International Institute for
Applied Systems Analysis
IIASA www.iiasa.ac.at

Prospects for Cassava in Domestic and International Markets

Jumah, A.

IIASA Working Paper

WP-88-027

April 1988

Jumah A (1988). Prospects for Cassava in Domestic and International Markets. IIASA Working Paper. IIASA, Laxenburg, Austria: WP-88-027 Copyright © 1988 by the author(s). http://pure.iiasa.ac.at/id/eprint/3178/

Working Papers on work of the International Institute for Applied Systems Analysis receive only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute, its National Member Organizations, or other organizations supporting the work. All rights reserved. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage. All copies must bear this notice and the full citation on the first page. For other purposes, to republish, to post on servers or to redistribute to lists, permission must be sought by contacting repository@iiasa.ac.at

WORKING PAPER

PROSPECTS FOR CASSAVA IN DOMESTIC AND INTERNATIONAL MARKETS

Adusei Jumah

April 1988
WP-88-027

IIASA
International Institute
for Applied Systems Analysis

PROSPECTS FOR CASSAVA IN DOMESTIC AND INTERNATIONAL MARKETS

Adusei Jumah

April 1988
WP-88-027

Working Papers are interim reports on work of the International Institute for Applied Systems Analysis and have received only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute or of its National Member Organizations.

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

Author

Affiliation: YSSP/87

Institution: Institute of Agricultural and Nutritional Economics
Agricultural University of Vienna
Peter Jordan-Strasse 82
A-1190 Vienna, Austria

Foreword

For several years researchers at IIASA have been investigating the nature and dimensions of the world food problem and the policies available to alleviate it.

National food system are highly interdependent, and yet the major policy options exist at the national level.

As participant of the YSSP 1987, the author engaged in the research for food products that could fit the specific needs and conditions of developing countries.

Originating from a West African country, he took special interest in analysing the prospects of cassava in domestic and international markets.

The cultivation of cassava is not very labor intensive, does not depend on expensive capital equipment and imported oil. The crop tolerates dry conditions and is well adapted to soils with low fertility. As such cassava appears to be much less vulnerable than grain production.

The paper reviews the role of cassava in developing and developed countries, addresses the problematique of adequate technological development, and comments on economic aspects of cassava production, especially in relation to food grain production.

Günther Fischer
Food and Agriculture Program

CONTENTS

LIST OF TABLES

PROSPECTS FOR CASSAVA IN DOMESTIC AND INTERNATIONAL MARKETS

Adusei Jumah

1. INTRODUCTION

1.1. Background

Cassava is one of the cheapest sources of dietary energy in developing countries and it is an important diet for the rural populations (Dixon, 1982), which are usually large in the developing cassava producing countries. In these countries cassava is also used as animal feed, for starch production, and to a little extent for industrial alcohol production.

In the developed countries, cassava is a component in compound feeds and it acts as a substitute for feed grains.

The cultivation of cassava is not labor intensive, requires simple tools and does not depend on expensive capital equipment and imported oil. Cassava has the ability to tolerate dry conditions, is well adapted to soils of low fertility, and can be left to grow for two to three years before it is harvested (Cock, 1985), and thus offers flexibility and minimum risk in its production.

1.2. Statement of the Problem

It is paradoxical that developing countries whose exports are mainly agricultural products and whose economically active population in agriculture accounted for 63 per-cent of their total economically active population in 1985, (FAO, 1985), should encounter hunger. It is thus sometimes argued that the hunger situation in these countries could be alleviated by shifting scarce resources out of export production into the production of food for domestic consumption, see Pinstrup-Andersen (1983).

From the above perspective, most developing countries' governments have placed more emphasis on the production of grains. This proposition, however, has contributed only marginally to the food solution because neither governments nor farmers have been able to provide and/or maintain the adequate irrigation, storage, and fertilizer facilities which go along with grain production. While grains have been very prone to weather hazards, there has been a general apathy towards more hardy crops such as cassava from which sizeable gains could be realized with low capital investments.

Lack of interest in cassava traces its roots to two main facts. First, cassava has the reputation of being food for the poor, and second, it is feared (Bennison, 1984) that its cultivation would deplete the soil.
Today, numerous studies have revealed that cassava has the ability to grow in infertile soils and has a great potential as a source of food as well as an industrial and employment outlets

1.3. Objectives of the Study

Extensive literature exists on cassava today. Most of it concerns agronomy, whilst others discuss technical aspects such as its chronic cyanide toxicity, marketing and pro-cessing. Of recent importance has been policy implications for international trade in cas-sava.

The current paper reviews the role of cassava in both developing and developed countries and its implication for technological development in the producing countries. The use of appropriate technology adapted to developing countries' needs is an essential element of success in agriculture in those countries.

The results of the study could serve as a policy guide for both the agricultural and industrial sectors of the developing producing countries. The results could also further allow us to develop quantitative answers to issues that have been discussed in business and political circles concerning cassava.

1.4. Justification of the Study

Based on the important role that cassava plays in the diets of both humans and animals and on the low investment capital it requires in its production, it would be essential to increase its production in order to improve the hunger and malnutrition situations of the developing producing countries. The development of appropriate technology for use in the cultivation and processing of cassava can stimulate farm production and help to create new markets.

