Proceedings of the Tenth Symposium of the International Society for Tropical Root Crops, held in Salvador, Bahia, Brazil, October 23-29, 1994

TROPICAL ROOT CROPS AND SOCIO-ECONOMIC IMPROVEMENTS IN THE DEVELOPING WORLD

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Abstract

Tropical root crops play a significant role in the world's food supply. These crops are produced and consumed by nearly one third of the world's population, mostly from the lower socio-economic groups of Latin America, Africa, Asia, and the Pacific. Countries whose staple foods are tropical root crops need to continue developing appropriate policies and programmes that will encourage their sustainable production, marketing, and consumption. Recent trends indicate that tropical root crops will maintain their share in the world's food supply well into the 21st century.

Introduction

Tropical root crops are important staple foods for almost one third of the world's population. Table 1 shows the production of cassava, sweet potatoes, yams, taro, and potatoes by major world regions in 1992. Potatoes have the highest world production, but with only 18% of that production produced in the tropics. In this paper, therefore, potatoes are discussed in the context of their importance relative to the other four major tropical root crops grown in developing countries.

Among the other four tropical root crops, the most important in terms of production are cassava (49.0%) and sweet potatoes (40.4%), followed by yams (8.8%) and taro (1.8%). Most cassava is produced in Africa, Asia, and South America; sweet potatoes are heavily concentrated in Asia. Africa dominates in the production of yams and taro. Potatoes are an important staple for some communities located in the tropical highlands of North Central America, South America, and Asia.

Table 2 shows the world per capita consumption of tropical root crops and cereals for 1992. Potato consumption in the tropical world corresponds to about 18% of world production, and is equivalent to about 9 kg per capita. In contrast, other root crops are more

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important in the tropics, representing an annual per capita consumption rate of 66 kg. The consumption rates of tropical root crops compare favourably with those for major world cereals: wheat, rice, maize, barley, and sorghum.

In summary, tropical root crops already play a key role in the world's food supply. They also have natural advantages that could increase food production at costs lower than those for other food crops. Policies, based on increased tropical root crop production, could promote improved nutritional and living standards. These and other issues are discussed below.

Food Supply in the 21st Century

The nature of the world food supply problem in the 21st century is as follows: the achievements in food production over the past 20,000 years *[sic]* must be duplicated within the next 50 years (Swaminathan 1990). This cannot be done without the help of new technologies and management tools, nor can it be done without strong national and international support in terms of budgets, priorities, and commitment to the research, extension, and development of tropical root crops. Lastly, the development of tropical root crops must be based on policies and programmes that promote an ecologically sustainable environment.

In many developing countries, tropical root crops account for 50%-75% of the energy supply in the daily diet. Projections to year 2025 suggest a shortfall of 200 million tons of staple foods in developing countries, particularly in Africa and Latin America, where major population growth is expected. In these regions, tropical root crops play a significant role in maintaining or increasing the supply of food and thus in alleviating hunger on a wide scale.

Tropical root crops also have considerable potential for processing into higher priced foodstuffs and non-food products, if technology, product quality, packaging, and marketing can be improved. New technologies will also be required to improve the socio-economic conditions of farming communities and to increase production to meet food and non-food demands resulting from growth in population and income-induced consumption. Development of new technologies in tropical root crops would lead not only to the production of more food, but also to increased employment and reduced levels of poverty and hunger in developing countries.

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Food Supply Potential of Tropical Root Crops

As fresh food, tropical root crops have great potential to alleviate shortages of staple foods in many countries in Africa, Latin America, and Asia. But this strategy to increase the supply of tropical root crops as fresh food can only be employed if supplies are met almost entirely by domestic production. No developing country can service the foreign exchange costs of importing large amounts of staple foods. Nor can it adequately resolve the added problems of bulk, perishability, freight costs, and taxes.

The development potential of tropical root crops lies in the fact that they can produce large amounts of food per unit of effort (labour) or per unit of time (crop duration) (Coursey 1984; Coursey and Haynes 1970). Three types of factors underlie this potential: physical and biological factors, adaptation to a wide range of environments, and man-plant interdependence.

