Section 4

High-Value Commodities and Agroprocessing
Modernizing Africa’s fresh produce supply chains without rapid supermarket takeover: Towards a definition of research and investment priorities

David Tschirley\textsuperscript{1}, Milton Ayieko\textsuperscript{2}, Munguzwe Hichaambwa\textsuperscript{3}, Joey Goeb\textsuperscript{4} and Wayne Loescher\textsuperscript{5}

Abstract
After a burst of enthusiasm through the middle part of this decade regarding the “supermarket revolution”, there now exists a broad consensus that this phenomenon is likely to proceed much more slowly than once thought in Sub-Saharan Africa. This is especially true in fresh produce supply chains, where both the promise and the perils of supermarket expansion have received greatest attention. In nearly the entire continent, the so-called “traditional” marketing sector – primarily open air markets and dispersed informal vendors – is expected to play a dominant role in fresh produce marketing for several decades. If true, this finding has profound policy implications. Specifically, it suggests that private investment in modern, integrated supply chains cannot be relied upon to solve the multitude of problems that increasingly plague these traditional production and marketing systems over a time frame acceptable to most policy makers and donors. Public engagement, preferably through meaningful public/private partnerships and an accompanying re-definition of public and private roles, will be central to improving these systems. This paper first reviews the evolution of thinking on the supermarket revolution in Africa and presents empirical evidence from Kenya and Zambia. It then lays out a set of stylized facts and key gaps in knowledge regarding traditional fresh produce production and marketing sectors on the continent, and closes by outlining priorities for research and for public and private investment to modernize these systems in the absence of rapid supermarket takeover.

Introduction
Strengthened supply chains for fresh produce can improve lives in developing countries in several ways. First, because yields per unit land area can be very high, many of these crops provide the possibility for land-constrained farmers to become more commercialized in their farm operations, which a robust empirical literature shows has positive effects on incomes (Larkins et al., 2008; CGIAR, 2005). Second, fresh produce crops provide a wide array of opportunities to add value through packaging, canning, slicing and dicing, and production of juice, sauces, preserves and inputs to other food processing activities. Such value addition creates off-farm employment, a major channel through which rural households escape poverty. Finally, the nutrients in horticultural crops (particularly micronutrients, vitamins, and trace elements) can make a critical contribution to improving diets in the developing world (Willett, 2001; Flores and Gillespie, 2001).

Table 1 encapsulates the magnitude of the opportunities and challenges facing fresh produce sectors in Sub-Saharan Africa (SSA)\textsuperscript{6}. Annual growth in the worldwide per capita supply of fresh produce was four times higher than for cereals between 1970 and 2000. This growth was led by China, where investments in improved technical and market information, fertilizer availability, solar greenhouses, and plastic greenhouses (FAOSTAT and Chinese Academy of Agricultural Sciences Statistics, 2008), all in response to a vast opening to market incentives and very rapid income growth, led to a tripling of per capita supplies since 1970. Yet impressive growth was not limited to China: in South Asia, East and Southeast Asia, and Latin America, growth in fresh produce supply was 2.5 to 4 times greater than growth in the supply of cereals. This pattern is consistent with the high income elasticity of demand for fresh produce.

Africa alone among the major continents saw negative growth in per capita supplies throughout this period. Yet positive income growth on the continent since 2000 suggests that growth in fresh produce supply since that time has likely also been positive, and the experience of the rest of the world suggests that, if income continues to grow in Africa and proper investments are made, fresh produce can be a major source of growth for the rural sector.

The objective of this paper is to begin forging a consensus regarding priorities for applied research and programmatic investment in SSA’s fresh produce supply chains over the next two to three decades. We start with an overview of these

\textsuperscript{1}Professor, International Development in the Department of Agricultural, Food, and Resource Economics (AFRE), Michigan State University. Corresponding author (tschirle@msu.edu)
\textsuperscript{2}Graduate Research Assistant, AFRE/MSU and Research Fellow, Tegemeo Institute, Egerton University
\textsuperscript{3}Research Fellow, Food Security Research Project, Lusaka, Zambia
\textsuperscript{4}Graduate Research Assistant, AFRE/MSU
\textsuperscript{5}Professor, Department Horticulture, Michigan State University

The authors wish to thank one anonymous reviewer, Michael Weber, and Peter Timmer for helpful comments on earlier versions of the paper.
\textsuperscript{6}Unless specifically stated otherwise, reference to “SSA” and “Africa” does not include South Africa, given the vastly more developed state of its economy compared to other SSA countries.
chains’ current status and directions of change. Because the supermarket revolution has received wide attention in the professional and popular press since the early 2000s, we first review the evolution of thinking regarding this phenomenon. The review shows that expectations regarding supermarket growth in Africa have cooled considerably since the initial enthusiasm. We then show that empirical evidence from Kenya and Zambia is consistent with this changed thinking. Next, we suggest a set of stylized facts – along with important gaps in knowledge – regarding the current status and drivers of change in the continent’s traditional production and marketing systems, and close by outlining priorities for research and for public and private investment to modernize these systems in the absence of rapid supermarket takeover.

The evolution of thinking regarding supermarkets in African fresh produce systems

Retail modernization in developing countries and its effect on the broader food system has been an important issue since the early 1960s (Harrison et al., 1974; Goldman, 1974; Riley et al., 1970), and became a major new focus of research starting in the early 2000s. The most visible banner for this new work has been the supermarket revolution. Supermarkets existed in Latin America from at least the 1960s, but began to grow much more rapidly in that region during the economic boom and opening to Foreign Direct Investment (FDI) of the 1990s. Growth began later in East/Southeast Asia and Central Europe, followed by selected countries of Africa (Reardon et al., 2004). This growth, together with new procurement practices that the firms tried to apply, led to a rush of studies attempting to document and anticipate the impacts of these firms on existing actors in the food system, and to draw policy implications for governments and donors.

Early expectations of supermarket takeover

Though distinctions are made between countries, regions, and types of food products, recurring themes in the supermarket revolution literature have been the “rapid rise” of supermarkets, the difficulty of smaller retailers to compete with them, the difficulty of small processors to compete with large processors for the new “supermarket market”, and the urgent need to deal with the exclusion of smallholder farmers from the supermarket channel. Until recently, conditions for supermarket expansion in Africa were seen to lag, but not to differ fundamentally from those in other regions of the developing world; Africa was portrayed as a later “wave” in the surge of supermarket expansion, with “take-off” having already occurred in East and Southern Africa and beginning in West Africa (Reardon et al., 2004). The following quote encapsulates this view:

“Our premise is that supermarkets will continue to spread over the (African) region...and thus their requirements will either gradually or rapidly, depending on the country, become those faced by the majority of farmers...Understanding those procurement systems...is thus a way of predicting what will be the challenges and opportunities facing farmers...in the next 5-10 years” (Weatherspoon and Reardon, 2003; parentheses added).

