3. Research priorities for sweetpotato in Indonesia

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Abstract

Sweetpotato has important roles to play in feeding the developing world in the coming decades. By 2020, more people in Asia, Africa, and Latin America will depend on sweetpotato for food, feed, industrial uses, and income. Therefore, sweetpotato production is projected to increase by 47 percent the growth rate of 1.45 percent/year. Expansion of sweetpotato's uses and its constraints are summarized in this paper. To expand sweetpotato's uses, research should take the following priorities: (1) develop higher-yielding varieties for food, feed, industrial uses, or export; (2) improve postharvest processing, (3) develop integrated crop management, (4) study its use and its linkage to the emerging market, (5) develop planting material technology and distribution system, and (6) study technology adoption.

Introduction

Root and tuber crops have complex roles to play in feeding the developing world in the coming decades. By 2020, more than two billion people in Asia, Africa, and Latin America will depend on these crops for food, feed, and income (Scott et al. 2000).

China, the world's largest sweetpotato producer, uses fresh roots as source of starch for processed foods and other starch-derived products and as inexpensive source of animal feed, particularly in poorer, more isolated areas.

Sweetpotato processing is an income-earner for poor households. Sweetpotato processing for starch is also closely linked to pig production as residues are used as feed. This integrated system, which generates income from starch and noodle as well as livestock, requires improvement in efficiency and profitability if it is to remain sustainable in the coming decades (Wheatley 2000). Thus, research activities must be geared towards producing useful types of roots, commercially viable procedures and products, as well as policies to induce adoption of improved production and postharvest technologies.

In Indonesia, demand is high for sweetpotato as food, processed food, feed, and specialist starch both for export and domestic use. The competitiveness of these products and the resulting benefits to low-income households will be assured by the continued reduction of production cost. These can be realized if research work is done to produce higher-yielding varieties, higher dry matter content (to maximize conversion rates from raw material to processed product), and fertility and erosion management practices. These, together with incorporating improved processes and management practices by agroenterprises, can be highly beneficial to farmers.

Sweetpotato production in Indonesia has been relatively stable, increasing by an average of 0.1 percent/year during the last three decades (BPS 1999a). Since 90 percent of sweetpotato is used for food, low population growth of only 1.36 percent/year (BPS 1999b) partially explains the lack of growth in production. Sweetpotato yield during the last decade was stagnant at 9-10 t/ha and as such, production cost was difficult to reduce. Factors that affected the low sweetpotato productivity were: (1) low and fluctuating root prices at farmers'

level due to marketing system (about 30 percent spent for transportation cost); (2) local market for sweetpotato still undeveloped; and (3) postharvest technologies were not adopted by farmers (BPS 2000).

In Indonesia, sweetpotato is cultivated predominantly under lowland conditions. One common farming system is rotation, e.g., rice-sweetpotato-vegetable (high elevation); rice-rice-sweetpotato and rice-sweetpotato-rice (lower elevation); and rice-sweetpotato (rainfed). Intercropping sweetpotato with maize is a common practice. In this system, the crops are irrigated, where sweetpotato is harvested when it matures after four to five months. Maize is either planted at the same time as the sweetpotato or two weeks before sweetpotato is planted. The maize is harvested at physiological maturity or its milk stage. To back up the system, sweetpotato clones that mature early, are shade- and drought-tolerant, and are tolerant to pests and diseases are needed.

It is cheaper to produce sweetpotato than cereals for food security or as a famine crop (as staple food, rice substitute, or supplement). Sweetpotato is increasingly cultivated for its cash value, where both vines and roots are processed into food or starch prior to sale. Its production cost is low and the risk of growing it is lower than growing cereal crops.

Opportunities for Expanding Sweetpotato

Opportunities for expanding the use of sweetpotato lie in three categories: (1) fresh and processed for human consumption, (2) fresh and dried for animal feed, and (3) starches and flours for food and non-food uses.

Human consumption

Sweetpotato fulfills a number of basic roles in the global food system, all of which have fundamental implications for meeting food requirements, increasing food security, and reducing poverty. Sweetpotato is a cheap calorie producer and is rich in vitamin A and C and minerals (Table 1). For food security, the production growth of sweetpotato must be higher than the population growth. World sweetpotato production growth is projected at 1.45 percent (Scott et al. 2000), where sweetpotato production growth in Indonesia during the last three decades has been relatively low (0.1 percent/year) as presented in Figure 1. Roots in fresh form generally have little competitive overlap on either the supply or demand side. Processed products made from roots not only compete with cereals, but also with each other's processed products in terms of raw material and market. Declining availability of rice, population growth, modest absolute income levels for large segments of consumers, and declining farm size will contribute to a growing use of fresh roots, and in certain areas, of leaves for human consumption. Consumers prefer processed products of roots such as noodles to fresh roots.

