Tropical Root Crops

RESEARCH STRATEGIES FOR THE 1980s

Proceedings of the First Triennial Root Crops Symposium of the International Society for Tropical Root Crops – Africa Branch
TROPICAL ROOT CROPS: RESEARCH STRATEGIES FOR THE 1980s

PROCEEDINGS OF THE FIRST TRIENNIAL ROOT CROPS SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR TROPICAL ROOT CROPS — AFRICA BRANCH, 8–12 SEPTEMBER 1980, IBADAN, NIGERIA

EDITORS: E.R. TERRY, K.A. ODURO, AND F. CAVENESS

Although the editorial chores for these proceedings were the sole responsibility of the editors, the International Society for Tropical Root Crops — Africa Branch has a full Editorial Board comprising E.R. Terry, O.B. Arene, E.V. Doku, K.A. Oduro, W.N. Ezeilo, J. Mabanza, and F. Nweke. This Board serves the Society in various editorial capacities at all times.
The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre’s activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre’s headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

The International Society for Tropical Root Crops — Africa Branch was created in 1978 to stimulate research, production, and utilization of root and tuber crops in Africa and the adjacent islands. The activities include encouragement of training and extension, organization of workshops and symposia, exchange of genetic materials, and facilitation of contacts between personnel working with root and tuber crops. The Society’s headquarters is at the International Institute of Tropical Agriculture in Ibadan, Nigeria, but its executive council comprises eminent root and tuber researchers from national programs throughout the continent.

©1981 International Development Research Centre
Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa

Terry, E.R.
Odoro, K.A.
Caveness, F.