---


For early studies on Latin America, see Reardon and Benegue (2002) for a summary, and Alvarado and Charnel (2002), Schwentesius and Gomez (2002), Faigeuenbaum et al. (2002), Farina (2002), and Ghezán et al. (2002) for country studies. See also Reardon et al. (2004). For Asia, see Reardon et al. (2003a), Reardon et al. (2003b), Hu et al. (2004), and Coe and Hess (2005). For Africa, see Weatherspoon and Reardon (2003), Neven and Reardon (2004) and Neven et al. (2005).
More cautious voices
More cautious views regarding the likely rate of supermarket expansion were expressed early in Asia, and more frequently over the past three years in Asia, Africa, and even Latin America. Goldman et al. (1999) identified the “persistent continued strength of “wet markets” in Hong Kong” despite that city’s developed economy; they attribute this strength to these traditional markets’ adaptation to consumer shopping habits. Goldman (2000) was one of the first to identify consumers’ “selective adoption” of supermarkets, whereby “consumers who regularly shop in supermarkets continue to purchase fresh food in traditional outlets”; these findings echo those of others showing continued retail diversity even where supermarkets have expanded most. In Vietnam, Cadilhon et al. (2006) anticipate strong growth of supermarkets (from a base of only 2%) but suggest that “policy makers should not promote the ‘modernization’ of food systems at the expense of traditional channels, which meet important consumer needs”. Maruyama et al. (2007) also see strong growth, but cite serious challenges for supermarkets in lowering their prices and enhancing their locational convenience, both of which are key factors for the great mass of consumers in Africa and Asia.

Patterns in Latin America are relevant as a potential indicator of future patterns elsewhere. Booz-Allen Hamilton (2003) noted that “emerging consumers infrequently shop – if at all – at large supermarkets” in Brazil, despite the heavy market penetration of such outlets in that country. They refer to “the myth (that) it’s just a matter of money and time until emerging consumers flock to large supermarkets”, and conclude in general for Latin America that “small retailers have a sustainable business model”. Farina and Nunez (2005) echo this conclusion in Brazil, noting the persistent diversity of retail outlets, and that “the number of independent supermarkets (as opposed to large chains) and traditional retailers has grown, and their share in food sales has increased (in recent years)”.

Reviewing literature on supermarkets in Africa, Humphrey (2007) concludes that “the extent of transformation of retailing...as a consequence of (supermarket expansion) is overestimated”. In Kenya, where supermarkets had penetrated more than in any SSA country outside South Africa and perhaps Zambia, Tschirley et al. (2004a) and Tschirley et al. (2004b) estimate that supermarket chains held less than 2% of the national urban fresh produce market in late 2003, and that nearly all fresh produce purchases in these supermarkets were made by consumers in the top 20% of the income distribution. They calculate that, to reach a 10% market share in 10 years, supermarket sales of fresh produce would have to grow 22% per year in real terms. In a cross-country econometric analysis, Traill (2006) estimates that Kenyan supermarkets will hold at most a 16% share of total food sales by 2013; this would correspond to a 4-5% share of fresh produce. Ayieko et al. (2006) echo findings elsewhere of diverse shopping habits among consumers, noting that 94% of Nairobi consumers frequented at least three different types of food retail outlets in the previous month. By 2007, Reardon and Timmer (2007) had noted the very small market shares of supermarkets in nearly all of SSA. They suggested “considerable uncertainty about the rate at which the supermarket sector will grow” even in Kenya and Zambia; in most of the rest of SSA, they deemed it “unlikely that...we will see supermarket growth for several decades.” Echoing this, Reardon and Gulati (2008) do not include SSA outside South Africa in their table of “waves” of global supermarket expansion. In the most recent study, in Madagascar, Minten (2008) shows the very small market shares of supermarkets, notes that none of the global retailers have expansion plans, and suggests that “agriculture for local consumption in poor countries will be largely bypassed by the global food retail revolution.”

In India, market reform and opening to FDI, along with prospects for 7% yearly growth in retail sales in a market of 1.2 billion people, have generated billions of dollars of current and planned investment in supermarkets by local and multi-national firms, including Wal-Mart and Carrefour. Yet supermarket shares in India are currently very low (around 2%), due to the country’s massive and complex small retail sector. Supermarkets there face the 20/20/20 challenge: they must grow their food sales by 20% a year for 20 years just to reach a 20% market share, still leaving 80% to more traditional channels.

Supermarkets and the exclusion of small farmers
Concern about exclusion of smallholder farmers from supermarket supply channels was most acute in fresh produce, since farmers can market it directly to supermarkets. Concerns are based on the efforts of fresh produce procurement managers in supermarket chains to provide consumers with a stable, year-round supply of safe, high-quality produce at competitive prices.

---

Wet markets” refer to traditional open-air markets.
Farmers that cannot meet these criteria, especially the need for fixed quantities every week of the year, fall off the supermarkets’ "preferred supplier" lists. Smallholder farmers are especially challenged in this regard, and evidence is mounting that all but a tiny minority, whether independent or in farmer groups, are unable to remain on preferred supplier lists on a sustained basis\textsuperscript{10}. As a result, medium- and large-scale farmers supply the overwhelming majority of fresh produce moving through preferred supplier programs in Africa.

Yet these programs carry a tiny fraction of the food trade in African countries. For example, in Kenya in late 2003, this share was less than two-tenths of one percent of all food purchased in urban areas\textsuperscript{11}. Thus, while smallholder exclusion from large supermarket supply chains is a reality, it cannot now be considered among the top tier of rural policy concerns in this area of the world; nor is it likely to become a top tier concern over the next 10-20 years in most countries, given projected supermarket shares over this time.

**Evidence from Kenya and Zambia**

Outside of South Africa, Zambia and Kenya are arguably the two countries in SSA with the greatest prospect of supermarket expansion. Each has a meaningful commercial farm sector, making the supply base potentially more able to respond to supermarket requirements; Zambia is the most urbanized country in the region, putting a larger share of the population within reach of supermarkets; and Kenya’s economy is the most sophisticated in the region, allowing supermarket expansion to be fueled by local investment. Yet as this section will show, each country shows exceptionally low supermarket shares, especially for fresh produce, and continued reliance on high-income households to support those shares.

Data for this section come from two urban household surveys. In November 2003, Tegemeo Institute and Michigan State University carried out a survey of 560 randomly selected households throughout low, middle, and high income areas of Nairobi, obtaining recall data on food expenditures over the previous 30 days, along with data on incomes from salaries, own business, and urban farming. In August 2007 and February 2008, Michigan State University collaborated with Zambia’s Central Statistical Office (CSO) in a two-round survey of 1,856 households in four cities of the country: Lusaka, Kitwe, Kasama, and Mansa. This survey used the same 30-day recall period as in Kenya, but used total expenditure rather than income as its measure of households’ economic level. Lusaka and Kitwe are the two largest cities, each falling within the urbanized central arc of the country; Kasama and Mansa are smaller towns lying outside this area. Zambia’s sample was designed to be representative of each city individually and of the four cities as a whole. Nairobi accounts for 43% of Kenya’s population in towns and cities above 20,000 inhabitants; the four surveyed cities in Zambia account for 50% by this same measure.