2. THE ROLE OF CASSAVA IN DEVELOPING COUNTRIES

2.1. Production

Cassava (Manihot esculenta Crantz) is a root crop which is grown almost within 30 degrees North and South of the equator (see Figure 1). It is sometimes referred to as *manioc* or *tapioca*. Almost all the countries which produce this crop are developing countries and these are found in the three regions of Africa, Latin America and the Caribbean, and Asia and Oceania.

World production in 1985 was about 136 million tonnes – which was an increase of 3 percent over the previous year's production (see Table 1). Five countries: Brazil (16.9 percent), Thailand (14.7 percent), Zaire (11.4 percent), Indonesia (10.7 percent), and Nigeria (9.6 percent) accounted for nearly two-thirds of total world production of cassava in 1985 (see Table 2). Annual yields range from 2,000 kg/ha in Equatorial Guinea to 32,000 kg/ha in the Cook Islands, (FAO, 1985).

2.2. Food Use

The main importance of cassava to developing countries is its use as a source of dietary energy for humans. Unlike most tropical export crops which are produced mainly in the developing countries but consumed in the developed countries, almost two-thirds of global cassava production is consumed as food in the producing countries (see Table 3). About 10 percent of the world's population depends on cassava as a source of food. As a supplier of calories, it ranks fourth in the tropics and eighth in the world (see Table 4). Its role as a supplier of protein is, however, negligible.

In Africa where about 40 percent of the crop is produced, almost all the crop is used for human consumption (Table 3), which implies an average consumption of more than 100 kilos per head per year. In Asia, the proportion consumed as food is over two-thirds and in the Americas it is slightly over 40 percent.

Food consumption of cassava both in quality and the form of product is strongly related to the consumers level of household income. Processed cassava consumption falls rapidly as income rises while fresh root consumption increases as income increases but tends to fall at higher levels (e.g., Falcon et al, 1984).

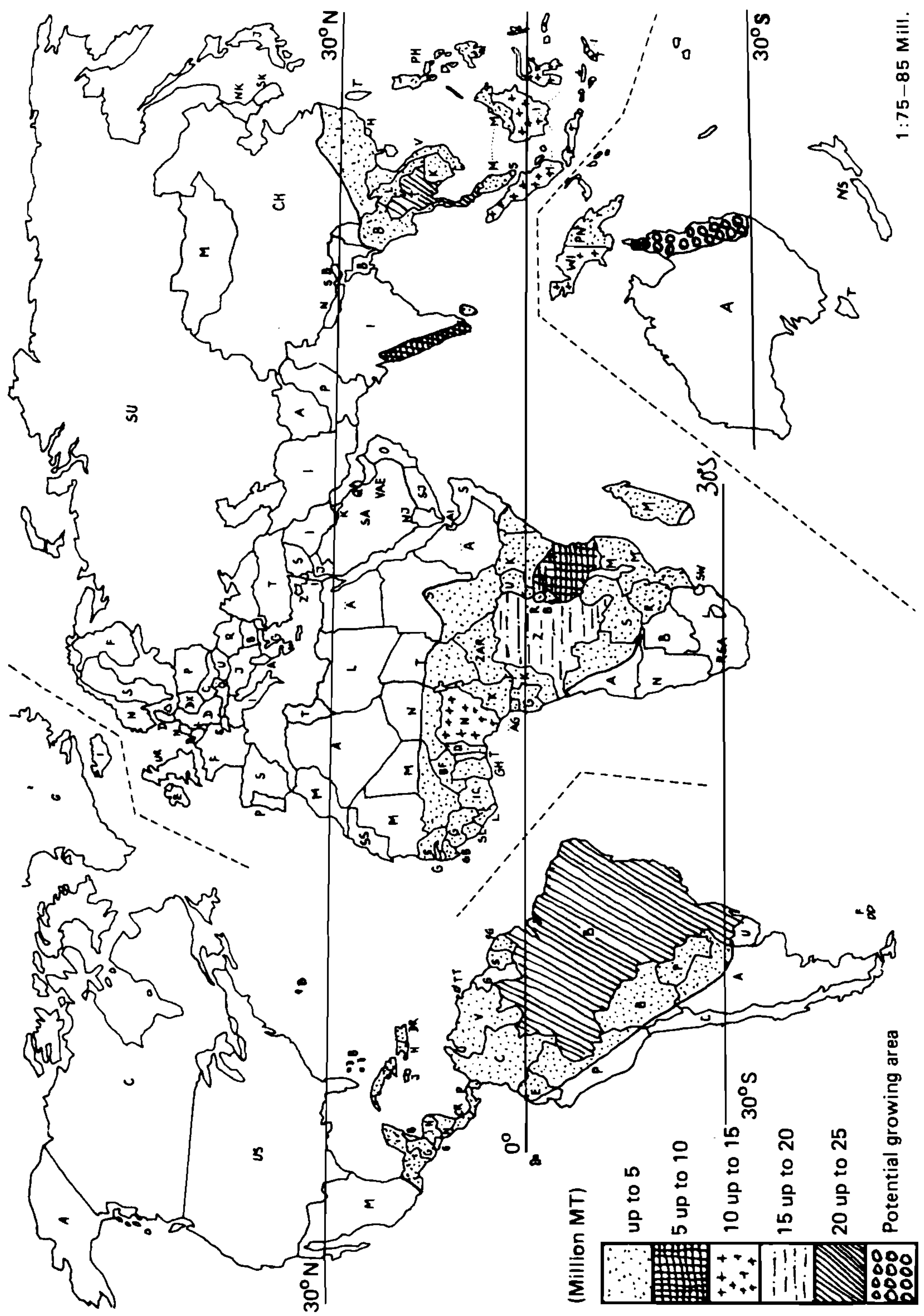

Figure 1. The Limits of Cassava Growing Areas

Table 1: **Production of Cassava in Regions 1979-1985 (in 1,000 MT)**

Year	World	Africa	Latin America and Caribbean	Asia and Oceania
1979-1981 average	123341	47931	30551	44860
1983	125050	50787	27577	46686
1984	134385	56187	27598	50599
1985	136532	56527	29298	50708