International Society for Tropical Root Crops. Africa Branch, Ibadan NG


UDC: 633.4 (213) ISBN: 0 88936 285 8

Microfiche edition available
Cooperating institutions
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>E.R. Terry</td>
<td>7</td>
</tr>
<tr>
<td>Participants</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Welcoming Addresses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bede N. Okigho, President, International</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Society for Tropical Root Crops — Africa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Branch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alhaji Ibrahim Gusau, Minister of Agriculture, Nigeria</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>S. Olajuwon Olayide, Vice-Chancellor, University of Ibadan, Nigeria</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>E. Hartmans, Director-General, International</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Institute of Tropical Agriculture, Nigeria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to Major Economic Diseases and Pests in Africa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava Improvement in the Programme National</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Manioc in Zaire: Objectives and Achievements</td>
<td>H.C. Ezumah</td>
<td></td>
</tr>
<tr>
<td>up to 1978</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment of Cassava Cultivars for Extension</td>
<td>C. Oyolu</td>
<td>35</td>
</tr>
<tr>
<td>Work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breeding Cassava Resistant to Pests and Diseases</td>
<td>T.P. Singh</td>
<td>37</td>
</tr>
<tr>
<td>in Zaire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selection of Cassava for Disease and Pest</td>
<td>Joseph Mabanza</td>
<td>40</td>
</tr>
<tr>
<td>Resistance in the Congo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some Characteristics of Yellow-Pigmented</td>
<td>K.A. Oduro</td>
<td>42</td>
</tr>
<tr>
<td>Cassava</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava: Ecology, Diseases, and Productivity:</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Strategies for Future Research</td>
<td>E.R. Terry</td>
<td></td>
</tr>
<tr>
<td>Field Screening of Cassava Clones for</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>Resistance to <em>Cercospora henningsii</em></td>
<td>J.B.K. Kasirivu, O.F. Esuruoso, and E.R. Terry</td>
<td></td>
</tr>
<tr>
<td>Properties of a Severe Strain of Cassava</td>
<td></td>
<td>58</td>
</tr>
<tr>
<td>Latent Virus Isolated from Field-Grown</td>
<td>E.C.K. Igwegbe</td>
<td></td>
</tr>
<tr>
<td>Tobacco in Nigeria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava Bacterial Blight Disease in Uganda</td>
<td>G.W. Otim-Naape and T. Sengooba</td>
<td>61</td>
</tr>
<tr>
<td>Insect Dissemination of *Xanthomonas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>manihotis* to Cassava in the People’s</td>
<td></td>
<td>66</td>
</tr>
<tr>
<td>Republic of Congo</td>
<td>J.F. Daniel, B. Boher, and N. Nkouka</td>
<td></td>
</tr>
<tr>
<td>Cassava Root Rot due to *Armillariella</td>
<td></td>
<td>69</td>
</tr>
<tr>
<td>tabescens* in the People’s Republic of Congo</td>
<td>Casimir Makambila</td>
<td></td>
</tr>
<tr>
<td>Screening for Resistance Against the Green</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Spider Mite</td>
<td>K. Leuschner</td>
<td></td>
</tr>
<tr>
<td>Biological Control of the Cassava Mealybug</td>
<td>Hans R. Herren</td>
<td>79</td>
</tr>
<tr>
<td>in the People’s Republic of Congo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entomophagous Insects Associated with the</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>Cassava Mealybug in the People’s Republic</td>
<td>G. Fabres</td>
<td></td>
</tr>
<tr>
<td>of Congo</td>
<td></td>
<td>84</td>
</tr>
<tr>
<td>Dynamics of Cassava Mealybug Populations in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the People’s Republic of Congo</td>
<td>G. Fabres</td>
<td></td>
</tr>
<tr>
<td>Consumption Patterns and Their Implications</td>
<td>Felix I. Nweke</td>
<td>88</td>
</tr>
<tr>
<td>for Research and Production in Tropical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Africa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Problems of Cassava Production in Malawi  R.F. Nembozanga Sauti 95
Effects of Soil Moisture and Bulk Density on Growth and Development of Two Cassava Cultivars  R. Lal 104
Performance of Cassava in Relation to Time of Planting and Harvesting  F.O.C. Ezedinma, D.G. Ibe, and A.I. Onwuchuruba 111
The Effects of Previous Cropping on Yields of Yam, Cassava, and Maize  S.O. Odurukwe and U.I. Oji 116
Intercropping of Plantains, Cocoyams, and Cassava  S.K. Karikari 120
Weed Control in Maize—Cassava Intercrop  I. Okezie Akobundu 124
Cassava Leaf Harvesting in Zaire  N.B. Lutaladio and H.C. Ezumah 134
Effects of Leaf Harvests and Detopping on the Yield of Leaves and Roots of Cassava and Sweet Potato  M.T. Dahniya 137
Metabolism, Synthetic Site, and Translocation of Cyanogenic Glycosides in Cassava  M.K.B. Bediako, B.A. Tapper, and G.G. Pritchard 143
Loss of Hydrocyanic Acid and Its Derivatives During Sun Drying of Cassava  Emmanuel N. Maduagwu and Aderemi F. Adewale 149
The Role of Palm Oil in Cassava-Based Rations  Ruby T. Fomunyam, A.A. Adegbola, and O.L. Oke 152
Comparison of Pressed and Unpressed Cassava Pulp for Gari Making  M.A.N. Ejiofor and N. Okafor 154
Gari Yield from Cassava: Is it a Function of Root Yield?  D.G. Ibe and F.O.C. Ezedinma 159

Yams
Parameters for Selecting Parents for Yam Hybridization  Obinani O. Okoli 163
Anthracnose of Water Yam in Nigeria  Okechukwu Alphonso Nwankiti and E.U. Okpala 166
Strategies for Progress in Yam Research in Africa  I.C. Onwueme 173
Study of the Variability Created by the Characteristics of the Organ of Vegetative Multiplication in Dioscorea alata  N. Ahoussou and B. Toure 177
Growth Pattern and Growth Analysis of the White Guinea Yam Raised from Seed  C.E. Okezie, S.N.C. Okonkwo, and F.I. Nweke 180
Artificial Pollination, Pollen Viability, and Storage in White Yam  M.O. Akoroda, J.E. Wilson, and H.R. Chheda 189
Improving the In-Situ Stem Support System for Yams  G.F. Wilson and K. Akapa 195
Yield and Shelf-Life of White Yam as Influenced by Fertilizer  K.D. Kpeglo, G.O. Obigbesan, and J.E. Wilson 198
Weed Interference in White Yam  R.P.A Unamma, I.O. Akobundu, and A.A.A. Fayemi 203
The Economics of Yam Cultivation in Cameroon  S.N. Lyonga 208
Effect of Traditional Food Processing Methods on the Nutritional Value of Yams in Cameroon  Alice Bell and Jean-Claude Favier 214