(1) *Physical and biological factors.* Table 3 shows that, even after the Green Revolution, which saw huge improvements in grains but with no major improvement effort in tropical root crops, these crops can out yield rice, both in total edible yield and in food energy. Even when the measure of yield per unit time is used for comparison, cassava, sweet potatoes and, perhaps, taro can still out yield rice. In terms of total DM production, Doku (1984) estimated that the use of improved cultivars under conditions of good husbandry would result in yearly production levels of 140 t/ha for cassava and yams; 200 t/ha for sweet potatoes and taro. Therefore, the highest recorded edible yield per crop shown in Table 3 is only a fraction of the total DM production that can be attained in these crops.

(2) Because some yield components of tropical root crops can be harvested and consumed from about halfway through their crop duration onwards, they are potentially able to supply food over a long time horizon during crop growth, a very desirable characteristic for subsistence and semi-subsistence smallholders. In contrast, grain crops have a very sharp maturity period, culminating in a few days; the potential risk of crop failure from natural calamities such as floods is therefore very high.

(3) Tropical root crops have suitable plant architecture for yield increases. As the storage organs are underground (except for the stems of the giant taro), these crops are able to accept high amounts of yield-increasing, scale-neutral inputs such as fertilizers. Before the Green Revolution could be achieved, the plant architecture of grain crops needed major restructuring to form short varieties that could withstand high fertilizer inputs without lodging. Tropical root crops already have a stature suitable for

withstanding high fertilizer inputs, thus allowing for higher yields without risks.

(4) Most tropical root crops are adapted to a wide range of climatic and edaphic environments, hence they can be grown in most of the agro-climatic zones present in the tropical and subtropical world. Each crop also has a large number of cultivars, each suitable for a particular locality within an individual country. The plants can also readily adapt to new conditions as has been the historical experience with potatoes.

(5) Probably the most important reason for tropical root crops' high potential for development is their strong interdependence with man throughout history. This group of crops has been cultivated in confined ecological niches in many regions and islands of the developing world for thousands of years. Over this period man has adapted his life around the life of tropical root crop plants, and the plants themselves have been adapted to fit the needs of the people. Because these farmers have a strong affinity for tropical root crops, it follows that any suitable research, development, and extension efforts in tropical root crops would be potentially highly acceptable to farmers. In the long run this will mean a substantial boost to the socio-economic conditions of the tropical root crop farming communities.

Hence, just as in the 1960s and 1970s massive investments were made in rice, wheat, and maize to achieve the fruits of the Green Revolution and improve the socio-economic conditions of millions of small farmers, so could similar investments be made in tropical root crops (Chandra 1984).

Poverty Alleviation

Tropical root crops have the potential to contribute significantly to improving the socio-economic conditions of developing countries where these crops are important staple foods. If food production could be increased and sustained at a rate above that of population growth, the standard of living of large numbers of rural people would improve. The problem is to achieve an annual rate of sustainable food production (and agricultural production) that is higher than
3%—the rate of population growth in many countries of Asia, Africa, and Latin America (Mellor 1988).

Since the 1960s, technological advances in agriculture have substantially contributed to growth in crop production in developing countries, particularly in Asia. Despite this, food demand has continued to outpace supply, and trade has increased as imports rise to meet

domestic production shortfalls. Between 1961-1980, food consumption in developing countries grew at an annual rate of 3.3%, whereas production grew at a rate of 3.1% (Paulino 1986). Food production growth was slowest in West Africa (<1%/y), compared with an average yearly increase in population of 3%. Population growth has been the dominant factor in food consumption growth in developing countries, but income-induced consumption growth is becoming an increasingly important factor in several countries, especially in East and South-East Asia. Most staple foods are consumed directly as food; about 15% are converted to animal feed, another 15% to other non-food uses, and some go to waste. The income elasticity of demand for these commodities is also low (Mellor 1988).