Tables 2 and 3 show market shares of comparable retail channels in each country, broken down by food group. In each country we distinguish between chain supermarkets and typically smaller independent supermarkets. This distinction is based on the idea that corporate supermarket chains are in the best position to fund rapid expansion while implementing the procurement practices, described above, that have been the focus of concern regarding smallholder exclusion from these channels. The two dominant supermarket chains in Kenya are Nakumatt and Uchumi, with competition from Tuskys and Ukwala; all are Kenyan companies. Shoprite (South African) entered Zambia in 1997 and is the dominant chain, with the more recent entry of Spar (a Dutch corporation based on a franchise model), and some competition from Melissa, a local chain with three stores. The “ka sector” in Zambia (“ka” means “small” in Nyanja) encompasses a vast array of informal retailers operating small tables and rudimentary shops outside of marketplaces; kiosks in Kenya likewise lie outside of marketplaces but tend to be more substantial in their construction. “Dukas” in Kenya and “Grocers” in Zambia are both small shops with electricity and plumbing, distinguished from small supermarkets by personal service retailing in which the vendor selects items for the shopper; each are long-standing features of the retail landscape in these countries.

Four points emerge from these tables. First, traditional shops, open-air markets and the informal sector (kiosks in Kenya, the ka sector in Zambia) sell most of the food in each country: over 60% in Nairobi, and over 70% in Zambia’s four cities. In both cases, supermarket chains have the second lowest overall food share of all channels. Second, in both countries the

\textsuperscript{10}Regoverning Markets, 2004; personal interview with Mr. Willie Minnie, Procurement Manager for Freshmark Zambia (September 2005); Reardon and Berdegue, 2002; Reardon and Timmer, 2006.

\textsuperscript{11}Based on a 2% market share by supermarket chains in fresh produce, a 20% share of fresh produce in urban consumer food expenditure, and a 40% share of preferred supplier programs in supermarket chain fresh produce procurement (the rest being purchased in traditional wholesale markets; Neven and Reardon, 2004, for Kenya): 0.02*0.2*0.4 = .0016 = 0.16%.
market share of supermarket chains in fresh produce (fruit and vegetables) is one-third or less their share in staples and dairy; this finding is consistent with early themes in the supermarket literature, which acknowledge fresh produce as a lagging sector in supermarket penetration. Third, Kenya shows greater penetration of the modern sector than Zambia (despite its data being five years earlier), with small and chain supermarkets holding a combined overall food share of 16%, compared to 9% in Zambia. Finally, results from Zambia show that supermarket shares are much higher in fruit (11.1%) than in vegetables (1%). This finding is consistent with the fact that Shoprite popularized new fruits such as apples and suggests that some of their market share may reflect an increase in the range of items and in overall consumer expenditure on fresh produce, rather than solely a capturing of share from other vendors.

Supermarkets in both countries remain heavily reliant on upper income consumers for their sales (Tables 4 and 5). In Zambia in 2007/08, two-thirds of all food sales in supermarket chains were to the top 20% of the income distribution, with the bottom 60% accounting for only 12% of sales. In both countries, even the top 20% of earners spend between twice as much (Kenya) and more than three times as much (Zambia) in traditional shops, markets, and informal locales as they do in supermarket chains.

Table 2. Market share of various retail channels by food group, Nairobi, 2003

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Supermarket Chains</th>
<th>Small supermarket</th>
<th>Duka/shop</th>
<th>Open Market</th>
<th>Kiosk</th>
<th>Butchery</th>
<th>Other minor outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staples</td>
<td>21.0</td>
<td>12.9</td>
<td>49.5</td>
<td>6.4</td>
<td>8.1</td>
<td>0.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Dairy</td>
<td>13.9</td>
<td>2.1</td>
<td>55.4</td>
<td>0.0</td>
<td>10.8</td>
<td>0.0</td>
<td>17.8</td>
</tr>
<tr>
<td>Meat</td>
<td>3.9</td>
<td>0.4</td>
<td>8.9</td>
<td>11.5</td>
<td>3.9</td>
<td>68.4</td>
<td>3.1</td>
</tr>
<tr>
<td>Fresh Fruit &amp; Veg.</td>
<td>4.4</td>
<td>0.3</td>
<td>0.7</td>
<td>56.4</td>
<td>35.7</td>
<td>0.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Overall</td>
<td>11.5</td>
<td>4.8</td>
<td>28.7</td>
<td>18.7</td>
<td>14.3</td>
<td>16.7</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Source: Tegemeo Institute/MSU Urban Household Survey, 2003

Table 3. Market share of various retail channels by food group, four cities of Zambia, 2007/08

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Super-market Chains</th>
<th>Indep. Super-markets &amp; Mini-marts</th>
<th>Grocers</th>
<th>Open Market</th>
<th>Ka Sector</th>
<th>Butchery</th>
<th>Other minor outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staples</td>
<td>8.8</td>
<td>2.2</td>
<td>43.8</td>
<td>17.7</td>
<td>22.0</td>
<td>0.2</td>
<td>5.3</td>
</tr>
<tr>
<td>Dairy</td>
<td>19.6</td>
<td>4.1</td>
<td>38.7</td>
<td>7.8</td>
<td>23.4</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Meat</td>
<td>7.1</td>
<td>1.6</td>
<td>5.2</td>
<td>37.8</td>
<td>12.8</td>
<td>28.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Fresh Vegetables</td>
<td>1.0</td>
<td>0.8</td>
<td>0.4</td>
<td>67.6</td>
<td>27.9</td>
<td>0.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Fresh Fruit</td>
<td>11.1</td>
<td>1.9</td>
<td>0.9</td>
<td>55.7</td>
<td>28.1</td>
<td>0.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Fresh Fruit &amp; Veg</td>
<td>3.1</td>
<td>1.1</td>
<td>0.5</td>
<td>65.5</td>
<td>27.6</td>
<td>0.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Pulses</td>
<td>3.2</td>
<td>1.2</td>
<td>5.3</td>
<td>74.6</td>
<td>13.7</td>
<td>0.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Other</td>
<td>6.7</td>
<td>1.6</td>
<td>29.9</td>
<td>17.6</td>
<td>26.3</td>
<td>0.0</td>
<td>17.9</td>
</tr>
<tr>
<td>Overall</td>
<td>7.3</td>
<td>1.8</td>
<td>21.8</td>
<td>31.2</td>
<td>21.7</td>
<td>7.3</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Source: Central Statistical Office/FSRP/MSU Urban Household Consumption Survey, 2007/08
Table 4. Overall food market share of various retail channels by quintile of per capita total income, Nairobi, November 2003