Source: FAO Production Yearbook, 1985

Table 2: **Production of Cassava in Selected Countries 1979-1985 (in 1,000 MT)**

Year	World	Brazil	Thailand	Zaire	Indonesia	Nigeria
1979-1981 average	123341	24315	15128	12652	5921	10833
1983	125050	21841	18989	14600	5341	9950
1984	134385	21466	19985	15038	5886	11800
1985	136532	23073	20044	15500	5569	13000

Source: FAO Production Yearbook 1985

Table 3: **World Utilization of Cassava, 1975-1977 (in percentage of total production)**

Area	Human Food		Animal Feed[a]	Industrial Use and Starch	Export[b]	Waste	Change in Stocks
	Fresh	Processed					
World	30.8	33.8	11.5	5.5	7.0	10.0	1.4
Africa	37.9	50.8	1.4	c	c	9.5	c
Americas	18.5	23.9	33.4	9.6	c	14.0	c
Asia	33.6	21.7	2.9	8.6	23.0	6.3	3.9
Asia without Thailand	45.7	27.9	3.9	11.7	2.3	8.6	c

Source: FAO, Food balance sheets 1975-1977 average (Rome, 1980), modified based on additional information by Cock, J.H. Cassava: New Potential for a Neglected Crop, Boulder, 1985.
[a]Excludes chips and pellets exported as animal feed
[b]Includes exports for animal feed
[c]Less than 1 percent

Table 4: **Staple Crops as Sources of Calories in Human Diets in the Tropics and Worldwide (in billion kcal/day)**

Crop	Tropics	World
Rice	924	2043
Sugar (cane and beet)	311	926
Maize	307	600
Cassava	172	178
Sorghum	147	208
Millet	128	204
Wheat	<100[a]	1877
Potato	54	434
Banana	32	44
Plantain	30	30
Sweet potato	30	208

Source: FAO, Food balance sheets 1975-1977 average (Rome, 1980). Cited from Cock, J.H. Cassava: New Potential for a Neglected Crop. Boulder, 1985.
[a]Excluding Brazil, Mexico and India as the major wheat production zones of those countries are outside the tropics

Cassava leaves, unlike the starchy roots, are rich in protein (20-30 percent on dry weight basis) and they are used for soups and sauces in some parts of Africa (Cock, 1985) and in Asia (Dixon, 1982). Cassava contains adequate vitamin C, thiamine, niacin and riboflavin. It is deficient in protein and vitamin B and also contains prussic (hydrocyanic) acid, which can cause diseases like goitre, sterility and neurological disorders, (Nestel and McIntyre, 1973; Prinz and Schmutzhard, 1986), especially in Africa where protein intake is generally low and traditional processing of cassava as food has been found to be inefficient (Cock, 1985).

It is, however, speculated that cassava might have some beneficial effects such as its probable use in the treatment of sickle-cell anemia, schistosomiasis and possibly cancer, through ingestion of food (Oke, 1979; Neuffen et al. 1984).

2.3. Feed Use

Cassava is also utilized as animal feedstuff in developing countries, especially in Latin America where about a third of its production is fed to animals. Just as in humans, the root is consumed both in fresh and processed forms by both livestock and poultry. The leaves are also consumed to some extent by animals. In certain parts of Brazil, the complete plant is processed and used as fodder for cattle (Albuquerque and Ramos, 1980).

2.4. Income Source

A considerable proportion of cassava is sold off the farm providing income to farmers, processers, truckers, middlemen and retailers. Processing of cassava into products such as ***gari***, ***kokonte***, and ***gaplek***, pellets and chips, starch and other forms creates employment in the rural areas and thereby helps to reduce rural–urban migration. Investment capital required for both cassava cultivation and small-scale processing is low and as such income could be generated at low cost. In Thailand, the cassava industry employs over 8 million people who account for about 20 percent of the Thai population (Bennison, 1984).

2.5. Industrial Uses

Industrial uses of cassava has three main outlets: chips and pellets, starch and industrial alcohol production. Chips are manufactured by slicing cassava roots into small rectangular pieces and then drying them in the sun. When the chips are further ground and compressed, pellets are obtained. Chips and pellets form the bases of cassava as an export commodity and its use in the compound feed industry.

Of the 16 million tons of global starch* production in 1980, starch extracted from cassava accounted for about 10 percent. About one million tons of cassava starch was used in the producing countries (Jones, 1983). Starch is used mainly in the paper, cardboard, plywood, food and textile industries. In Brazil and Columbia a special type of starch is used for making cassava bread, ***pan de yuca***, (Cock, 1985). In Indonesia, the major user of starch is "krupak" (a snack food), see Walters, 1987. In Thailand, Monosodium glutamate manufacturing is the largest user of starch and in 1983 it accounted for about 28 percent of total usage of starch in Thailand (Titapinatanakun, 1986). Indonesia and Brazil also produce fructose syrup from cassava for local use (Guritno and Sitompul, 1986; and Cock 1985).

