chad	30	6.5	43	6
Niger	20	7.6	39	8
Mali	19	3.7	41	10
Burkina Faso	9	5.3	51	9
Humid Central Africa:				
Zaire	40	4.8	24	37
Congo	41	4.7	68	2
Gabon	46	6.2	57	1
CAR	47	4.8	51	3
Cameroon	41	5.9	16	12
Sub-humid/mountain E. Africa:				
Madagascar	25	6.4	23	12
Uganda	10	4.4	41	20
Burundi	6	5.5	82	6
Rwanda	8	8	54	8
Kenya	24	7.9	26	25
Sub-humid/semi-arid S. Africa:				
Tanzania	33	10.5	21	28
Mozambique	27	10.4	38	16
Angola	28	5.8	61	10
Zambia	50	6.2	24	9
Malawi	12	6.2	31	9
Zimbabwe	28	5.9	31	10

SOURCE: WORLD DEVELOPMENT REPORT 1992, Table 31.

Tanzania wheat flour hygeine standards

APPENDIX 15

7.3 Wheat flour shall be free from objectionable matter and shall be free from pathogenic micro-organisms, substances originating from micro-organisms or any other deleterious substances in amounts which may constitute a health hazard. The flour shall also comply with the microbiological requirements as given in table 2.

Microbiological requirements

Type of micro-organism	Maximum number of counts permissible	Methods of test (see clause 2)
Total aerobic count	10^5 per g	TZS 118:1981
Escherichia coli	shall be absent in 1 g.	TZS 119:1981
Salmonella	shall be absent in 30 g.	TZS 122:1981
Moulds and yeasts	10^3 per g	TZS 131:1981

(Source: Tanzania Standard, Wheat flour Specification TZS 439:1989, p5, Tanzania Bureau of Standards.)

PROPOSED DRAFT AFRICAN REGIONAL STANDARD FOR EDIBLE CASSAVA FLOUR
(Advanced to Step 5 of the Codex Procedure)

1. SCOPE

This standard applies to cassava flour intended for human consumption.

2. DESCRIPTION

2.1 Definition of the product

Edible cassava (Manihot esculenta Crantz) flour is the product prepared from dried cassava chips or paste by a pounding, grinding or milling process, followed by sifting to separate the fibre from the flour. In case of edible cassava flour prepared from bitter cassava, detoxification is carried out by soaking the tubers in water for a few days, before they undergo drying in the form of whole, pounded tuber (paste) or in small pieces.

2.2 Classification

Edible cassava flour is classified into two categories, as follows:

(a) "Fine" cassava flour
Edible cassava flour of which not less than 90 percent by weight shall pass easily through a sieve of 0.60 mm aperture size (Section 9.2).

(b) "Coarse" cassava flour
Edible cassava flour of which not less than 90 percent by weight shall pass easily through a sieve of 1.20 mm aperture size (Section 9.2).

3. ESSENTIAL COMPOSITION AND QUALITY FACTORS

3.1 Raw materials

The cassava tuber from which the edible cassava flour is milled shall be peeled, clean and in good physiological condition.

3.2 Organoleptic properties

The colour, taste and odour of edible cassava flour shall be characteristic of the product.

3.3 Analytical characteristics

3.3.1 Hydrocyanic Acid Content

The total hydrocyanic acid content of edible cassava flour shall not exceed 10 mg/kg (Section 9.5).

3.3.2 Moisture content

The moisture content of edible cassava flour shall not exceed 13 percent m/m (Section 9.3).

3.3.3 Crude fibre content

The crude fibre content of edible cassava flour shall not exceed 2 percent m/m (Section 9.6).

(Source, FAO Codex Alimentarius (1989) Eighteenth Session, W12 4194)

3.3.4 Ash

The ash content of edible cassava flour shall not exceed 3 percent m/m (Section 9.4).

4. FOOD ADDITIVES

No food additive shall be added to edible cassava flour.

5. CONTAMINANTS

Edible cassava flour shall be prepared with special care under good manufacturing practices, so that residues of those pesticides which may be required in the production, storage, or processing of the cassava, cassava chips, cassava flour, or the premises and equipment used for processing do not remain, or, if technically unavoidable, are reduced to the maximum extent possible.

6. HYGIENE

6.1 It is recommended that the product covered by the provisions of this standard should be prepared in accordance with the Recommended International Code of Practice, General Principles of Food Hygiene (CAC/RCP 1-1969 Rev. 1).

6.2 When tested by appropriate methods of sampling and examination the product:

(a) shall be substantially free from pathogenic microorganisms;

(b) shall be substantially free from substances originating from micro-organisms in amounts which may represent a hazard to health; and

(c) shall not contain any other poisonous or deleterious substances in amounts which may represent a hazard to health.

7. PACKAGING, TRANSPORT AND STORAGE

7.1 Edible cassava flour shall be packaged, transported or stored in containers which will safeguard the hygienic, nutritional, technological and organoleptic qualities of the product.

