

Global Projections for Potato and Sweetpotato to the Year 2020

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Many of the developing world's poorest producers and undernourished households are highly dependent on roots and tubers—including potato and sweetpotato—as a major, if not principal, source of food, nutrition, and cash income (Alexandratos, 1995). Potato and sweetpotato are currently planted on about 27 million hectares worldwide, producing 432 million metric tons (t), 56% of this is harvested in developing countries (FAOSTAT, June 1998). By the mid-1990s, an estimated 158 million t of potato and sweetpotato were consumed annually in developing countries, representing part of the diet of several billion consumers in these regions (FAOSTAT, January 1999). An improved understanding of the importance of production, utilization, and future role of potato and sweetpotato in the global food system for the 21st century has potentially far-reaching implications for investments in agricultural research at both the international and, perhaps even more importantly, national level.

This paper represents some of the key findings of a recent collaborative study carried out by CIP and IFPRI with input from scientists at CIAT and IITA (Scott et al., 1999). It presents future projections for potato and sweetpotato to the year 2020 for the purpose of contributing to a clearer vision of the role these crops can play in the global food system in the decades ahead. Previous projections for these commodities, particularly potato, have proved to be highly misleading when compared to FAO statistics on actual output trends. Those for sweetpotato and potato

are also considered suspect because the FAO production data frequently underreport production and/or yields for particular developing countries. Hence, there is a sense among commodity specialists and some global food analysts that a new set of projections using a different methodology is required in order to provide projections for potato and sweetpotato that merit consideration in the highest international agricultural policymaking circles.

In the first part of this paper, the novel elements of this approach, which emphasizes presenting disaggregate results and incorporating potato and sweetpotato in a multi-commodity model, are explained. Subsequent sections then spell out findings with regard to utilization, production, trade, and the estimated value of output according to alternative scenarios. A concluding section presents two sets of policy recommendations. One focuses on regional priorities based on the projections themselves. The other concerns the process of collecting and analyzing potato and sweetpotato data for the purpose of generating such estimates.

Material and Methods

Global food projections in this paper were calculated using IFPRI's international model for policy analysis of agricultural commodities and trade (IMPACT). The model, covering 37 countries and regions and 18 commodities, (including all cereals, soybeans, roots and tubers, meats, and dairy products, accounting for the vast majority of the world's food production and consumption), is specified as a set of country-level demand and supply equations

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linked to the rest of the world through trade. Demand is a function of prices, income, and population growth with total demand equal to the sum of food, feed, and other (non-food, non-feed) demand. Growth in crop production in each country is determined by crop prices and the future rate of productivity growth, which in turn is estimated by its component sources including advances in management and plant breeding research. Other sources of growth considered in the model include private sector investments in agricultural research and development, agricultural extension and education, markets, infrastructure, and irrigation (see Rosegrant et al., 1995, for details of the methodology). The results presented here are generated from an updated version of IMPACT that takes as its base period 1992-94. The projections are for the year 2020. Projected growth rates then are annual average rates estimated for the period 1993-2020. All other modeling methodology is consistent with the IMPACT model reported in Rosegrant et al. (1995).

In order to put the following set of results into perspective, it should be pointed out that these calculations attempt to go beyond past projections made for these crops in a number of important respects including:

- Previous attempts often focused only on a single root and tuber crop, e.g., potato (FAO, 1995), thereby making less explicit the possible linkages in production, consumption, and trade with other food commodities.
- Other attempts to model future trends for potato and sweetpotato were calculated on an aggregate basis, for roots and tubers in total, overlooking the complexities that can be more effectively captured in a disaggregate approach.
- Past efforts at estimating the future relative value of major food commodities including potato and sweetpotato have assumed fixed relative prices throughout the planning period. IMPACT specifically allows prices to vary.
- Finally, previous attempts at multi-commodity projections were often carried out without the participation of commodity specialists for roots and tubers (Rosegrant et al., 1995). Given the relative shortage of published information on potato and sweetpotato (there is no extensive body of literature on projections for these crops, particularly for developing countries), this represents an important aspect of any modeling exercise for these commodities. The results presented here represent the output of collaboration over the last three and a half years between CIP and IFPRI economists.