The use of cassava for industrial alcohol production in certain cassava producing countries is of considerable importance (more so in an era threatened by petroleum crisis and falling prices of primary commodities). In Brazil where alcohol (ethanol) accounts for about 5.4 percent of total fuel consumption, steps are being taken to increase the usage of cassava in the production of alcohol. Feasibility studies into the use of alcohol from cassava as a substitute for petroleum are under serious consideration in some developing producing countries.

2.6. Export Commodity

Only a small percentage of global cassava production enters international trade. Exports are mainly in the form of chips and pellets.

In 1984, global exports of cassava totalled about 7 million tons (in product weight of chips and pellets), see Table 5. This was about 16 percent of world cassava production. Thailand, the leading exporter of cassava accounted for almost 95 percent of this amount whilst Indonesia and China accounted for about 4 percent and less than half percent of world cassava exports respectively.

During 1976 to 1983, cassava ranked second after rice in export earnings for Thailand. In 1982, the value of Thailand's cassava exports (chips and pellets) was estimated at 870 million US dollars, representing 12.5 percent of Thailand's total export earnings. This proportion fell to 7.7. percent in 1985 due to a fall in cassava prices and the reduction in 1984 of Thailand's import quota of cassava into the EC (largest buyer) from 5 million to 4.5 million tons in 1985.

Tanzania, Madagascar, Ghana, Brazil and Malaysia have, at one time or another, also exported small amounts of cassava (FAO).

Of the 600,000 to 700,000 tons of starch traded globally annually, cassava starch account for about 75 percent of total starch exports. Thailand accounts for about two-thirds of cassava starch exports, Indonesia, Brazil, China, Malaysia and other small exporters account for the rest (Jones, 1983).

*Other forms of starches are those extracted from maize and potatoes.

Thailand's dominant position in the cassava export trade is based mainly on its willingness and ability to respond to export opportunities opened up by the Common Agricultural Policy (CAP) of the European Community (EC), see Chapter 3.

Table 5: World Exports of Cassava 1980-1985 (in thousand tons of product weight of chips and pellets)

	1980-1982 Average	1983	1984	1985 Forecast
World Total	7200	5635	7150	7400
Latin America	10	15	12	15
Asia	7180	5620	7130	7350
China	500	150	60	30
Indonesia	325	270	380	300
Thailand	6350	5200	6690	7000

Source: FAO Commodity Review and Outlook 1980-1985

3. THE ROLE OF CASSAVA IN THE DEVELOPED COUNTRIES

3.1. Imports

Over 90 percent of cassava which enters international trade goes to developed countries (see Table 6). In 1984, total world imports of cassava was about 6.5 million tons (in product weight of chips and pellets).

Global imports of cassava is dominated by the European Community (EC). Since 1980, while the EC's imports of cassava have been increasing in absolute terms, its share in world imports has fallen from about 90 percent in 1980 to 69 percent in 1985, see Table 7, and section 3.4. Important importing countries in the EC are The Netherlands, 58 percent in 1984, West Germany 28 percent, Belgium 10 percent and France 4 percent of EC total.

3.2. The Role of Cassava in the EC*

The main importance of cassava to the EC is its use in the manufacture of compound animal feed. The compound feed industry is the EC's largest buyer of feed grains and cassava due to the fact that livestock production accounts for about 60 percent of the community's total agricultural output.

The cassava root is very low in protein and this deficiency is offset in compound animal feed mixes by combining cassava pellets or chips with soya – which is a high protein vegetable meal, see Table 8. Normally feed grains, maize or barley, are fed to the animals. Köhne, 1978, estimated that roughly 0.8 unit weight of cassava and 0.2 unit weight of soya is required to compensate for one unit weight of feed grain in pig rations, see Table 9. A farmer's choice of feed grain or cassava ration depends on their relative

*Nelson (1983) and the International Trade Centre (ITC, 1984) discuss the EC market for cassava in detail. This section and the next relies a great deal on their reports.

Table 6: World Imports of Cassava 1980-1985 (in thousand tons of product weight of chips and pellets)

	1980-1982 Average	1983	1984	1985 Forecast
World Total	7210	5600	6550	8000
Developing Countries	210	600	550	850
Latin America	10	13	12	15
Asia	200	500	540	800
Korea Rep. of	60	140	150	200
Singapore	20	50	40	40
Developed Countries	7000	5000	6000	7150
North America	50	50	60	70
United States	50	50	60	70
EC*	6550	4550	5260	5500
Portugal	–	–	50	350
E. Europe and USSR	140	150	200	400
Japan	120	80	180	550
Israel	–	–	50	150

*Excluding EC intra-trade
Source: FAO Commodity Review and Outlook 1985-86

Table 7: Imports of Cassava in the EC* 1980-1985 (in thousand tons of product weight of chips and pellets)

	World	EC*	Percentage of World Imports to EC
1980-1982 (Average)	7210	6550	91
1983	5600	4550	81
1984	6550	5260	80
1985 (Forecast)	8000	5500	69

*Excluding EC intra-trade
Source: FAO Commodity Review and Outlook 1985-86

price. Feed grain prices differ between countries within the EC due to the operation of the Monetary Compensatory Amounts (MCAs) and "Green" exchange rates. In countries with relatively stronger currencies, the prices of feed grains are higher and thus it is more profitable for them to use cassava than in countries where grain prices are lower, see Table 10.