Cocoyams
Strategies for Progress in Cocoyam Research  E.V. Doku 227
Root and Storage-Rot Disease of Cocoyam in Nigeria  G.C. Okeke 231
Fungal Rotting of Cocoyams in Storage in Nigeria  
J.N.C. Maduewesi and Rose C.I. Onyike  

A Disease of Cocoyam in Nigeria Caused by *Corticium rolfsii*  
O.B. Arene and E.U. Okpala  

Cocoyam Farming Systems in Nigeria  
H.C. Knipscheer and J.E. Wilson  

Yield and Nitrogen Uptake by Cocoyam as Affected by Nitrogen Application and Spacing  
M.C. Igbokwe and J.C. Ogbannaya  

**Abstracts**

Cassava Research Program in Liberia  
Mallik A-As-Saqui  

Effects of Cassava Mosaic on Yield of Cassava  
Godfrey Chapola  

Effects of Green Manure on Cassava Yield  
James S. Squire  

Alleviating the Labour Problem in Yam Production: Cultivation without Stakes or Manual Weeding  
I.C. Onwueme  

**Discussion Summary**

Strategies for the 1980s  

**References**
CONSUMPTION PATTERNS AND THEIR IMPLICATIONS FOR RESEARCH AND PRODUCTION IN TROPICAL AFRICA

FELIX I. NWEKE

DEPARTMENT OF AGRICULTURAL ECONOMICS/EXTENSION, UNIVERSITY OF NIGERIA, NSUKKA, NIGERIA

With the exception of Nigeria, the countries in the African root crops belt are experiencing low growth rates in real income. One of the ways in which this trend is manifested is changes in dietary habits. Average Nigerians seem to be substituting rice and wheat for root crops, in their diet, whereas average consumers in the other countries seem to be substituting root crops for rice and wheat. In future, root crops consumption will likely decline in Nigeria but increase in the other countries. For the whole region, there is likely to be a surplus of production over consumption needs of root crops in general in the future. However, there would be deficits of specific root crops in specific countries. A surplus of one root crop cannot offset a deficit of another because one is not a perfect substitute for the other. Also, a surplus in one country may not offset a deficit in another because trade in the commodities is limited. There is therefore a need to develop trade in the commodities; there is also need to encourage research in and production of the root crops in which deficits of production over consumption are likely to occur in the future.


During 1970—75, Africa produced 42% of the world production of cassava and 18% of yams and cocoyams combined (FAO 1971—76). Cassava, yam, cocoyam, and perhaps sweet potato are the staples of many people of tropical Africa just as millet, sorghum, or maize is a staple of other low-income peoples of the world. Because of the present world economic situation of high energy prices, inflation, and unemployment, most of the countries in tropical Africa are experiencing low rates of growth of or declining real income. Under such a situation, root crops are likely to assume greater importance in the diets of the people.

My objective in this paper is to reappraise the relative importance of cassava, yams, cocoyams, and sweet potato in tropical Africa in the light of changing economic conditions and suggest research and production strategies through which the importance of the root crops can be most efficiently realized. The paper is based partly on time-series data generated by the International Bank for Recon- struction and Development (IBRD), the Food and Agriculture Organization of the United Nations (FAO), and the United States Department of Agriculture (USDA) and partly on farm-management studies carried out in Nigeria, Ghana, and Zaire.

AFRICAN ROOT CROPS BELT

The African production of cassava, yam, cocoyam, and sweet potato is concentrated in the countries lying within 15° of both sides of the equator — the African root crops belt; production in other African countries is relatively unimportant (FAO 1971—76). From 1970 to 1975, most of the countries within the belt cultivated an average of between 0.04 hectares and 0.15 hectares per person annually. This was 28% of the per-person area of arable lands cultivated in the belt annually. The area is also the belt of production of such tropical
industrial crops as cocoa, rubber, oil palm, and timber. Of the countries in the belt, Central African Republic, Togo, People’s Republic of Congo, Liberia, Gabon, Comoros, Equatorial Guinea, and Guinea-Bissau had populations of 2.5 million or less in mid-1976 (IBRD 1978) and, thus, are not included in this analysis. Up-to-date, time-series data are unavailable for Mozambique, Uganda, Burundi, Rwanda, and Benin, so they are also excluded from the analysis even though their total populations are greater than 2.5 million. My analysis is therefore based on Nigeria, Zaire, Tanzania, Ghana, Madagascar, Cameroon, and Ivory Coast. It is hoped that the conclusions reached are applicable to the entire belt. The seven countries account for nearly 80% of the mid-1976 population (IBRD 1978) and also nearly 80% of 1970–76 annual average area under root crops in the entire belt (FAO 1971–76).