7.2 The packaging material shall be such as to protect the product against bacteriological and other contamination, it shall protect the product as far as possible against any infiltration of moisture, rehydration and against leakage. The packaging material shall not impart any odour, taste, or colour or any other extraneous property to the product and shall not result in contamination of the product with substances of which the packaging material is made.

8. LABELLING

In addition to Sections 1, 2, 3, 4, 5, 7 and 8 of the Codex General Standard for the Labelling of Pre-packaged Foods 1/ (Ref. CODEX STAN 1-1985), the following specific provisions apply:

8.1 Name of the Product

The name of the product to be shown on the label shall be "edible cassava flour" preceded or followed by the common or ordinary name legally accepted in the country where the product is sold. The name shall show the particle size of the flour in accordance with the descriptions contained in Section 2.2.

1/ Hereafter referred to as the "General Standard"

8.2 Net Contents

The declaration of net contents shall be in accordance with Sections 4.3.1 and 4.3.2 of the General Standard.

8.3 Name and Address

The declaration of the name and address shall be in accordance with Section 4.4 of the General Standard.

8.4 Country of Origin

The declaration of the country of origin shall be in accordance with Sections 4.5.1 and 4.5.2 of the General Standard.

8.5 Lot Identification

The declaration of lot identification shall be in accordance with Section 4.6 of the General Standard.

8.6 Date Marking and Storage Instructions

The declaration of date marking and storage instructions shall be in accordance with Sections 4.7.1 and 4.7.2 of the General Standard.

9. METHODS OF ANALYSIS AND SAMPLING

9.1 Sampling

9.1.1 Instructions for drawing primary samples according to ISO 2170-1972 (Cereals and Pulses) or ICC Method of Sampling No. 101-1960 (Sampling of Milled Products).

9.1.2 The size of the sample to be taken from a homogeneous lot should be in accordance with Table 3 of the Instructions on Codex Sampling Procedures (CX/MAS 1-1987, Appendix V).

9.1.3 For all determinations the laboratory sample should be prepared in accordance with the variables plan for proportion defective (CX/MAS 1-1987, Appendix IV).

9.1.4 For all determinations, except particle size of flour (Section 2.2), analysis should be performed on the "blended bulk sample".

9.1.5 In order to verify granularity (ie. to verify particle size of flour declared on the label) (Sections 2.2 and 7.1), determinations in consignments of prepackaged products should be on individual packages.

9.2 Determination of Granularity (Type I Method)
According to ISO 259-1973, Test sieving.

9.3 Determination of Moisture (Type I Method)
According to ISO 712-1979 Cereals and Cereal Products - Determination of Moisture (routine method).

9.4 Determination of Ash (Type I Method)
According to ISO 2171-1972 Cereals, Pulses and Derived Products - Determination of Ash.

9.5 Determination of Total Hydrocyanic Acid
Method to be selected.

9.6 Determination of Crude Fibre (Type I Method)
According to ISO/DIS 5498 - Determination of Crude Fibre Content.

Organisations involved with the mechanisation of gari in Nigeria

Unit	Owner	Date of Establisnment	Fixed Cost (N)	Variable Cost	Employment (number of employees)	Scale of Operation (kilograms/ day)	Source of Cassava Tubers	Type of Cassava	Channels of Distribution	Problems
Texagri	TEXACO (major)	1985, but started production in 1978	164,087.34	119,389.00	50	6,000-7,000	Own farm; government farms; co-operative farms	Initially local, later improved varieties	TEXACO petrol stations or directly to institutional consumers	Spare parts; inadequate supply of fresh cassava
Federal Institute for Industrial Research (FIIRO)	National Research Institute	1957	124,371.98	269,760.00	30	1,200	Government farms and cooperatives	TMS 30572 TMS 30555	Directly to consumers	Spare parts; scarcity of cassava tubers; inadequate power supply
Ido Cooperative Farming and Produce Marketing Society	Farmers	1972	155,802.00	66,253.33	n.a.	2,000	Own farm	...	Appointed distributors	Finances; scarcity of farm implements; small acreage under cultivation; pests and diseases affecting production
Iperu Gari Procesing Factory	Private	1983	158,300.00	128,600.00	25	500	Own farm; government farms; co-perative farms	TMS 30555 TMS 30572	Directly to consumers	Transportation; increasing cost of inputs
Oke-Ayo Farms Factory, Ondo	Private	1981	377,500.00[a]	64,000.00	50 (20 skilled)	1,500	...	TMS 30572 TMS 30555	Directly to consumers	Power supply; storage facilities; raw materials
Cooperative under Ere-agbe Coordinating and Management Board, FDA, Abeokuta (5 cooperatives)	Farmers	1982	39,500.00	40,000.00	20 each (6 skilled)	600	Own farm	TMS 30572 TMS 30555	Through the Board	Shortage of transport, water, and power

Source: W. O. Fasasi, "Economic Appraisal of Cassava (Gari) Production and Marketing; Case Study of Gari Processing Firms in Lagos, Ogun, and Oyo States" (B.Sc. Project, University of Ibadan, 1985).

Note: Where n. a. appears, the figure was not available.

[a]This figure is for total equipment; the depreciation value is not included.

(Source: Adamu, 1989, p46-47)