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NEW MARKETS AND ALTERNATIVE USES FOR ROOT AND TUBER CROPS IN ASIA

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Introduction

Recent trends in production and consumption of cassava and sweet potatoes in Asia clearly indicate the urgent need to search for new markets and alternative uses for the sustained production of these crops. Production trends have been highly variable. In Asia as a whole, cassava production has declined from 54.9 million tons in 1989 to 53.2 million tons in 1991. For sweet potatoes, the decrease in area planted is substantial: about 35% from 1961/63 to 1986/88. The direct consumption of both cassava and sweet potatoes as fresh food has declined considerably. With growing urbanization and improved purchasing powers, opportunities and interest in new product development based on root and tuber crops are likely to increase.

In Thailand and Indonesia, which produce about 70% of all cassava grown in Asia, the export of dried cassava chips and other products is the major contributing factor to sustained cassava production. In Thailand, where increased production of cassava is export driven, cassava is exported mainly as dried chips, pellets, or starch to the EU for use as animal feed and modified starch. Hard pellets and super-high-grade starch are in more demand in the industrial market. Native starch is used by the food industry to produce sausages, glucose, monosodium glutamate, and bakery products. Modified starch is used in the textile, paper, plywood, and pharmaceutical industries.

In India, about 20% of total cassava production goes to starch and more than 17% to animal feed. About 170,000 t of cassava is processed into starch and tapioca (also called *sago* or *cassava pearls*). Some tonnage is converted into dextrin and glucose. In Vietnam, cassava is already an important, low-cost, raw material for industrial processing. At present, 45%-62% of the total cassava production of central Vietnam is processed into dried chips.

In Asia, about 40% of sweet potato production goes to animal feed. Recent estimates suggest that, in China alone, 30%-35% of the total sweet potato production goes to animal

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feed. Sweet potato processing for human consumption and industrial use has also attracted growing interest. China has already started exporting dried sweet potato chips to different EU countries, and other Asian countries are also competing for the export market.

Uses for sweet potato vary from one country to another. Commonly, it is boiled, fried, or roasted for human Consumption. Fresh roots are fed to pigs and vines to cattle. The sweet potato has certain advantages over other crops: it is an excellent source of carbohydrate in animal feed, it has a short growing period (4-5 months), and can readily adapt to the various cropping systems found throughout Asia. New technologies, for example, high-yielding cultivars with higher dry matter content, low-cost processing techniques, and new products, are encouraging a diversified use of sweet potatoes in some Asian countries.

In Taiwan, most sweet potato production is still used for animal feed, with about 20% used for baking, boiling, steaming, or frying. Bread made from composite flour, sweet potato flakes, fillings, chips, and sweet potato French fries may enjoy a certain market demand in the future. In China, sweet potato roots are receiving high prices because of the growing demand by industries producing wines, vinegar, alcohol, lactic acid, acetone, butyric acid, and monosodium glutamate. In Thailand, sweet potato flour is currently being used to make noodles for export to Korea and Japan.

Success Stories in Technology Generation and Adoption

Thailand

Thailand is perhaps the world's third largest cassava-producing country (23.46 million tons in 1989). In 1991, the country had an export target of about 7.75 million tons (5.25 million tons for the EU) for chips and pellets. Thailand also had an export target of 800,000 tons for cassava starch. Hard pellets and super-high-grade starch are in more demand on the international market.

Thailand has 54 large mechanized starch factories (capacity 70-500 t of starch per day), exporting mainly to Japan, Taiwan, the former USSR, USA, Indonesia, and Singapore. The quality characteristics for export are a pure white colour, moisture content (MC) of less than 13%, viscosity of 400 BU, a pH of 5-6, and a higher than 97.5 percentage of granules. Earnings from exported cassava starch are about US$190-200 million. Export earnings from cassava pellets and chips were targeted at US$752 million in 1991.

Thailand's current production capacity of 15 million tons of cassava chips/year is

filled. Standard contents levels specified for export are starch, 65% minimum; raw fibre, 5% maximum; MC, 15% maximum; and sand, 3%. Dust-free hard pellets from dried cassava chips are produced by 381 pelletizing factories, which have an installed capacity of about 11 million tons of pellets/year. Standards similar to those described for dried cassava chips are also maintained for pellets. In addition, there should be a minimum hardness of 12 kg/in.^{2}, according to the Khal hardness tester, a maximum of 8% meal (1-mm sieve), and no foreign matter. Thai pellets are exported mostly to the Netherlands, Spain, Germany, Portugal, Belgium, and Italy.

India

Cassava is used as a raw material for numerous processed products such as starch, tapioca (cassava pearls), liquid glucose, dextrin, vitamin C, gums, and high fructose syrup.

A very successful small-scale tapioca and starch industry, exclusively using cassava roots as raw material, has developed in the state of Tamil Nadu. Tapioca is a food starch that is processed by drying wet cassava starch in the sun to a MC of 40%-50% and then shaking in power-driven globulators. The resulting small granules are marketed as ‘pearls’ or sago.

An industrial cooperative of starch and tapioca manufacturers, popularly known as SAGOSERVE, has made a significant contribution to stabilizing cassava cultivation and organized marketing of the processed products. SAGOSERVE has largely controlled price fluctuations and the exploitative tendencies of middlemen, and has developed warehouse and credit facilities for its members. The cooperative has developed warehouse facilities to store as much as 27,000 t of processed products by encouraging state participation in the share capital in the form of loans. Also helping to place SAGOSERVE on a strong footing are governmental incentives, that is, sales tax concessions, exemption from excise duties, introduction of a single-point tax system, and participation in share capital.