Consumption of fresh roots tends to decline as per capita income rises and consumers will switch to more preferred foods. Therefore, future research must investigate the feasibility of improving quality and lowering unit cost, or channelling output into emerging specialist markets such as the starch market for upstream industries. Future economic trends will also help determine whether shifts in relative prices and exchange rates, and pace of technological innovation, will change the market for this type of product either into a more regional market, or a highly localized one.

Sweetpotato starch and flour can be processed into many food and non-food products (Figure 2). It is possible to develop starch and flour as strategic products for upstream

industries. Expanding sweetpotato for industrial uses must be backed up by innovative postharvest technologies. Physicochemical properties of sweetpotato significantly differ among varieties. Therefore, suitable varieties for each processed product are needed (Lin 2000). Sweetpotato starch can provide modified starch that is a raw material for processed products like sauces (Idris 2000). This indicates that there is an opportunity for expanding the uses of sweetpotato in industry. The physical properties of starch differ widely across varieties and these differences markedly affect the quality of starch noodle produced (Collado 2000).

Animal feed

Until 2000 the volume of fresh roots processed as feed in Indonesia was relatively low (BPS 2000). Use of unmarketable fresh roots (very small size, damaged by pests/diseases) was most common in production areas. Moreover, sweetpotato foliage as feed for livestock has been gaining importance. Cattle fed with it produce much manure which can be recycled as fertilizer in crop production. In a rice-sweetpotato cropping system where rice is fertilized with cattle manure, root yield increases significantly (Wargiono et al. 2000). Good sweetpotato growth means robust foliage for feed that, in turn, increases cattle manure to fertilize rice after growing sweetpotato. Therefore, it is necessary to develop integrated crop management in production areas.

Constraints to Expanding the Use of Sweetpotato

Technical constraints

- Bulkiness/perishability
  Swetpotato roots are bulky, have low value-to-volume ratio in fresh form can shrink and are prone to pests and diseases after harvest. This discourages transport and can lead to low market prices.
- Low multiplication rates
  Vine cuttings are the planting materials for sweetpotato. The cuttings require longer time to produce roots but can cover a bigger area with less seed. Thus, it takes longer to produce an adequate supply of the crop's planting material than that of cereals.
- Phytosanitary restrictions
  International germplasm evaluation for sweetpotato has been done much later than that of other major food crops. There are phytosanitary restrictions for moving germplasm. This limits the evaluation of sweetpotato clones in multiple locations.
- Dry matter content
  High dry matter content means high extractable starch. Thus, sweetpotato producers can reduce their per-unit production cost of raw material for processing if they have a good yield of sweetpotato with high dry matter content.
- Pests
  Root quality as well as quantity is affected by weevil (*Cylas* sp.) infestation. The pests are particularly serious during the long dry spells before harvest. Vegetative cycles are conducive to the growth of the weevil population.

- Diseases

  In more humid growing areas, sweetpotato viruses and fungi (scab) can devastate crops. Sweetpotato viruses that are relatively unknown to farmers make it difficult to eradicate them.

Socioeconomic constraints

- High per unit production cost
  For sweetpotato to become more widely used in processed form, higher yield in starch equivalent is necessary to bring down the cost of the roots as a source of raw material. If sweetpotato remains expensive, there may be a need to identify new specific uses to reduce, if not eliminate, competition with other sources of raw materials. It may be necessary to create market niches where sweetpotato's peculiar traits are promoted.
- Low status
  Sweetpotato carries the stigma of being the "poor people's food" and as such, consumption is low. To counteract this widespread perception will require either processing to disguise the presence of sweetpotato or campaigning to bring to the consumers' attention the various nutritional attributes of both roots and leaves, which are often completely overlooked. One such attribute is the plant's high vitamins A and C and mineral contents.
- Small resource-poor producers
  Farmers who cultivate sweetpotato are typically among the poorest farm households in a region. They rarely have collective representation before policy-making bodies, and they lack commercial status because the crop is not imported or exported to any appreciable extent. This contributes to their isolation from research and extension.
- Supply chain linkages
  Sustained improvements in sweetpotato production are often highly contingent upon access to new markets and the development of processing and marketing activities. The interdependence of these supply chain linkages generates additional inertia that can be much more difficult to overcome than merely developing marginal improvements in yield potential.