Nigeria alone accounts for more than 50% of the mid-1976 population and more than 40% of the 1970–76 annual average areas under root crops.

**RELATIVE IMPORTANCE OF INDIVIDUAL ROOT CROPS**

Cassava accounted for about 65% of the total area cultivated with root crops, yam accounted for about 15%, and cocoyam and sweet potato accounted for about 10% each in 1970–75 (FAO 1971–76). Cassava production and consumption are evenly distributed throughout the belt, but yam and cocoyam production and consumption are concentrated in the countries of West Africa (Nigeria, Ghana, Cameroon, and Ivory Coast), and sweet potato production and consumption are concentrated in the countries of East Africa (Tanzania, Madagascar, and Zaire).

In 1970–75, root crops (cassava, yam, cocoyam, and sweet potato) contributed 38% of the average person’s daily energy intake in the root crops production belt. Of the 38%, 22% was from cassava, 10% from yam, 4% from cocoyam, and only 2% from sweet potato. In comparison, 43% came from grains, 8% from bananas and plantains, 7% from pulses, and 3% from meat, dairy products, etc. Hence, root crops, especially cassava, are major sources of dietary energy in tropical Africa at present.

Although in the western half of the belt cassava and yam are of about equal popularity, cassava is by far the most popular of all the root crops when the whole belt is considered. Nevertheless, the popularity of a root crop in tropical Africa cannot be determined on the basis of area or contribution to dietary consumption because some root crops have cultural values in certain areas within the belt.

**IMPORTANCE OF ROOT CROPS IN THE FUTURE**

The importance of root crops as a source of dietary energy in future will depend on what happens to real income in the belt. In developing countries, rice and wheat are eaten primarily by high-income consumers, whereas root crops, maize, millet, and sorghum are low-income consumers’ staples — root crops in root crop-production regions and maize or millets and sorghum in grain-production regions.

Although individuals may not increase the quantity of root crops that they consume in a year as incomes decline, annual average per-person consumption increases because more people begin to substitute root crops for grains in their diets.

With the exception of Nigeria, major countries in the African root crops belt experienced little growth or even declining real income in 1970–76. Zaire, Tanzania, Cameroon, and Ivory Coast experienced low rates of growth of real income, whereas Ghana and Madagascar experienced declining real income in the period (Table 1). Available consumption figures show that an average Nigerian has started to substitute grains, especially rice and wheat, for root crops in his or her diet, whereas in countries with low rates of growth or declines in real income an average consumer is substituting root crops for grains, especially rice and wheat, between 1968–72 and 1973–77 (Fig. 1 and 2). In Nigeria, the annual average per-person consumption of root crops declined from 524 kg in 1968–72 to 518 kg in 1973–77 at an average annual compound rate of 0.2%; the annual average per-person consumption of rice and wheat increased from 10 kg in 1968–72 to 17 kg in 1973–77 at an annual average compound rate of 11.2%. In the countries with low rates of growth or declines in real income, the weighted (with population) annual average per-person consumption of root crops increased from 332 kg in 1968–72 to 336 kg in 1973–77 at an annual average compound rate of 0.3%, the weighted annual average per-person consumption of rice and wheat declining from 37 kg in 1968–72 to 34 kg in 1973–77 at an annual average compound rate of 0.3%.

An average annual compound rate of decline of
Table 1. Population, totals (1976) and growth rates (1970–76), and GNPs per capita (1976) and growth rates (1970–76) for major countries in the African root crops belt.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>77056</td>
<td>2.6</td>
<td>400</td>
<td>5.4</td>
</tr>
<tr>
<td>Zaire</td>
<td>25389</td>
<td>2.7</td>
<td>130</td>
<td>0.4</td>
</tr>
<tr>
<td>Tanzania</td>
<td>15136</td>
<td>2.7</td>
<td>180</td>
<td>1.7</td>
</tr>
<tr>
<td>Ghana</td>
<td>10310</td>
<td>2.9</td>
<td>370</td>
<td>–0.7</td>
</tr>
<tr>
<td>Madagascar</td>
<td>9112</td>
<td>3.1</td>
<td>200</td>
<td>–2.3</td>
</tr>
<tr>
<td>Cameroon</td>
<td>7606</td>
<td>2.0</td>
<td>310</td>
<td>1.0</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>7025</td>
<td>3.8</td>
<td>650</td>
<td>1.9</td>
</tr>
</tbody>
</table>