The degree of self-sufficiency in cereals as well as internal transportation costs also affect the utilization of cassava. Such is the case for France which has the highest degree of self-sufficiency in cereals (174 percent for all cereals) and which experiences very high

Table 8: Nutrients of Selected Feedstuffs for Pork Production

Product Feedstuff	Digestible Protein	Total Nutrients
	(P e r c e n t)	
Maize	7.5	80.0
Barley	8.0	71.0
Soya (bruised grain)	39.5	72.0
Cassava pellets	0.3	74.0

Source: Manfred Köhne, Getreidepreis, Einkommens oder Kostenfaktor für die Landwirtschaft, (Bonn, MFI Schriftenverkehr, 1978, p.39).

Table 9: Rates of Substitution of Cereals Substitute for Pork Production

Product/Original Feed	Substitutes and Rates of Substitution	
	(metric tons/metric tons of original feed)	
	Cassava	Soya
Maize	0.9	0.18
Barley	0.77	0.20

Source: Manfred Köhne, Getreidepreis, Einkommens oder Kostenfaktor für die Landwirtschaft, (Bonn, MFI Schriftenreihe, 1978, p.41).

transportation costs from Rotterdam to its southern parts.

Price coefficients are not the only determinants in the manufacture of mixed feeds. Physiological requirements reflecting on the animal species and/or age also influence the composition of feed mix. Often, the maximum amount of cassava that can be used in a particular feed is controlled by law or by recommendation of a concerned authority. Depending on which country, pig rations may contain up to 40 percent cassava; cattle rations may contain 15 to 25 percent; whilst poultry rations from 7 to 15 percent.

3.3. The Common Agricultural Policy (CAP) and Cassava

The demand for cassava in the European Community has been greatly influenced by the Common Agricultural Policy (CAP). Basically, the CAP seeks to guarantee prices for the farmers' products by introducing import levies and export subsidies making up the gap between the community and world prices.

The CAP has 5 key elements (Schiff, 1985):

1. A target price which is announced each year for each crop at planting time as a guide for farmers acreage decisions.
2. Threshold prices, equal to the target price minus transportation costs to Rotterdam represent minimum import prices.
3. Variable tariffs imposed on imports from the rest of the world are equal to the excess of the fixed threshold price over the variable world price, and are adjusted daily.

Table 10: 1978 Prices of Barley and the Percentage Share of Cereals in Compound Feeds in West Germany and the UK

	West Germany	United Kingdom
Intervention Price of Barley UA/ton	122	122
Intervention Price of Barley in National Currency	DM 415	£72
Intervention Price of Barley Barley in US Dollars	$197	$140
Green Rate	3.4 DM/UA	0.59 £/UA
Market Rate	2.11 DM/$	0.52 £/$
Share of Cereals in Compound Feeds (percent)	30·34	49·42

Source: European Food Manufacturers Association (FEFAC), Feed and Food Statistical Yearbook, 1978.

4. At the intervention price, authorities are willing to accept any quantity of cereals sold and this is usually 5 to 10 percent below the target price.
5. Exporters receive export subsidies, called "restitutions", which is equal to the excess of the EC market price over the world price.

Under the CAP, EC cereal prices are maintained within boundaries, with the target price as the upper limit and the intervention price as the lower limit.

At its inception in 1962, the CAP regulations were applicable only to cassava meal in the cassava related group of commodities. An import levy was imposed comprising a fixed component and variable component based on the barley levy, see ITC, 1968. These regulations were later applied to cassava pellets and chips in 1967. As part of the Kennedy round of the General Agreement on Tariffs and Trade (GATT) in 1968, cassava attracted a special tariff of only 6 percent, or 18 percent of the levy on barley, whichever is lower. These low tariffs made cassava gain an edge over its cereal competitors in the manufacture of feed compounds in the EC and stimulated increased production in Thailand.

Growing cereal surpluses in the EC called for the market to be protective against cassava. During the period 1983 to 1986, the applicable import taxes to cassava and allied products included a preferential maximum levy of 6 percent *ad valorem* on the different annual import quotas allotted to the different exporting countries. Under the import regime, only cassava in the form of hard pellets attracted the low duty rate of 6 percent *ad valorem*. All other cassava products as well as imports in excess of quotas attracted 28 percent *ad valorem*, i.e., levies imposed on grains.

3.4. Other Markets

In recent years, lower prices of both tapioca pellets and protein meals is encouraging the use of cassava in other countries outside the EC. Between 1984 and 1985 aggregate purchases by non-EC countries rose from 1.3 million tons to 2.5 million tons with their proportion in global cassava imports rising from 20 to 30 percent. The main non-EC purchasers were the USSR, Japan, Israel, Taiwan and the Republic of Korea (FAO, 1986).

4. THE ROLE OF TECHNOLOGY IN CASSAVA PRODUCTION

The application of technology to cassava production has two facets: on-farm and off-farm technologies, see Figure 2.