<table>
<thead>
<tr>
<th>Per capita income quintile</th>
<th>Mean per capita income (USD)</th>
<th>Market Outlet</th>
<th>Super-market Chains</th>
<th>Small Super-markets</th>
<th>Duka/shop</th>
<th>Open Market</th>
<th>Kiosk</th>
<th>Butchery</th>
<th>Other minor outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (lowest)</td>
<td>96</td>
<td>2.5</td>
<td>4.0</td>
<td>33.9</td>
<td>20.6</td>
<td>19.6</td>
<td>12.0</td>
<td>7.4</td>
<td>7.4</td>
</tr>
<tr>
<td>2</td>
<td>249</td>
<td>6.4</td>
<td>5.0</td>
<td>33.0</td>
<td>17.4</td>
<td>15.0</td>
<td>16.2</td>
<td>7.0</td>
<td>7.0</td>
</tr>
<tr>
<td>3</td>
<td>436</td>
<td>2.8</td>
<td>5.7</td>
<td>34.7</td>
<td>21.6</td>
<td>13.4</td>
<td>15.9</td>
<td>6.0</td>
<td>6.0</td>
</tr>
<tr>
<td>4</td>
<td>774</td>
<td>9.0</td>
<td>4.3</td>
<td>30.0</td>
<td>19.8</td>
<td>15.0</td>
<td>18.3</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>5 (highest)</td>
<td>3,593</td>
<td>25.7</td>
<td>4.9</td>
<td>19.0</td>
<td>15.7</td>
<td>12.0</td>
<td>18.1</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Overall</td>
<td>1,027</td>
<td>11.5</td>
<td>4.8</td>
<td>28.7</td>
<td>18.7</td>
<td>14.3</td>
<td>16.7</td>
<td>5.4</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Source: Tegemeo Institute/MSU Urban Household Survey, 2003

Table 5. Overall food market share of various retail channels by quintile of per capita total expenditure, four cities of Zambia, 2007/08

<table>
<thead>
<tr>
<th>Per capita expenditure quintile</th>
<th>Mean per capita expenditure (USD)</th>
<th>Market Outlet</th>
<th>Super-market Chains</th>
<th>Indep. Super-markets &amp; Mini-marts</th>
<th>Grocers</th>
<th>Open Market</th>
<th>Ka Sector</th>
<th>Butchery</th>
<th>Other minor outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (lowest)</td>
<td>256</td>
<td>0.8</td>
<td>0.1</td>
<td>21.7</td>
<td>36.6</td>
<td>29.9</td>
<td>3.2</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>437</td>
<td>1.3</td>
<td>0.3</td>
<td>23.4</td>
<td>35.7</td>
<td>26.5</td>
<td>6.2</td>
<td>6.6</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>638</td>
<td>2.7</td>
<td>0.6</td>
<td>23.5</td>
<td>36.2</td>
<td>21.7</td>
<td>7.2</td>
<td>8.1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>974</td>
<td>6.4</td>
<td>1.9</td>
<td>22.8</td>
<td>30.0</td>
<td>21.0</td>
<td>8.2</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td>5 (highest)</td>
<td>2,582</td>
<td>17.1</td>
<td>4.1</td>
<td>19.0</td>
<td>23.7</td>
<td>15.6</td>
<td>9.3</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>977</td>
<td>7.2</td>
<td>1.8</td>
<td>21.9</td>
<td>31.2</td>
<td>21.6</td>
<td>7.4</td>
<td>9.0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Central Statistical Office/FSRP/MSU Urban Household Consumption Survey, 2007/08

Consistent with other literature on the topic, shares are substantially lower and reliance on high-income consumers is greater in fresh produce than in overall food (Tables 6 and 7). In both countries, open-air markets and informal vendors together hold about a 92% market share in fresh produce, with supermarket chains at 3-4%. In Zambia, over 75% of all fresh produce sales by supermarket chains were to the upper 20% of the income distribution, while the bottom 60% accounted for 8%; in Kenya, nearly 100% of fresh produce sales by chains were to the upper fifth of the income distribution.

Table 6. Fresh produce market share of various retail channels by quintile of per capita total income, Nairobi, November 2003

<table>
<thead>
<tr>
<th>Total Per capita income quintile</th>
<th>Mean per capita income (USD)</th>
<th>Market Outlet</th>
<th>Super-market Chains</th>
<th>Small Supermarkets</th>
<th>Duka/shop</th>
<th>Open Market</th>
<th>Kiosk</th>
<th>Butchery</th>
<th>Other minor outlets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (lowest)</td>
<td>96</td>
<td>0.0%</td>
<td>0.1%</td>
<td>0.2%</td>
<td>53.3</td>
<td>42.9</td>
<td>0.0%</td>
<td>3.6%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>249</td>
<td>0.0%</td>
<td>0.4%</td>
<td>1.3%</td>
<td>56.7</td>
<td>38.0</td>
<td>0.0%</td>
<td>3.6%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>436</td>
<td>0.0%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>64.3</td>
<td>33.9</td>
<td>0.0%</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>774</td>
<td>1.0%</td>
<td>0.1%</td>
<td>0.3%</td>
<td>59.3</td>
<td>38.3</td>
<td>0.0%</td>
<td>1.0%</td>
<td></td>
</tr>
<tr>
<td>5 (highest)</td>
<td>3,593</td>
<td>14.9%</td>
<td>0.1%</td>
<td>1.3%</td>
<td>48.9</td>
<td>30.8</td>
<td>0.0%</td>
<td>4.0%</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1,027</td>
<td>4.4%</td>
<td>0.3%</td>
<td>0.7%</td>
<td>56.4</td>
<td>35.7</td>
<td>0.0%</td>
<td>2.6%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Tegemeo Institute/MSU Urban Household Survey, 2003
Table 7. Fresh produce market share of various retail channels by quintile of per capita total expenditure, four cities of Zambia, 2007/08

<table>
<thead>
<tr>
<th>Total per capita expenditure quintile</th>
<th>Mean total per capita expenditure (USD)</th>
<th>Market Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Supermarket Chains</td>
</tr>
<tr>
<td>1 (lowest)</td>
<td>256</td>
<td>0.4</td>
</tr>
<tr>
<td>2</td>
<td>437</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>638</td>
<td>0.7</td>
</tr>
<tr>
<td>4</td>
<td>974</td>
<td>2.2</td>
</tr>
<tr>
<td>5 (highest)</td>
<td>2,582</td>
<td>9.1</td>
</tr>
<tr>
<td>Overall</td>
<td>977</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Source: Central Statistical Office/ FSRP/MSU Urban Household Consumption Survey, 2007/08

Regression analysis of the factors influencing the probability of purchasing an item in a supermarket chain delivers very similar results across the two countries and helps shed light on the reasons for the chains’ low market shares. Controlling for household income, (which we expect to positively influence the likelihood of shopping in a supermarket chain), we expect the following:

- Owning motorized transport and a refrigerator will both increase the likelihood of such shopping due to the lesser locational convenience of supermarkets; each of these assets facilitates making fewer shopping trips and buying greater quantities each time;

- Because the vast majority of urban dwellers in Africa do not have their own motorized transport, distance to the various types of retail outlets will have an important influence on which outlets are chosen;

- More educated households will prefer supermarket chains due to greater cleanliness and convenience;

- Younger household heads will prefer supermarkets due to greater openness to new behaviors; and

- Processed food items are more likely to be purchased in supermarkets than unprocessed foods, one reason for which would be supermarkets’ ability to negotiate attractive prices with large-scale processors.