Research activities to solve these constraints in expanding sweetpotato production for the global food system in 2020 should be backed up by appropriate technologies.

Sweetpotato Research Priorities

The main goal of sweetpotato research is to support the national development program. Research will be directed to the most critical technical and socioeconomic constraints. Research priorities include the following:

- Development of higher-yielding varieties adapted to different agroecologies and suitable for food, feed, and industrial uses;
- Improvement in postharvest processing;
- Development of integrated crop management (ICM);

- Study on the use and its linkage to emerging market; and
- Improvement planting material technologies and their distribution.

Higher-yielding varieties

Breeding activities shall be done to find out suitable varieties for food, feed, and industrial uses. Table 2 shows the characteristics needed for these varieties.

Postharvest processing

- Postharvest processing using low and intermediate technology aimed at the household and village factory levels need to be developed to produce long-lasting stable products of high value. Research should cover aspects of postharvest pests and microorganisms control, handling and storage of fresh product, advanced processing and waste utilization.

Development of Integrated Crop Management (ICM)

ICM component technology development should include the use of inorganic fertilizers to supplement organic fertilizers, minimizing the use of insecticides, and development of synergistic cropping systems.

Marketing and utilization

Studies should include assessment of market size and differentiation, and market development, identification of farmers' and consumer's preferences, improvement of existing product uses, as well as the development of new uses.

Improvement of planting materials production and distribution

Research on planting materials must look into improvements in planting materials storage, pre-treatment, production technology and supply. It is also important to develop policies and socioeconomic mechanisms for the production and distribution of propagative materials to different regions and for different uses in Indonesia.

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Table 1. Food crops and their vitamin-calorie contribution per capita/day (???)

Food Crops	Calorie cost (Rp)	Vitamin			Minerals		
		A (Si)	B1 (mg)	C (mg)	Fe	Ca	Fe
					--------mg--------		
Rice	172	0	0,69	0	20.82	486	2.78
Maize	86	1795	1,34	0	35.20	901	8.45
Cassava	59	3065	236	0,48	262.68	318	5.57
Sweeetpotato	84	78232	224	0,91	304.80	498	7.11

Table 2. The characteristics needed for varieties suitable for food, feed, and industrial uses

Characteristics	Foods		Industrial uses/export	Feed
	Fresh roots	Processed food		
High yield *)	X	X	X	X
Drought tolerant	X	X	X	X
Shading tolerant	X	X	X	X
High DM content	X	X	X	-
Roots size	X	X	X	-
Roots appearance	X	-	X	-
Good taste	X	-	X	-
Tolerant to	X	X	X	-
Pests & diseases	X	X	X	X

* Root and foliage

Figure 1. Sweetpotato production trends in Indonesia 1970-2000

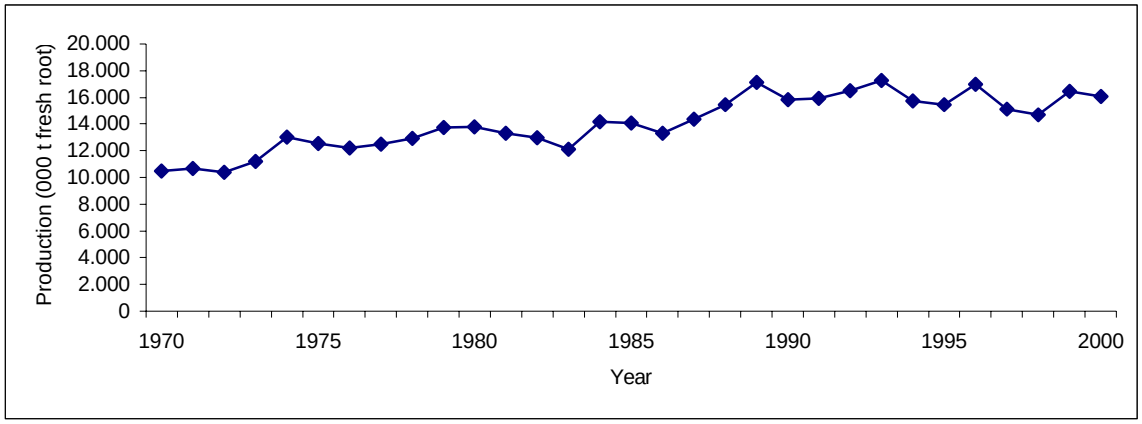

Figure 2. Flow chart on the use of sweetpotato as starch and flour