Results and Discussion

IMPACT posits two scenarios for future growth in demand, production, trade, and prices for potato and sweetpotato in the context of generating projections to the year 2020 for the world's major food commodities: (1) the baseline scenario; and (2) the high demand and production growth (HDP) scenario. In the baseline scenario, projections for potato and sweetpotato are driven by more conservative estimates of the effect of income growth on demand for these commodities and their derivatives. As a corollary, the rate of technological change is more modest than in the HDP scenario contributing to less rapid increases in production and yields.

Baseline scenario

IMPACT's baseline scenario for projected growth rates in food and animal feed demand from 1993 to 2020 are high and uneven across the globe. They are highest for potato with an average annual increase in total demand of 2.02%, and 2.33% for average annual food demand (Table 1). For sweetpotato, total food demand is projected to grow at 0.44% over the period reflecting reduced demand for fresh sweetpotato for direct human consumption in China.

Regional growth rates for food demand for potato are highest for Sub-Saharan Africa (3.10%) and India (3.09%), and

Table 1. Trends and projections for potato and sweetpotato in developing countries, 1987-97 vs. 1993-2020 according to different scenarios.

Category	Potato			Sweetpotato		
	1987-97 ^a	1993-2020A ^b	1993-2020B ^c	1987-97 ^a	1993-2020A ^b	1993-2020B ^c
Growth rates in production (average annual %)						
- Area	2.4	0.51	0.84	1.3	0.27 ^d	0.35 ^d
- Yield	2.0	1.50	1.85	0.9	0.97 ^d	1.10 ^d
- Production	4.5	2.02	2.71	2.2	1.25 ^d	1.45 ^d
Growth rates in utilization (average annual %)						
- Total food demand	—	2.33	2.75	—	0.44 ^d	0.50 ^d
- Total feed demand	—	0.37	2.66	—	1.81 ^d	2.23 ^d
- Total use	—	2.02 ^e	2.76 ^e	—	1.25 ^{de}	1.46 ^{de}
Net trade (mil. mt)	—	-1.2	-4.6	—	0.6 ^d	0.4 ^d
Value (%)	—	3.9 ^f	4.9 ^f	—	1.5 ^f	1.9 ^f

Source: Scott et al. (1999) and FAOSTAT (June 1998, accessed July 1998).
 Note: Developing countries as defined by FAOSTAT.
^a Calculated for the period 1985-87 to 1995-97, without central Asia in the case of potatoes.
^b 1993/baseline scenario.
^c 1993/high demand and production growth scenario.
^d The growth rate projections are for sweetpotato and yam combined with a ratio 80/20 for sweetpotato to yam. China produces no yam.
^e Total food, feed, and industrial (non-food, non-feed) demand.
^f See Table 2.

lowest for other East Asian countries (e.g., North Korea), and Latin America (1.69%). These strong results reflect:

- the high status of potato as a preferred food in these regions;
- population growth, particularly strong in Africa; and,
- the extent to which the crop fits into local food systems in terms of, e.g., labor requirements, soil, and climate conditions.

For sweetpotato, regional growth rates for food demand are highest in Sub-Saharan Africa (2.74%) and lowest in China (-1.02%) with most other regions showing little or no growth. Feed demand presents just the opposite picture with strong growth in China (1.81%). This dichotomy partly reflects the relative availability of basic foodstuffs in the two regions; China is relatively well endowed and Sub-Saharan Africa much less so. Differential population

and income growth rates, slower demographic expansion and more rapid economic growth increasing demand for meat in China, with an opposing scenario in Sub-Saharan Africa, also drive the dichotomy.

Projected production growth rates are variable and driven by yield increases. Average annual growth rates in production from 1993-2020 for potato (2.02%) and sweetpotato (1.25%) are dominated by growth rates in yield (1.50% and 0.97% respectively) (Table 1). However, in relation to recent actual trends in production in the period 1987-97, these estimated production growth rates are less than half that for potato, and 25% higher for sweetpotato (Table 1). Whereas in absolute terms the projected increases from 1993 to 2020 in area planted in potato (1.0 million ha, or 15%) and in sweetpotato (0.9 million ha, or 8%) are by no means insignificant, the projected average annual declines in

the growth of area planted from the periods 1987-97 to 1993-2020 is more noteworthy than the slowing of production growth over the period.