We cannot form a priori expectations regarding female-headed households nor the size of the household. Female-headed households may prefer the cleanliness of supermarket chains, but may also put a greater premium on the locational convenience of markets and informal vendors, due to greater pressure on their time. Larger households may value the large purchases that can be made in supermarkets, but may also find it more difficult to accurately plan their needs and so value the locational convenience of the traditional sector. We also cannot form a priori expectations regarding the effect of city size (a variable we have in Zambia, because the survey was done in four cities). Larger cities can be expected to be the focus of most intense investment by supermarket chains and to have more high-income consumers to support them. Yet locational convenience might be greater in geographically smaller cities that have one or two outlets.

In each country, we run a probit model predicting whether a household purchased a specific food item primarily in a supermarket chain over the past 30 days, controlling for general food category and for the income, asset, demographic, and distance to market characteristics discussed above12. We also control for city in Zambia. Meat other than chicken is the excluded food category in each country. We separate chicken from other meat because production of the former is industrialized earlier in the development process and so may lend itself more to marketing through supermarket chains. In Zambia, we distinguish between processed and unprocessed

---

12Results are very similar when the dependent variable is defined to include smaller independent supermarkets.
staples and dairy, under the expectation that processed items are more likely to be purchased in supermarkets than unprocessed items.

Marginal effects are presented in Table 8. Results show that, in both countries, income, owning a car, owning a refrigerator, and having a more educated household head all positively influence the likelihood of shopping in a supermarket chain. All these results were expected. Results in both countries also show that households headed by a female are more likely to use supermarket chains. Larger households are less likely to use a supermarket in Zambia, but this effect is insignificant in Kenya. The only statistically significant result that differs across the countries regards the age of the household head: families with younger heads are more likely (as hypothesized) to use a supermarket chain in Zambia, but less likely to do so in Kenya. Overall, these results generally agree with those of Neven et al. (2005) in Kenya, highlighting the importance of income, education, and the ability to shop less frequently as drivers of supermarkets use.\textsuperscript{13} This analysis also strengthens findings from earlier research by showing (in Zambia) that, for a given food category, processed items are more likely than unprocessed items to be purchased in a supermarket.

Two results from the Zambia analysis are new and potentially noteworthy. First, supermarket chains may have more difficulty gaining market share in large urban centers than in smaller towns. Lusaka is the largest city in the sample, followed in order by Kitwe, Kasama, and Mansa (the excluded dummy); each city dummy has a negative and significant marginal effect, with the absolute value of these effects monotonically increasing with city size. To our knowledge, this is a new finding, the robustness, drivers, and implications of which deserve further investigation.

Second, even after controlling for other factors, distance to various retail outlets in Zambia has an important influence on choice of outlet. Two findings are particularly important here. First, proximity to a supermarket chain is a more important determinant of shopping in such a chain than is proximity to other outlets in shopping in them; the marginal effect for distance to a supermarket chain is double that of the next largest outlet type. Second, the results highlight the key competitive advantage that informal vendors (the “ka sector” in Zambia) have in being able to locate close to buyers: the marginal effect for the ka sector, while half that of supermarket chains, is three times that of distance to the main public market, and five times that of distance to small grocers. This is the first analysis of which we are aware that analytically demonstrates the importance of locational convenience in consumer shopping decisions.

Summarizing, results in Kenya and Zambia – the two SSA countries outside South Africa with the greatest supermarket penetration to date – strongly support the more cautious view outlined above regarding supermarket expansion on the continent. Overall food shares of supermarket chains remain relatively low, shares for fresh produce are even lower, sales depend heavily on upper income consumers, and motorized transport, access to refrigeration, and locational convenience are key determinants of use. While it is likely that supermarket shares will grow across the continent over time, and while this growth may at some point be rapid in selected countries, the overall rate of growth is likely to be much slower than was once expected in some circles; this is especially so for fresh produce, the food category where supermarkets’ transformational potential was most highly anticipated. This means that the so-called “traditional” marketing system is likely to remain the dominant center of fresh produce marketing across the continent for several decades.

This finding has profound policy implications. Specifically, it suggests that private investment in modern, integrated supply chains cannot be relied upon to solve the multitude of problems – logistical inefficiencies, deteriorating infrastructure, high product wastage, urban congestion and food safety concerns – that increasingly plague traditional production and marketing systems over a time frame acceptable to most policy makers and donors. Moreover, Africa’s high rate of urban population growth means that a rapidly rising share of the population will be subject to these problems over time (see the section, “Drivers of Change”, below). Public engagement (not to say full public funding) will be central to any improvement in these areas. This public engagement must be based on a solid understanding of these systems, including the broad similarities they share and, crucially, the differences among them that can be the source of learning to improve performance. We now turn to an assessment of what is known about these systems, an identification of key knowledge gaps and, finally, an outline of a research and investment agenda to address the festering problems in these traditional marketing systems.

\textsuperscript{13}Neven finds car ownership insignificant, unlike our results.
Table 8. Marginal effects from probit predicting purchase of specific food items in supermarket chains in Kenya and Zambia