0.2% in per-person consumption of root crops associated with annual compound rate of growth in real income of 5.4% in Nigeria shows that the effect of increases in real income on reduction in consumption of root crops is slow. It cannot be relied upon to offset the decline in root crops production, especially in a country where the level of annual per-person consumption is high. On the other hand, an increase of 4 kg, from 332 kg to 336 kg, in countries with low rates of growth or of declines in real income could be significant in total demand in countries where the population is large and increasing.

IBRD estimates show that, of the 43 tropical African countries for which data were available, 25 experienced annual compound growth rate in gross national product (GNP) of 1.0% or less and of these 25, 13 had negative growth in 1970–76 (IBRD 1978). Of the 25 countries with low rates of growth or declining real income, 13 are in the root-crops production belt. The only countries of the African root crops belt with GNP compound growth of 2.0% or more in 1970–76 were Nigeria, People's Republic of the Congo, and Gabon. People's Republic of the Congo and Gabon together had less than 2 million people in 1976 (IBRD 1978).

The current world economic situation, especially with respect to petroleum shortages and inflation, suggests that the downward trend in real income in tropical Africa, except in oil-producing countries, will continue for some time and that root crops will likely assume greater importance in the diets of the people in the region.

To determine the future importance of root crops in the region, I projected the annual total production and consumption of root crops in the major countries of the African root crops belt to the year 1995. In projecting production, I assumed that the 1961–77 production trend would be maintained. In projecting consumption, I assumed the 1970–76 annual compound rates of growth of GNP per person and of population as estimated for each country by IBRD (1978) and income elasticity of demand for each root crop as estimated by FAO (1971).

![Fig. 1. Indices (1968–72 average = 100%) of per-person consumption of root crops in Nigeria and in selected countries in the African root crops belt, 1961–1971.](image-url)
On the basis of these assumptions, the production of root crop (R) in country (N) in year t, \( P_{R,N}(t) \), is estimated as:

\[
P_{R,N}(1977)(1 + G_{R,N})^T
\]

where \( P_{R,N}(1977) \) = 1977 production trend estimate for root crop R in country N (tonnes); \( G_{R,N} \) = annual compound rate of growth of production of R in N during 1961-77 (%); and \( T \) = time interval between 1977 and t (years). \( P_{R,N}(1977) \) is estimated as:

\[
\log P_{R,N}(1977) = a + bT
\]

where \( T \) = time interval (16 years) between 1961 and 1977 (Table 2, Fig. 3).

Without population projections, it is not possible to estimate future consumption on a per-person basis. Yet the low rates of growth or declines in real income and income elasticities of demand of less than zero suggest that per-person consumption of the root crops will be higher in 1995 than in 1977 in countries other than Nigeria. Despite this, at 1961-77 rates of growth of production and at 1970-76 rates of growth in real income and population, by 1995 the belt as a whole would generate a surplus of production over consumption.
needs of more than 4 Mt of root crops. Most of the surplus would be generated in Nigeria where per-
person consumption is expected to decline.

The assumption of continuation of 1961–77 rate
of production to 1995 is perhaps the most subjec-
tive of all the assumptions behind the projections. It
implies that substitutions in resource allocation will
not take place. However, in Nigeria where a high
rate of increase in GNP is expected it is likely that
resources will be shifted from root-crop to grain
production because demand for grains will be
higher than for root crops. In the other countries
resources will likely be shifted from high-cost
grains to root crops. Then, the deficits for those
countries would be lower and the surpluses higher
than projected.

In analyses of actual data on root crops in
tropical Africa, production is generally equated
with consumption because recorded trade on the
commodities between nations is insignificant.
Nevertheless, surpluses and deficits occur from
year to year, absorbed as fluctuations in returns to
producers. The available data on market prices for
root crops show not only seasonal and locational
differences but also major fluctuations in annual
averages (FAO 1971), reflecting year to year dif-
fences in supply and demand.