Ecologically Sustainable Development

Tropical root crops have certain characteristics that avoid the need for large inputs of chemicals and irrigation (as required with cereal crops) and promote more environmentally sustainable cultivation. These characteristics include:

(1) Higher resistance to pests and diseases, thus requiring less chemical control;

(2) Almost no irrigation;

(3) Simple husbandry practices that do not need expensive research and extension support;

(4) High use of in-ground storage;

(5) Use of non-chemical means to reduce post-harvest losses;

(6) Reduced use of fertilizers and other yield-increasing inputs to generate an equivalent amount of economic yield increase; and

(7) Reduced need for mechanization (except perhaps in yams and potatoes), thereby consuming less fossil fuel and thus contributing less to global warming.

Apart from population growth, income level and prices are other key factors influencing tropical root crop demand. As economic conditions improve in the developing countries through better economic policies and world trade liberation (including the Uruguay Round of the General Agreement on Tariffs and Trade), the production and marketing of tropical root crops will most likely become more specialized. Against this backdrop is the rapid growth of urbanization in many developing countries. This will create demand for

storable, fast-food products that are derived from tropical root crops. The future holds great opportunities for poverty alleviation and enhanced food security through investment in tropical root crops.

Strategies to Achieve Socio-Economic Improvements

Decreasing poverty and improving the nutritional status of the poor in countries where tropical root crops are important staple foods must be based on three key strategies (Mellor 1988):

(1) An efficiently operating research and extension organization whose researchers produce information that result in wide adoption of highly productive technologies. Such technologies cannot be simply transferred from other countries or international agricultural research centres because they require adaptation. Extension workers must understand that only through net increments to household production will socio-economic improvements result. For research and extension services to function efficiently, massive investments must be made in the development of human resources and institutions.

(2) Correct price formation and the development of an efficient market system will enable both producers and consumers to respond in a manner that would lead to economic growth and equity improvement. Tropical root crop development requires some purchased inputs to accompany the new technologies, but price incentives provide the main impetus for economic growth.

(3) Investments in rural infrastructure, particularly roads, schools, electricity, telephones, potable water, and health facilities, will help answer the basic needs of most of the population. Improved rural living standards will reduce the tendency for trained personnel to migrate to urban areas in search of better amenities. Such infrastructure development is also essential to ensure food security for the nation.

Conclusions

A major challenge faced by mankind today is to provide sufficient food for the growing number of poverty-stricken people in the developing countries, while ensuring continued economic growth and environmental protection. One way of meeting this challenge is to base research, development, and extension efforts on tropical root crops, where these crops are important staples. If farm productivity, in terms of land, labour, and capital, is increased, then

tropical root crops have a high potential to produce large amounts of cheap food for both rural and urban households.

Although researchers and extension workers recognize the root crops' potential, governments, key policy-makers, and donors have yet to be convinced that investments in tropical root crops will have high pay-offs that, over time, will translate into socio-economic improvements, that is, reduced levels of poverty and hunger, in the developing world.

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Table 1. World root crop production (in thousands of tons), 1992.

Region	Cassava	Sweet potatoes	Yams	Taro	Potatoes
Africa	70,445	6,303	26,591	3,439	7,531
North Central America	999	1,233	371	24	23,885
South America	29,343	1,426	309	7	10,645
Asia	51,237	118,404	249	1,800	68,848
Oceania	194	578	293	337	1,440
Europe and former USSR	-[a]	73	2	-[a]	156,143
World	152,218	128,017	27,815	5,607	268,492

a. *– = Not cultivated.*

SOURCE: FAO. 1994.

Table 2. World consumption of tropical root crops and cereals, 1992.

Crop	**Consumption (kg per capita)**
Cassava	28
Sweet potatoes	23
Yams	5
Taro	1
Potatoes	49
Wheat	103
Rice	96
Maize	96
Barley	29
Sorghum	13

SOURCE: FAO. 1994.

Table 3. Highest recorded edible yield per crop.

Crop	**t/ha**	**kJ/ha (in millions)**	**Country**
Cassava	68	384	Brazil
Sweet potatoes	47	212	Taiwan
Yams	36	163	Nigeria
Taro	65	255	USA (Hawaii)
Potatoes	72	226	Netherlands
Rice	8	118	Japan

SOURCES: Various.