Trade is not projected to increase to any extraordinary extent, although the published FAO database for trade used for generating these projections is particularly suspect because it often lacks statistics on trade in processed products for particular countries. Current estimates suggest that processed potato exports, for example, would at least double the overall trade volume (FAO, 1995). For sweetpotato, recent research in China suggests that exports of starch-based products may be far more important and are growing more rapidly than previously realized. Notwith-

standing, some marked increases in trade are projected to take place. Southeast Asia and Sub-Saharan Africa will each import 300,000 t more of seed and table potatoes in 2020 than the estimated 100,000 t imported in 1993. China's exports of sweetpotato are projected to rise by 900,000 t to 1.4 million t.

The baseline scenario projects the value of potato and sweetpotato as a share of the total value of the major food commodities in the study to fall from 6.9% in 1993 to 5.4% in 2020 (Table 2). Much of this decline is attributable to the fall in price for sweetpotato. Higher than previously estimated prices for cereals in 2020 also are driving this result (Rosegrant et al., 1995).

Table 2. Total value of selected commodities for developing countries, 1993 vs. 2020 according to different scenarios.

	1993 ^a				2020A ^b				2020B ^c			
	Price (US\$/t)	Production (000 t)	Value (US\$)	Total (%)	Price (US\$/t)	Production (000 t)	Value (US\$)	Total (%)	Price (US\$/t)	Production (000 t)	Value (US\$)	Total (%)
	(millions)				(millions)				(millions)			
Potato	160	94,336	15,094	4.1	137	161,994	22,193	3.9	145	194,006	28,131	4.9
Sweetpotato	80	124,703	9,976	2.8	56	154,722	8,606	1.5	68	163,369	11,186	1.9
All roots and tubers ^d		422,573	38,586	10.5		654,504	50,076	8.8		714,584	60,946	10.5
All cereals ^e		928,115	176,622	48.0		1,407,478	241,253	42.6		1,409,470	242,195	41.9
Soybean		57,705	15,176	4.1		106,149	24,839	4.4		106,203	24,958	4.3
All meat ^f		88,326	137,752	37.4		182,749	249,862	44.1		182,831	250,467	43.3
Total		368,136				566,030				578,567		
1993 share of R & T in all commodities				10.5				8.8				10.5
Share of R & T in cereals + R & T + soybean				16.7				15.8				18.6

Source: Scott et al. (1999). Note: Roots and tubers = R & T.

^a Average for the three years; 1993 equivalent to 1992-94.

^b Baseline scenario.

^c High demand and production growth scenario.

^d Includes potato, sweetpotato, cassava, yam, and other roots and tubers.

^e Includes wheat, maize, barley, sorghum, millet, and rice. ^f Includes beef, pork, poultry, sheep, and goat meat.

High demand and production growth scenario

Recent trends indicate that the structure of demand and supply for potato and sweetpotato may be undergoing fundamental shifts in parts of the developing world (Table 1). The HDP scenario is used to examine the impact of faster supply and demand growth in selected regions.

The HDP scenario projects that growth of both food and feed uses will account for the faster growth in overall demand for potato and sweetpotato. In the HDP projection, the jump in demand for potato is almost entirely due to faster growth in food use in China and India. In China, average annual growth in food use for potato from 1993 to 2020 is 2.74% versus 2.20% for feed use. In India, average growth in food use during the period is 3.80% per year versus 3.09% for feed use. Overall average annual per capita demand for potatoes in developing countries will rise only modestly beyond the level projected in the baseline scenario—from 16.18 to 18.05kg. These consumption levels remain a minor percentage of the level currently observed in industrialized countries, 74 kg/capita/yr.

For sweetpotato, the major growth is in total feed demand (2.33% average annually from 1993 to 2020). This result largely reflects the strength of feed demand in China, where sweetpotato will become a more efficient animal feed source to help satisfy the country's growing demand for meat. This reflects higher prices for maize and improvements assumed by the HDP scenario.