<table>
<thead>
<tr>
<th>Variable</th>
<th>Zambia (N=128,640; Pseudo Rsq=0.24)</th>
<th>Kenya (N=9,381, Pseudo Rsq=0.36)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dy/dx</td>
<td>Std. Err.</td>
</tr>
<tr>
<td>HH per capita income</td>
<td>0.0004</td>
<td>0.0001</td>
</tr>
<tr>
<td>HH Demographics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH size</td>
<td>-0.0013</td>
<td>0.0002</td>
</tr>
<tr>
<td>Education of HH head</td>
<td>0.0028</td>
<td>0.0002</td>
</tr>
<tr>
<td>Age of HH head</td>
<td>-0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>HH is female headed</td>
<td>0.0119</td>
<td>0.0013</td>
</tr>
<tr>
<td>HH Assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HH owns a bicycle</td>
<td>0.0004</td>
<td>0.0009</td>
</tr>
<tr>
<td>HH owns a motorcycle</td>
<td>0.0007</td>
<td>0.0030</td>
</tr>
<tr>
<td>HH owns a car</td>
<td>0.0232</td>
<td>0.0018</td>
</tr>
<tr>
<td>HH owns a refrigerator</td>
<td>0.0247</td>
<td>0.0014</td>
</tr>
<tr>
<td>Food Categories</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processed staples</td>
<td>0.0313</td>
<td>0.0032</td>
</tr>
<tr>
<td>Processed dairy</td>
<td>0.1287</td>
<td>0.0111</td>
</tr>
<tr>
<td>Chicken</td>
<td>0.0179</td>
<td>0.0043</td>
</tr>
<tr>
<td>Irish Potato</td>
<td>0.0099</td>
<td>0.0064</td>
</tr>
<tr>
<td>Vegetables</td>
<td>-0.0182</td>
<td>0.0010</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.0067</td>
<td>0.0021</td>
</tr>
<tr>
<td>Pulses</td>
<td>-0.0040</td>
<td>0.0017</td>
</tr>
<tr>
<td>Other processed food items</td>
<td>0.0180</td>
<td>0.0019</td>
</tr>
<tr>
<td>Other food items</td>
<td>-0.0121</td>
<td>0.0014</td>
</tr>
<tr>
<td>Distance to Markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to main public market</td>
<td>0.0003</td>
<td>0.0001</td>
</tr>
<tr>
<td>Distance to informal vendors (ka)</td>
<td>0.0010</td>
<td>0.0004</td>
</tr>
<tr>
<td>Distance to small grocers</td>
<td>0.0002</td>
<td>0.0001</td>
</tr>
<tr>
<td>Distance to supermarket chain</td>
<td>-0.0021</td>
<td>0.0002</td>
</tr>
<tr>
<td>Distance to other market outlets</td>
<td>-0.0001</td>
<td>0.0000</td>
</tr>
<tr>
<td>City Sizes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lusaka (largest city)</td>
<td>-0.0326</td>
<td>0.0017</td>
</tr>
<tr>
<td>Kitwe</td>
<td>-0.0103</td>
<td>0.0008</td>
</tr>
<tr>
<td>Kasama</td>
<td>-0.0055</td>
<td>0.0007</td>
</tr>
<tr>
<td>Mansa (smallest city; excluded)</td>
<td>------</td>
<td>------</td>
</tr>
</tbody>
</table>

*** significant at 0.01; ** significant at 0.05; * significant at 0.10

Dependent variable: 1=item was purchased in a supermarket chain, 0=item was purchased in a different channel
Current status of horticultural systems in sub-Saharan Africa

Horticulture is an exceptionally broad topic. Yet if we focus on the production and marketing of fresh produce in SSA, strong common patterns emerge out of this diversity. Smallholder farmers dominate production and marketing in most countries, but a very small share of these farmers account for the vast majority of marketed output. Data in Zambia and Kenya show that well under 10% of farmers provide upwards of 80% of all marketed fresh produce; this pattern is almost certainly repeated throughout the continent.

Production by these smallholder farmers is heavily dependent on purchased seeds, fertilizers, crop protection chemicals, and irrigation. Yet availability, cost and knowledge of how to use these inputs constitute major barriers to participation by most farmers; these constraints also limit the yields and profits earned by those that do participate. Credit constraints to access inputs and equipment are a special problem for smallholders. Public sector research and extension capacity is exceptionally limited in most countries and so has made minimal contributions to improved farmer cultural practices that could increase yields and quality. Indeed, yield improvements in fruits and vegetables have been lower than in cereals, and productivity growth has been particularly low in SSA, where yields in vegetables have grown at an average annual rate of 0.6% compared to 0.7% for cereals and the world average of 1.4% between 1961 and 2004 (Weinberger and Lumpkin, 2005).

Uneven genetic quality and poor phytosanitary status of seeds is a fundamental limit to yield growth and stability in these regions. Most countries see very limited adaptive research to produce or select varieties suitable for the agro-climatic and input-limited production environments found in most of SSA. Due to deficiencies in seed production, processing technology, quality assurance, or management supervision, locally produced seeds (of both indigenous and exotic crops) are often contaminated by seed-transmitted pests and diseases, and are genetically diverse. The lack of proper storage facilities often leads to low or uncertain seed viability and vigor.

Production and marketing risks, driven by the production constraints identified above, the perishability of many of these crops, and inadequacies in post-harvest management (see below) also hinder participation by many farmers. Heavy and unpredictable pest pressure, unreliable rainfall, the possibility of substantial post-harvest losses, and enormous price variability (linked to poor information flows and lack of coordination along the supply chain) create opportunities for high returns to farmers who are able to control their production environment and provide steady supplies to the market – and for large losses for those unable to do so.

As discussed above, modern wholesale and retail sectors are growing in the region, but the so-called “traditional” marketing sector, especially open-air (wholesale and retail) markets and an array of informal retail vendors outside of marketplaces, continues to carry more than 90% of domestically marketed fresh produce in nearly all countries. Like India, the modern retail sector in most countries of the region faces the 20/20/20 challenge: retail sales through these channels will have to grow 20% per year in real terms for 20 years for these modern sectors to reach a 20% market share. As a result, for several decades in most countries, and longer in the poorest countries, improved performance in the traditional production and marketing system will remain tremendously important for income growth and equity objectives.

With some exceptions, the public marketplaces at the center of these traditional marketing systems have become physically overwhelmed and managerially dysfunctional over the past 30 years. Physical capacity has not kept up with rapid urban population growth, resulting in unplanned and often chaotic decentralization of trade; wholesaling has often spread into existing retail markets without any new physical investment, while retailing has expanded into streets and informal marketplaces. As a result, traffic congestion and lack of sanitation have become major economic and public health concerns, and conflict with city authorities, residents and other businesses has escalated.

“Soft infrastructure” is also inadequate in these markets: formal market information and grades and standards are typically absent or nascent, and active coordination upstream with farmers to regulate the flow of produce to the market is the exception rather than the rule. These inadequacies lead to enormous day-to-day – and even within day – price swings, with unexpected price collapses being a special problem (Mwiinga, 2009). Meanwhile, the risky production environment discussed above, and the more limited geographical space over which markets can draw their supply (due to lack of cold chains and frequently poor roads) lead to sharp and less predictable patterns of seasonal price variability.
Ineffective public management of public markets has often been a key contributor to this decline. While new managerial approaches featuring greater collaboration between public and private sectors are emerging, these face major obstacles in the form of outdated laws that limit private sector involvement, rent seeking by city authorities loath to give up revenue from fees levied on traders, and pervasive mistrust between public officials and traders. Some also claim that “strong-arm” tactics by brokers and even organized criminal gangs also add costs to the system in some countries.

The modern horticultural export sector has grown substantially in some countries over the past two to three decades, but even where such growth has been the most impressive, the volume of produce flowing through domestic and regional markets far surpasses that in modern export channels. For example, the ratio of the farm gate value of fresh produce sold into domestic and regional markets in Kenya to fresh produce exported through modern channels was between five and six in 2003 (Tschirley et al., 2004a); in Zambia, which in the early 2000s had a growing export sector, the ratio is at least 20:1 (Hichaambwa and Tschirley, 2006). Even in Mexico, with one of the largest horticultural export sectors in the world, the domestic system is about twice as large (USAID, 2005). Furthermore, quality and health standards and demands for reliability of supply are substantially higher in western markets than in local and regional markets. As a result, and despite sometimes more than a decade of donor and government support for smallholder involvement, farm production for export is dominated by large commercial farmers to a much greater extent than is production for local and regional markets, where smallholders typically predominate (Diaz Rios and Jaffee, 2009; Asfaw, Mithofer and Waibel, 2009; Graffham and MacGregor, 2009; Graffham, Karehu and MacGregor, 2009; Humphrey, 2009).