4.1. On-farm Technologies

On farm technological improvements currently being applied to cassava production are mainly agronomic (biological) and they are geared towards obtaining improved varieties of higher yield and root quality. These technologies include the breeding of disease resistant varieties, clones which contain very low cyanide levels and roots of higher yield and better tastes. Other on-farm technologies are rapid propagation practices, fertilizer trials, weed control, integrated pest management as well as appropriate farming systems with cassava. A recent development has been improved labor saving harvesting techniques.

On-farm technology application to cassava are undertaken mainly by the International Institute of Tropical Agriculture (IITA) at Ibadan, Nigeria and the Centro International de Agricultura Tropical (CIAT), in Cali, Columbia. The IITA concentrates on the improvement of production systems for the African conditions, whilst CIAT concentrates on the development of production systems for the Americas and Asia. Local research institutions such as the Instituto Agronomic de Campina in Brazil and the Central Tuber Crops Research Institute of India are also important in this respect.

Due to the biological nature of cassava and the consequent time lapse that is required to achieve meaningful results and the fact that the role of cassava in national and international research programs is quite recent, widespread adoption of on-farm technologies by farmers is currently very small.

4.2. Off-farm Technologies

Off-farm technology applications to cassava production are post-harvest and mainly mechanical. They contribute directly or indirectly to the raising of yields and quality of production by reducing production losses and prolonging the shelter life of cassava. They include various ways of preserving the crop due to its high perishability, as well as processing the crop for food, feed, industrial and other alternative uses.

Storage technologies are those involved with the elimination of both physiological and microbial deterioration of the fresh crop after harvest. As of now no effective preservation method for the fresh root has been discovered. Storage technologies also include processing cassava into various forms such as chips, pellets and flour, as well as ways and means of improving their quality. These technologies are under widespread use in Thailand, Indonesia, China, Brazil, Columbia and Mexico where cassava production is highly commercialized.

Technology is increasingly being used to increase the various ways in which cassava could be utilized. Already, Brazil and Indonesia have taken strides in the conversion of cassava starch to sugar, the saccharification being done with microbiologically produced enzymes. Cassava starch is also currently being used in the manufacture of certain drugs and chemicals.

One area that needs to be tapped is the processing of the leaves to make use of their rich store of protein. The development of appropriate methods for converting the leaves and the shrubby stem into silage and the extraction of the rich protein base from the