Projected growth rates for production of potato (2.71%) and sweetpotato (1.45%) are higher—and for potato considerably so—than those of the baseline scenario of 2.02 and 1.25%, respectively. For potato, higher growth rates result from faster growth in China, 2.72% versus 1.49% in the baseline scenario, and in India 3.67% versus 3.10%. In both countries, production growth is a result of stronger expansion

in area planted. It should be noted here that even these higher projected growth rates actually represent a major drop from recent historical levels, e.g., from 6.2% per year in China during 1987-97 (FAOSTAT, June 1998). For sweetpotato, stronger growth in area planted in Sub-Saharan Africa and moderately higher yields in China (though area planted is projected to fall by 600,000 ha) account for the accelerated growth rate for production of sweetpotato (roughly 2.7%).

In the case of trade, the big change is with potato—although the lack of data on processed products still applies. From 1993 to 2020, total imports for developing countries jump from 1.2 to 4.6 million t as China, India, and the West Asian and North African regions go from net exporters to net importers. Strong demand under the HDP scenario is likely to generate greater imports of processed potato products for human consumption (e.g., frozen french fries, chips) from industrialized countries.

The shares of potato and sweetpotato in the projected value of the commodities is projected to remain stable, if not rise (Table 2). This result is the combined effect of the faster growth rates in production and a moderately slower rate of decline in prices for these commodities with the bulk of the increase due to faster production. Furthermore, all of the more rapid projected increases are well within the range of recent trends in production and utilization for roots and tubers in developing countries as derived from FAOSTAT statistics. The additional expansion in area planted in roots and tubers is a small fraction of the total land area devoted to crop production in 2020.

Conclusions

The implications of these projections for the location of potato and sweetpotato production in the year 2020 and the value of production for these crops can be summarized briefly.

Potato and sweetpotato are, as far as developing countries are concerned, overwhelmingly Asian commodities (Figure 1). Based on these projections, particularly the HDP scenario, they will become increasingly so in the years ahead, albeit for different reasons. Rising incomes will stimulate added consumption of potatoes as consumers look to diversify their largely cereal-based diets. This increased consumption of potatoes will include high percentage increases, but modest in absolute quantities on a per capita basis, in the consumption of fast foods and snacks as Asia's largely rural-based population becomes more urbanized and incomes improve.

For sweetpotato, rising incomes and urbanization will catalyze increased use of the roots and vines for animal feed and processed food products such as noodles made from starch.

From a global perspective, the relatively minor importance of potato and sweetpotato in Africa is noteworthy. However, potato and sweetpotato will maintain, if not rise, in relative importance

in particular sub-regions within Africa, particularly in East Africa.

Finally, the estimates of the value of production permit us to calculate the geographic distribution of the future value of production for potato and sweetpotato. This comparison highlights the importance of China and India for potato and China and Sub-Saharan Africa for sweetpotato (Figure 2). Policymakers and research scientists should keep these consumption and production trends in mind when formulating plans for future research and related development efforts.

Recommendations

Experience in working with the available data to generate these projections suggests a series of measures are needed to improve the process.

First, an international effort is needed to examine the databases for potato and sweetpotato in a select number of developing countries with the specific intent of reducing the margin of difference between FAO statistics and national data, as well as