Finally, government policy has substantial but mostly indirect effects on the sector. Direct government intervention in production, marketing or pricing is rare, unlike the widespread direct intervention seen in cereals markets. Key areas where government policy affects the fresh produce sector include (i) legal frameworks for the establishment and management of markets that often hinder active private sector engagement and contribute to the progressive decline of public marketplaces, (ii) land policies that make it difficult for potential private investors in marketplaces to obtain the land needed for such investments, (iii) seed regulations that often emphasize policing over facilitation of innovation and thus inhibit the development and dissemination of new varieties through mechanisms such as Community Based Seed Production (Muendo and Tschirley, 2004), (iv) neglect of grades and standards that could raise quality over time and improve price predictability for farmers, (v) weak chemical regulations that allow internationally banned chemicals to be used by farmers frequently unaware of their negative environmental or health effects, and (vi) cumbersome procedures for the formalization of businesses, which contribute to the propagation of numerous small-scale informal food trading businesses.

Drivers of change

The conditions identified above are not static. We identify four trends that will have major effects on African economies over the next two decades and briefly highlight how they will affect fresh produce systems. First, urban population is growing rapidly. Africa has the highest urban growth rate of any developing area, currently 3.7% per year and projected to remain above 3% through 2030. Urban population will grow about 170% over the next 30 years, far outstripping rural growth and pushing the urban population share above 50% (World Urbanization Prospects, 2007). In the past, rapid urban growth has been associated with explosive growth of low-income urban settlements, which are served by the informal marketing sector. We see no reason to expect this pattern to change over the medium term. These patterns pose major challenges and also offer great opportunities to modernize African food systems.

A second trend is that SSA achieved GDP growth of 4.3% per year from 2000 to 2005, implying a per capita income growth rate of about 2%. Agricultural GDP grew faster in SSA, at 3.8%, than in any other developing area except the Middle East and North Africa. Because many fresh produce commodities have high income elasticities of demand and provide broad opportunities for value added (through processing or “ready to eat” packaging), continued per capita income growth, combined with rising populations, could fuel increases in demand for fresh produce of more than 5% per year on the continent; growth would be even higher in urban areas, due to the urbanization trends discussed above.
Third, the cost of communications is falling and its reach is improving dramatically. Africa has the highest rate of growth of cell phone ownership, with the number of phones growing from 15 million in 2000 to 160 million by the end of 2006 (ITU, 2007). Increasing competition among providers is leading to reduced calling costs, further broadening ownership and leading to the emergence of services such as mobile banking. SMS, because of its very low cost, is becoming an important channel for financial transactions and marketing information. These trends are not limited to urban areas: in Kenya, over half of a representative sample of rural smallholder farmers surveyed in 2007 owned at least one cell phone; one-quarter of all smallholder farm families in Zambia in 2008 owned a phone and an additional 44% had access to one; three-quarters of farmers selling fresh produce in Lusaka’s main wholesale market in 2007 owned a cell phone and nearly 100% had access to one. More recently, services such as M-pesa in Kenya have emerged that allow low-cost, secure, and instantaneous transfers of funds through SMS messaging. A farmer can communicate with a trader and receive payment for his product through an SMS, then go to one of the rapidly growing number of outlets at which he can convert the SMS message into cash. Growth rates in the use of these services are likely to be extremely high, especially among commercialized farmers and traders, promising further reductions in the cost of exchange.

These numbers make it clear that cell phones now present a huge, still growing, and largely unexploited opportunity to improve timely access to technical production and marketing information for farmers and directly facilitate trade, even in the poorest countries of the world [see Aker (2009) for evidence from Niger]. Such improvements will dramatically reduce search (including time) and other transactions costs for all farmers, regardless of the crop they grow, and the perishable nature of most fresh produce means that the payoff to farmers in this sector should be especially large.

Finally, the recent explosion in petroleum prices and their subsequent collapse in the face of the worldwide financial and economic crises may portend a period of substantially greater uncertainty regarding the price of petroleum. If this proves to be the case, it will likely be reflected in greater variability in the price and availability of inorganic fertilizers and pest control chemicals; farmers operating in already weak input supply systems in developing countries may see their access to these items become even more uneven. Because fresh produce production is so reliant on fertilizer and chemicals, these trends could have especially negative effects in this sector. If energy prices begin to rise again, the scope for horticultural exports could be reduced and the relative competitiveness of air vs. sea freight would be affected, with associated implications for competitive advantage across countries in this market. All in all, the international export market looks to be an increasingly complex arena in which smallholder farmers have few competitive advantages.

Knowledge gaps

The discussion above highlights robust but very broad similarities in fresh produce production and marketing systems across the continent. These patterns are an important foundation for understanding these systems, but likely hide a great deal of variation across countries and across supply chains within countries. Quantifying that variation – developing a quantitative comparative assessment of the structure and performance of these systems across a representative set of countries and crops – holds one key to identifying investments that may improve performance. We identify below five areas where such quantitative benchmarking is needed.

Farm-level production and marketing patterns

We know a great deal about the structure of production and marketing of food staples like maize in SSA. For example, in Zambia large-scale commercial farmers account for approximately one-third of total production, but about half of the marketed surplus (Haggblade, Longabaugh and Tschirley, forthcoming). Within the smallholder sector, about 2% of farmers account for 50% of marketed production. Smallholders are more dominant in Mozambique, but patterns within that sector are similar to Zambia, with about 5% of farmers accounting for 70% of marketed production (Tschirley, Abdula and Weber, 2005).

Fresh produce is considered by many to hold great promise for land-constrained smallholder farmers to commercialize into higher value crops, due to the very high values that can be produced per unit area of land. Yet there are reasons to expect

---

14 All calculations for Kenya and Zambia are by author from, respectively, the Tegemeo Institute/MSU panel data set in Kenya, the Central Statistical Office/MSU Supplemental Survey panel data set in Zambia, and from the MSU fresh produce wholesale price and quantity data set in Lusaka, Zambia.
that the structure of marketing of these crops may be even more concentrated than for food staples, due to high input costs, poor access to credit, high perishability, great price risk, and a resulting need for greater technical knowledge in order to be successful. For example, typical smallholder farmers producing vegetables for the market in Zambia may use 5-10 different crop protection chemicals and 4-6 different types of fertilizer on a field. Total costs for these chemicals and fertilizers on typical cropped areas can exceed US$ 1,000. Additional costs include piecework labor, transport, fuel for running pumps, and amortization of pumps, irrigation pipes, animal traction equipment, and other needed equipment. These costs constitute a major barrier for many smallholder farmers.