IMPLICATIONS

A surplus of 4 Mt for the area as a whole would
mean that there would be no shortage of root crops
if the commodities moved freely across national
boundaries and if one root crop were a perfect
substitute for another. Zaire, Tanzania, and
Madagascar (all of the eastern belt countries) and
Nigeria would generate surpluses; Ghana, Ivory
Coast, and Cameroon (all of the western belt
countries) would generate deficits of production
over consumption by 1995. However, recorded
trade in root crops between countries, especially
among tropical African countries, is insignificant.
This means that surpluses in one country do not
offset deficits in another. Hence, producers in
countries with a surplus of production over con-
sumption, especially in Nigeria where income is
expected to grow rapidly, would suffer capital
losses and may divert their land and labour. This
shift would not be adverse if the resources were
diverted to tree crops such as oil palm, cocoa,
rubber, etc. for which an export market exists. If,
however, the resources were diverted to grains, in
the production of which tropical African resources
may be relatively inefficient, the effect would be
adverse.

Although average yield rates for both root crops
and grains are lower in tropical Africa than in the
rest of the world, the difference is smaller for root
crops than for grains. For example, in 1971–75,
the weighted (with area harvested) annual average
yield of root crops in Africa was 64% of the world
average and the weighted annual average yield of
grains in Africa was 57% of the world average
(FAO 1971–76). Rather than divert their resources
from root-crop production to grain production,
tropical African farmers would be better off if
encouraged to produce root crops for export. This
means that efforts should be made to establish such
export markets.

Although all the root crops have more or less the
same nutritive value, mainly carbohydrate, they are
not perfect substitutes for each other because of
local consumption habits. In most parts of south-
eastern Nigeria, for instance, yam is the food
security crop, and it is by far more important than
any other root crop not because of its nutritional but
because of its cultural value. In the area, yam is

Table 2. Estimates of production, consumption, and surplus or deficit of various root crops in major countries of

<table>
<thead>
<tr>
<th>Country</th>
<th>Cassava Production (’000 t)</th>
<th>Cassava Consumption (’000 t)</th>
<th>Cassava Surplus/Deficit (’000 t)</th>
<th>Yam Production (’000 t)</th>
<th>Yam Consumption (’000 t)</th>
<th>Yam Surplus/Deficit (’000 t)</th>
<th>Cocoyam Production (’000 t)</th>
<th>Cocoyam Consumption (’000 t)</th>
<th>Cocoyam Surplus/Deficit (’000 t)</th>
<th>Sweet potato Production (’000 t)</th>
<th>Sweet potato Consumption (’000 t)</th>
<th>Sweet potato Surplus/Deficit (’000 t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>22179</td>
<td>23211</td>
<td>968</td>
<td>34287</td>
<td>29989</td>
<td>-4298</td>
<td>2496</td>
<td>2803</td>
<td>-307</td>
<td>429</td>
<td>407</td>
<td>22</td>
</tr>
<tr>
<td>Cameroon</td>
<td>1329</td>
<td>1388</td>
<td>-59</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1069</td>
<td>1129</td>
<td>-60</td>
<td>429</td>
<td>407</td>
<td>22</td>
</tr>
<tr>
<td>Ghana</td>
<td>963</td>
<td>1802</td>
<td>-839</td>
<td>1556</td>
<td>2713</td>
<td>-1157</td>
<td>2294</td>
<td>2226</td>
<td>68</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>2485</td>
<td>2074</td>
<td>411</td>
<td>3671</td>
<td>4170</td>
<td>-499</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18</td>
<td>35</td>
<td>-17</td>
</tr>
<tr>
<td>Zaire</td>
<td>17445</td>
<td>16832</td>
<td>613</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>665</td>
<td>652</td>
<td>13</td>
</tr>
<tr>
<td>Tanzania</td>
<td>3700</td>
<td>3007</td>
<td>693</td>
<td>399</td>
<td>495</td>
<td>-96</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Madagascar</td>
<td>2907</td>
<td>2580</td>
<td>327</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>342</td>
<td>558</td>
<td>-216</td>
</tr>
</tbody>
</table>
"man's crop," whereas cassava and cocoyam are "woman's crops," and all production, marketing, and consumption decisions with respect to yam are made by the male head of a household. Similar decisions with respect to cassava, cocoyam, etc. are made by female members of the household (Nweke et al. 1980). In such a situation a surplus of production over consumption in cassava would not offset an equal amount of deficit of production over consumption in yam.