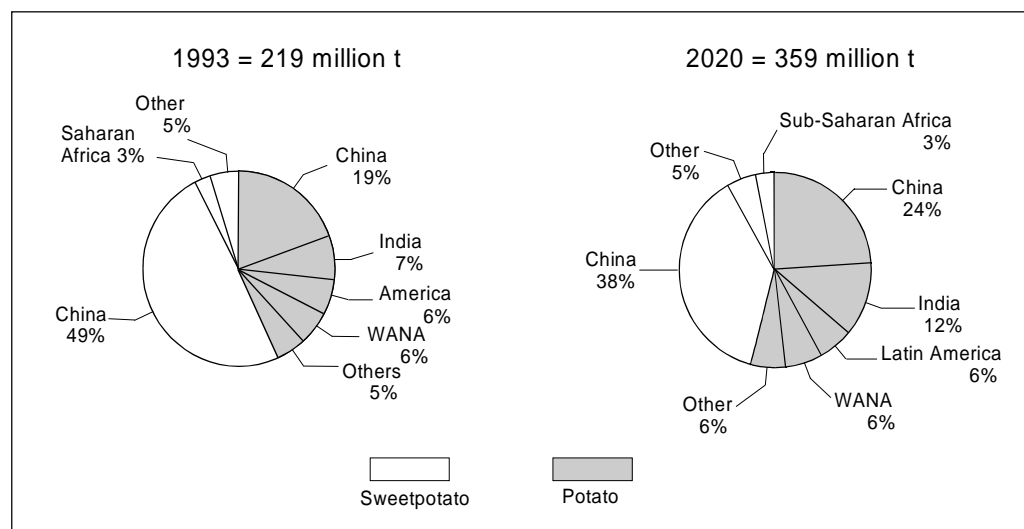


Figure 1. Potato and sweetpotato production (million t) in developing countries 1993 vs. 2020, according to the HDP scenario. (Source: Scott et al., 1999.)

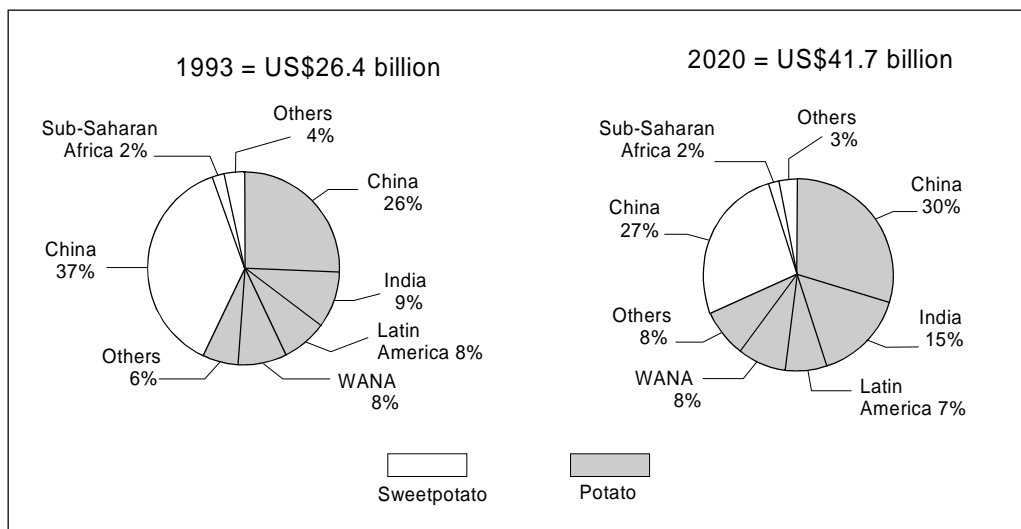


Figure 2. Value of potato and sweetpotato production (US\$ billion) in developing countries 1993 vs. 2020, according to the HDP scenario. (Source: Scott et al., 1999.)

between aggregate country figures and the findings of specific case studies and farm surveys.

Second, a systematic attempt to improve the FAO Food Balance Sheet data should be undertaken. This should include reconsideration of how food and non-food categories are reported. Specifically, inclusion of sweetpotato leaves in nutrition estimates would seem to make good sense. Feed use figures should include some estimate for sweetpotato vine use; if not in the Food Balance Sheet figures themselves, then in some other internationally accepted standard of feed availability.

Third, closer statistical monitoring and publishing of trade data on potato and sweetpotato should be a goal, so as to regularly include information on at least the major processed products, e.g., frozen french fries, chips, and dehydrated products for potato as well as starch and noodles for sweetpotato. Again, perhaps an experimental pilot effort in a few key countries could help identify the types of low-cost improvements in reporting procedures, estimates of difference in results these procedures

would make, as well as concrete suggestions on how the improvements might be implemented.

Impact

This joint effort of CIP and IFPRI to analyze historical trends and generate commodity projections has resulted in two major impacts. First, CIP, in conjunction with CIAT as well as IITA, and FAO are currently preparing the next set of projections for potato, sweetpotato, cassava, and yam for TAC. This more pro-active approach will reduce the need for post-publication debates about the accuracy of particular figures.

Second, the interaction between CIP and IFPRI has strengthened IFPRI's IMPACT model for the global food economy and helped CIP better appreciate the relationship between potato and sweetpotato and other major food commodities. As a result, the CGIAR's interaction with international and national policymakers will provide a more consistently accurate and optimistic outlook for these commodities in the years ahead.

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