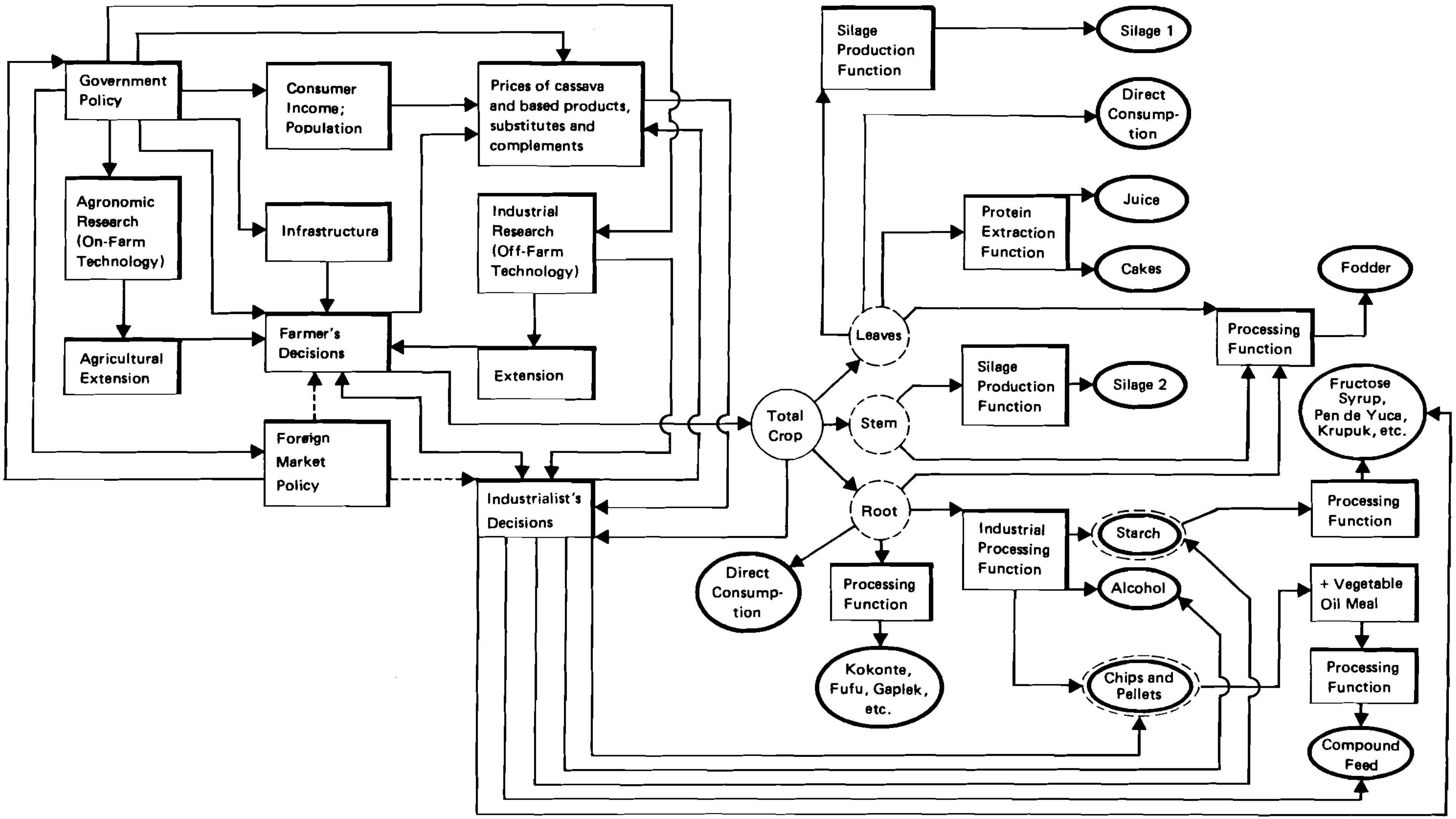

Figure 2. Structure of Cassava Production

leaves for both human and animal needs could help reduce the protein deficit in the developing producing countries. Research must also concern the development of cost-effective energy systems in the production of alcohol from cassava in order to obtain a better Net Energy Ratio (NER).

5. LONG RUN CONSEQUENCES OF POSSIBLE CHANGES IN AGRICULTURAL POLICIES RELATED TO CASSAVA IN BOTH DEVELOPING AND DEVELOPED COUNTRIES

5.1. Developing Countries

In developing countries (apart from Thailand) a change in only one direction of policies related to cassava can be envisaged i.e., increased investment in the crop. The gradual increase of investment into cassava research at both the national and international levels, has resulted in new plant types that are high yielding and hardy and have already been adopted by some farmers – at least in some countries in West and East Africa – among other places in the world. Two possible remarkable consequences are likely to ensue out of increased investment in cassava: economic and ecological.

5.1.1. Economic Consequences

Assuming a market oriented approach to reap the benefits of technology (research) applied to cassava production, there would be 3 main marketing outlets: food, feed and industry.

In the producing countries (apart from Thailand), cassava is used mainly as food for humans. From 1975 to 1985, cassava production increased at the same rate as the population in the cassava producing countries. In most of these same countries hunger prevails. Thus, policy related to cassava must aim essentially at satisfying the food end.

Processing of cassava as food becomes important in two respects. Processed cassava is consumed more by the low income groups whilst fresh cassava is preferred as income increases. Processing would increase employment and the general income level as well as the supply of food for the low income groups. Innovations in processing could also make cassava available in new and more acceptable forms to the middle and high income groups and thereby increase the overall demand for cassava, see Figure 2.

In Africa, Latin America, Asia and the Far East, the rate of growth of cereals for animal feed from 1966 to 1981 was almost twice the rate of growth of their use as food, see Table 11. This means that the animal industries in these regions are growing rapidly. The use of cassava in the manufacture of animal feed compounds will reduce the food-feed competition for cereals and thereby lower grain prices as well as reduce the reliance on cereal imports.

In the industrial sector, technology could also stimulate new uses of both starch and alcohol. Countries in Latin America and Asia, where cassava production is highly commercialized, have already started using starch in food industries, thus increasing the forms in which cassava can be used as food. The production of ethanol from cassava would not only be useful in automobiles as already exists in Brazil, but could form the basis for certain chemical industries such as the paint industry.

Table 11: Rates of Growth of Demand for Cereals in Less Developed Countries, 1966-81

	Rates of Growth 1966-81 (percent)		
Region	Total Demand*	Food	Feed
Africa	3.1	3.1	6.3
Latin America	4.2	3.3	5.7
Asia and Far East	3.2	3.1	6.1

*Total demand includes food, feed and residual uses such as industrial, seed waste, etc.
Source: FAO, 'Supply Utilization Accounts'

5.1.2. Ecological and Nutritional Consequences

As already discussed in section 2.2., cassava is deficient in digestible protein and vitamin B and it also contains prussic (hydrocyanic) acid. Increased consumption of cassava (emanating from increased production), unless efficiently processed and combined with adequate intake of protein can cause diseases like goitre swelling, sterility and neurological disorders.

Prolonged cultivation of cassava could lead to the deterioration of soil fertility which could also lead to permanent changes in the environment. For example, in Thailand whilst the area under cassava cultivation expanded at the rate of 16 percent per annum from 1974/75 to 1980/81, production grew at the rate of 14 percent, and average yield declined from 16.8t/ha to 14.2t/ha within that same period.

To offset these problems, a more diversified crop mix, essentially of legumes, with cassava must be encouraged. The legumes, which while restoring soil fertility by fixing nitrogen in the soil, will also contribute protein to a cassava diet. Farmers must also be encouraged to adopt proper land use practices such as soil and water conservation measures.

5.2. The Developed Countries

Currently global imports of cassava is dominated by the EC due to the CAP which seeks to protect the EC grain sector. Trade barriers in the developed countries are of great importance to developing countries because they affect agricultural export prospects (Valdes, 1982). Koester, (1982), revealed that EC grain trade liberalization would wipe out cassava from the EC market because the price of cassava would be less competitive.

Thus, any policy that tends to lessen the protection for the EC grain economy would lower cassava imports as well as the demand for vegetable oil meals which compliment cassava in the manufacture of animal feed compounds.

A complete dismantling of the protection for the EC grain economy is unlikely due to the fact that a reversion to national policies would lead to competitive subsidies that would probably end in a breakdown of free European trade in farm products.