In its initial year of establishment (1981/82), SAGOSERVE marketed goods worth Rs. 4 million (Rs. 30 = US$1.00). Since then, its growth has been phenomenal. In 1993/94, of about 800 factories, 720 are members of the cooperative, and the annual sales turnover was about Rs. 1000 million. As a result of the steady demand of raw roots from the industry, about 60,000 ha are under cassava cultivation in the state today, generating employment for about 500,000 rural people.

The cooperative has adopted a unique method of marketing its members' goods through a daily tender (auction) system. Members send their finished products (starch and

tapioca) to the cooperative, which pays them 50% in advance. The consignments are given lot numbers. Samples drawn from the lots are displayed for daily auction in a hall especially made for this purpose. The registered traders or merchants quote their competitive rates secretly against each and every lot according to their requirements. The rates offered by the traders are tabulated for the different lots, and the results are announced at 14:30. The highest bidder's name and the rate he offers for each sample or lot is displayed before the members and traders. The producer of the respective lot (or sample) reserves the right to accept or reject the highest rates offered by the traders. Once he agrees to a sale, he is paid another 40%, in advance, of the total value calculated on the basis of the final rate thus confirmed. Payments are made immediately on the day of confirmation of sale. Full settlement is made subsequently after deducting service charges.

Commercial production of potable alcohol from cassava roots has recently been launched. An agro-industrial project, capable of manufacturing 7.5 million litres of potable alcohol, and vitamin-rich cattle feed, has begun operations in Kerala State, where demand is high. In 1988/89, the total consumption of the rectified spirit in the state was 18.45 million litres, as against a local production of about 7.39 million litres. The project, which uses technology provided by the Vienna-based VOGELBUSCH GmbH, needs 18,000 t of dried cassava chips/year. It expects to reach a daily production of about 25,000 litres, and plans to use the superior quality alcohol in pharmaceutical and aromatic industries. The cost of raw material per litre of alcohol is about 40% of that of molasses, the raw material commonly used in the country.

China

There are 50 types of commercialized sweet potato processed foods, with an annual production of about 1.2 million tons. Recent Chinese estimates show that 30% of sweet potatoes now go to animal feed, while another 45% are used for processing. The main processed products are starch, white or yellow wine, alcohol, malt, fructose, glucose, and citric acid. Because of increased use in the brewing industry, the market price of sweet potatoes has steadily increased. Fresh roots, dried chips, and flour are used to produce such products as wine, vinegar, gum, feed protein source, alcohol, lactic acid, acetone, butyric acid, monosodium glutamate, and butyl alcohol.

Technologies for New Products

Low-cost technologies for using cassava and sweet potato roots have been developed and

adopted in certain countries of Asia. Some with market potential are:

(1) *Sweet potato French fries in Taiwan.* Chiang and Kao (1989) discovered that high-quality French fries can be produced from sweet potatoes by first balancing sweet potato strips with 1% sodium acid pyrophosphate solution at 100 ^{o}C for 2.5 min. The strips are then partially dehydrated by forced air at 120 ^{o}C for 5 min and then frozen at –30 ^{o}C. The product is fried directly at 145-175 ^{o}C for 2-6 min. Sweet potato French fries should sell well in fast-food restaurants.

(2) *Sweet potato silage for hog feed.* Crushed sweet potato roots and rice bran at a ratio of 80:20 (w/w) or crushed sweet potato roots, vines, and leaves, and rice bran at a ratio of 60:30:10 (w/w/w) stored for 1 month in silos were found to improve the quality of hog meat in Korea.

(3) *Modified cassava starch in Thailand.* Cassava starch can be more efficiently used by modifying it. Commercial processes include degradation, pregelatinization, and derivation. Degradation is done by roasting starch at high temperatures and spraying with an acid to reduce viscosity. White dextrin, yellow dextrin, and British gum are obtained by this technique.

Pregelatinized starch, a kind of gluey product, is obtained through quickly drying concentrated starch on hot plates. Starch esters, starch ether, and cross-linked starch can be obtained by modifying starch molecules through chemical treatments. The modified starch is used mostly by textile, paper, plywood, and pharmaceutical industries.

(4) *Cassava starch chip production in Vietnam.* Vietnam has developed a low-cost technology for producing chips out of cassava starch or flour. The steps followed for processing chips are:

(a) Make paste from cassava starch or flour.

(b) Chips prepared out of the paste are steamed at 100 ^{o}C for 5 min.

(c) Chips are sun-dried (14% MC) or oven-dried (10% MC).

(d) High (8 atmospheres) pressure treatment for 15 min (in used gas cylinder or barrel).

(e) Reduce pressure to 1 atm. to increase the volume (expansion 30-40 times).

(f) Pack in plastic bags.

The experience gained in the areas of diversified use of tropical root crops such as cassava and sweet potatoes in different countries of South-East Asia is already considerable. Some of the new products will be more remunerative and cost effective once improved cultivars are identified and developed to match industrial requirements. Research, however, must be more focused towards those needs.

Reference

Chiang W; Kao YM. 1984. Effect of variety and frying conditions on the quality of French fry type sweet potato. J Chinese Agric Chem Soc 27(1):97-107. (In Chinese.)