The African root crop belt would generate 2.1 Mt of cassava and 2.6 Mt of yam as surpluses and only marginal deficits in cocoyam and sweet potato by 1995. The marginal deficit in sweet potato is important, because it is mainly in one country, namely Madagascar. The surplus of production over consumption of cassava would be generated in Nigeria and in eastern belt countries; countries in the western belt would generate deficits of cassava production over consumption. The surplus of production over consumption of yam would be generated only in Nigeria; the surplus in that country would be large enough to offset major deficits in Ghana, Ivory Coast, and Tanzania if trade in the commodity were developed among these countries.

The surplus of more than 4 Mt of yams in Nigeria would be at a high cost because compared with production of other food crops, yam production is very labour-intensive (Table 3).

Producing 1 Mcal from yam takes nearly three and a half times the amount of labour required to produce the same amount of calories from cassava. In most places yam is grown on huge mounds and also staked. The tasks involved are labour-intensive; mounding is necessary to enhance drainage in yam plots because the yam tuber is susceptible to rot under waterlogged conditions.

In addition, surplus yam output would be more difficult than surplus cassava output to dispose of without major capital losses to the producers. Its high production costs are not offset by potential uses; apart from its cultural value the utility of yam is limited to human consumption. In contrast, cassava has uses in livestock feed, industrial starch,

<table>
<thead>
<tr>
<th>Crop</th>
<th>Mandays/ha</th>
<th>Mandays/Mt</th>
<th>Mandays/Mcal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yam</td>
<td>325</td>
<td>45</td>
<td>69.31</td>
</tr>
<tr>
<td>Cassava</td>
<td>183</td>
<td>21</td>
<td>20.57</td>
</tr>
<tr>
<td>Maize</td>
<td>90</td>
<td>121</td>
<td>35.51</td>
</tr>
<tr>
<td>Rice</td>
<td>215</td>
<td>145</td>
<td>59.92</td>
</tr>
</tbody>
</table>

Fig. 3. Total production and consumption of root crops in Nigeria and in selected countries in the African root crops belt: actual (1961–77) and estimated (1961–95).
etc. There is, therefore, a major need for new technology that would reduce yam production costs. Such technology could be mechanical methods of mounding and staking for yam or, preferably, breeding of yam varieties that are resistant to waterlogged conditions. Such efforts should be in addition to attempts now under way at the National Root Crops Research Institute, Umudike, Nigeria, and at the International Institute of Tropical Agriculture, Ibadan, Nigeria, to develop yam planting materials from seeds and stem rather than from the tuber, which is the edible part.

**RESEARCH AND PRODUCTION STRATEGIES**

Given the 1961–77 production trend for various root crops, 1970–76 annual compound rates of growth of GNP per person and population, and income elasticities of demand for various root crops, one may assume that the African belt will generate a surplus of root crops in general in future. However, there would be major deficits in specific countries and in specific root crops. It is necessary to encourage trade in root crops among the countries of the African root crop belt so that surplus in one country offsets deficits in another. In the absence of such trade, producers in countries with surpluses will suffer capital losses and could divert their resources to less-efficient uses; consumers in countries with deficits would pay high prices for root crops.

Surpluses generated in yam would be at high costs because of the high production costs. In areas where yam does not have a high cultural value, resources are more efficiently used in cassava production than in yam production because a unit of calorie is cheaper to produce from cassava than from yam and because cassava has uses other than for human consumption and, hence, surplus production of cassava is more easily disposed of without capital losses to the producers than is surplus production of yam.

Where yam must be produced, probably because of its high cultural value, there is need for development of cost reduction technologies, including planting materials from seed and stems as well as yam varieties with tubers and foliage resistant to rot under waterlogged conditions. Such varieties would be grown on flat beds rather than on mounds and would not need staking. These developments would significantly reduce yam production directly by eliminating mounding and staking and indirectly by facilitating mechanization of yam cultivation. One of the major bottlenecks to mechanization of yam production where the soil and sociologic factors such as land tenure are conducive to mechanization is the heavy power that would be needed to make huge yam mounds.

I acknowledge gratefully the useful comments made by Professor F.O.C. Ezedinma.