Policies by the USSR and Japan towards a more favorable terms of trade with developing countries could also lead to an increase in imports of cassava.

6. CONCLUSION

In most developing countries, the agricultural sector is the mainstay of the economy. Policies must seek to make agriculture productive and improve rural incomes. In countries where there is a comparative advantage in cassava, its cultivation must be encouraged through the provision of economic incentives.

In this regard cassava producing countries would require major investments in infrastructure and appropriate technology as well as new initiatives by commercial traders and banks. Domestic marketing, distribution and processing would have to be supported financially. Financing would have to cover both hardware such as trucks and warehouses and software, such as packages to provide better information about prices of cassava and its substitutes and compliments. All these are marketing strategies which will help to lower the cost of cassava production.

The role of technology in cassava production cannot be overemphasized. Technology would improve the efficiency of labor involved in cassava production as well as the yield and quality of cassava.

On the international market, export prospects for cassava into the EC seems to be limited by the imposition of a maximum import quota on cassava. With the recent entry of Spain and Portugal into the EC it is likely that the limit could be raised. Prospects exist in the USSR where grain production is erratic due to climatic reasons, in Japan and in the newly industrialized countries of South Korea and Taiwan.

REFERENCES

Albuquerque, M. de, and Ramos, C.E.M. (1980), *A mandioca no Tropico umido Brasilia.*

Bank of Thailand. *Monthly Bulletin: Variono issua*, Bangkok, Thailand.

Bennison, R.H. (1984), The Cassava Industry of Thailand, *The Courier no.83*, January-February 1984.

Cock, J.H. (1985), *Cassava: New Potential for A Neglected Crop.* (Westview Press, Boulder and London).

Dixon, J. (1982), *Food Consumption Patterns and Related Parameters in Indonesia: A Review of Available Evidence*, Working Paper No.6 (International Food Policy Research Institute, Washington, DC).

FAO, *Food Balance Sheets 1975-1977 Average* (FAO, Rome).

FAO, *Commodity Review and Outlook 1980-1986* (FAO, Rome).

FA0, *Production Yearbooks* (FAO, Rome).

FAO, *"Supply Utilization Accounts"* (FAO, Rome).

Falcon, W.P., Jones, W.O., Pearson, S.R., Dixon, J.A., Nelson, G.C., Roche, F.C., and Unnevehr, L.J. (1984), *The Cassava Economy of Java* (Stanford University Press, Stanford, CA).

Guritno, B. and Sitompol, S.M. (1984), Cassava in the agricultural economy of Indonesia, in *Cassava in Asia, its Potential and Research Development Needs*, Proceedings of a Regional Workshop held in Bangkok, Thailand 5-8 June, 1984.

International Trade Centre UNCTAD/GATT, (1968), *The Market for Manioc as a Raw Material for the Manufacture of Compound Animal Feeding Stuffs*, Geneva, Switzerland.

International Trade Centre UNCTAD/GATT, (1984), *Major European Markets for Cassava as Raw Materials for Compound Animal Feedstuffs.* Short Market Surveys, Geneva.

Jones, S.F. (1983), *The World Market for Starch and Starch Products with Particular Reference to Cassava (tapioca) Starch*, Report No. G173 (Tropical Development and Research Institute, London, UK).

Köhne, M. (1978), *Getreidepreis, Einkommens oder Kostenfaktor für die Landwirtschaft*, (MFI Schriftenreihe, Bonn).

Koester, U. (1982), *Policy Options for the Grain Economy of the European Community: Implications for Developing Countries*, Research Report 35 (International Food Policy Research Institute, Washington, DC).

Nelson, G.C. (1983), *Time for Tapioca 1970 to 1980: European Demand and World Supply of Dried Cassava*, (Food Research Institute Studies, Stanford).

Nestel, B. and McIntyre R. (Eds), (1973), *Chronic Cassava Toxicity* in: Proceedings of an Interdisciplinary Workshop held in London 29-30 January 1973. International Development Research Centre, Ottawa, Canada.

Oke, O.L. (1979), Some Aspects of the Role of Cyanogenic Glycosides in Nutrition, *World Dev. Diet*, **33**,70-103.

Pinstrup-Andersen, P. (1983), Export Crop Production and Malnutrition, Occasional Paper Series, Vol.11, No.10 (The Institute of Nutrition, The University of North Carolina).

Prinz, A., Schmutzhard E. (1986), *Der Maniok in Afrika: Geschichte-Toxikologie-Ethnographie*, Band 116, p71-87 (Mitteilungen der Anthropologischen Gesellschaft in Wien (MAGW)).

Schiff, M. (1985), *An Econometric Analysis of the World Wheat Market and Simulation of Alternative Policies, 1960-1980*, (ERS Staff Report No. AGES 850827,Washington, DC).

Titapiwatanakun, B. (1984), Cassava in the Agricultural Economy of Thailand, in: *Cassava in Asia, its Potential and Research Development Needs*, IBID.

Valdés, A. (1982), *Ceres*, **15**(6), November to December 1982.

Walters, P.R. (1987), Industrial Uses of Cassava, *The Courier no. 101*, January-February.

Weuffen, et al. (1984), *Aktuelle Schwerpunkte der medizinischen und biologischen Thiocyanatforschung*, Med. Reihe (Wiss. Z. Ernst-Moritz-Arndt Univ, Greifswald).