The number of different chemicals and fertilizers used highlights the complexity of the production process and the need for solid technical knowledge. Meanwhile, the great majority of African governments provide almost no extension assistance for such crops, meaning that farmers have to piece together what knowledge they can from neighbors and input dealers. Documenting the impact of these characteristics on the actual structure of production and marketing of the major fresh produce crops in SSA is the starting point for devising approaches to enhance smallholder access to these potentially very profitable markets.

**Price behavior and information flows throughout the supply chain**

Comparison of price levels across countries, especially in relation to import and export parity prices, is a standard feature in the assessment of food staple systems. Examination of the level and trends in gross margins is also common. This kind of comparative knowledge is largely lacking in fresh produce systems. In part this discrepancy is due to the greater tradability and storability of food staples. Yet fresh produce is traded regionally in Africa, so that comparison of price levels and spatial margins across neighbors becomes important. Gross margin analysis for major crops across a range of countries would provide an important benchmark to then examine the reasons for differential performance. Price variability and predictability are also measurable performance dimensions that influence consumer and producer welfare and should be strongly correlated with the level of development of the production and marketing system (Mwiinga, 2009).

The behavior of these variables is strongly related to the adequacy and efficiency of information flows in the supply chain. A signal feature of effective fresh produce wholesale markets is that they are strongly linked backwards to the farm level and forwards to retailers through information flows. Traders or brokers in the market are in constant contact with farmers and buyers, packaging and quality standards are clear and adhered to, farmers have a good sense of what price they will receive when they take produce to the market (and of what they would receive in alternative markets), and traders/brokers have a good grasp of the quantities they are likely to receive on a given day and what they will be able to sell. Fluctuations in physical arrivals do occur and can drive sharp price adjustments, but extreme day-to-day price changes (e.g., of more than 20%) are the exception (Mwiinga, 2009).

While much of this communication takes place through private, informal communications, timely public availability of information on prices and quantities moving through markets is an important complement to these private communications. For example, brokers operating in South Africa’s national network of fresh produce wholesale markets have access to real-time information on transacted quantities and prices throughout the day, and daily average prices and total quantities for all grades of all products are posted on the web at the end of each day. North of the Limpopo, this type of active coordination from market to farm appears to be much less developed, and real-time information on prices and quantities is nearly always lacking. Little is known about what information farmers and traders do have, about how level the information playing field is, and about what the payoff would be from improved, real-time marketing information.

Price determination, and especially the role of brokers, is another key issue in this area. Many wholesale markets feature brokered transactions rather than transfer of ownership between “first sellers”¹⁵ and wholesalers. This brokering activity frequently becomes a focus of suspicion among farmers and smaller traders, who often believe that brokers under-report their sales price, so that the actual cost to the first seller is greater than the official commission they pay to the broker. Impacted information is simultaneously a serious constraint to good research in this area and an indicator that such research is needed.

¹⁵By “first seller” we mean anyone arriving at the wholesale market with product to sell; typically these are farmers or rural assembly traders.
Wholesale market logistics
Wholesaling facilities for fresh produce on the continent range from South Africa’s national system of modern wholesale markets with strong linkages down to the farm level, to more rudimentary but updated marketplaces, and from markets that were once adequate but have failed to keep pace with rising urban populations (e.g., Wakulima market in Nairobi), to woefully inadequate locations offering almost no hard or soft infrastructure to facilitate efficient and safe wholesale trade (e.g., Soweto market in Zambia). Assessing the benefits of upgrading existing facilities, building new facilities, and promoting coordination down to the farm level requires a range of system-wide information, but needs to start with a common set of metrics regarding the performance of these marketplaces. These include measures of time and other costs for sellers and buyers, gross throughput and value added per unit area (and per unit investment) in the market, product wastage (including the typical magnitude of price decline over the course of a day, required to find a market for poor quality produce), and gross margins within the wholesale markets themselves (in many cases this involves the difficult task of quantifying formal and informal brokerage fees within these markets).

Wholesale and retail market ownership and management
Though exceptions exist, formal wholesale and retail markets in Africa are most often owned and managed by municipal authorities, with oversight from ministries of local government. Too often, relationships between the traders using the markets and these public sector authorities are confrontational. Fee structures are often not well defined, fee collection is a source of conflict, use of the funds is not transparent, and there is often little if any evidence of meaningful investment of the funds into market improvements or even basic upkeep such as trash collection. As a result, many markets have become physically overwhelmed and sources of major concern about urban congestion and public health. Innovative efforts led by private investors to build new, formally recognized wholesale markets, such as the Kasarani effort outside Nairobi in which the City Council granted 100 acres of land to potential investors, have foundered on disagreements with municipal authorities about public and private roles in ownership and management.

Yet the unplanned decentralization of markets noted above in the section on horticultural systems driven by the dysfunction too often seen in formal marketplaces, has led to a greater variety of ownership and management structures, typically with much more private sector control. Documenting what these structures are, how they emerged, and linking measurable performance indicators to them could begin to provide insights as to how this often chaotic decentralization of trade can be turned to advantage in institutionalizing more effective ownership and management structures.

Towards a research and investment agenda to improve fresh produce supply chains in Africa
This review has argued that production and marketing systems for fresh produce in Africa are unlikely to be transformed within an acceptable time frame by private investment in modern, integrated supply chains. Public engagement is crucial to prevent the severe problems in these systems from becoming much worse in the face of rapidly growing urban populations. Experience in the rest of the world suggests that the right public policies, by catalyzing collaborative investment by government, donors, and private sector, could turn fresh produce systems into major sources of rural growth through direct production and downstream linkages in value added. In this final section we outline several areas that present major opportunities, and highlight the constraints that will need to be overcome and the research that needs to be done in each area.

Improved information throughout the supply chain
The first opportunity stems from identifying ways to use the expanding ownership and falling costs of communication through mobile phones to bring a wide array of timely information to farmers and traders to improve supply chain performance. Recent research has demonstrated large improvements in market efficiency after the introduction of cell phones through their effect on reducing the cost of information needed for spatial arbitrage (Jensen, 2007; Aker, 2008). These improvements did not require public or donor investment: private cell phone providers invested in the systems and traders (few farmers in these cases) used the phones to search more widely and quickly for price information through their own private contacts. The challenge now, especially in light of the vast expansion of cell phone ownership among smallholder farmers over the past five years, is to find ways, when possible through public/private collaboration, to broaden the scope of information provided in this way. Examples abound:

• An SMS-based system in Zambia automatically provides callers with bid price and contact information for a range
of food staples in markets across the country – the system is low cost because buyers see it in their own interest to provide this information free of charge;

- An SMS system in Sri Lanka provides gherkin farmers with daily information on amount and reasons for rejection of produce in the market so that they can take immediate action on their own farms to avoid the problem [typically related to insect infestation (de Silva and Ratnadiwakara, 2005)]; and

- Another project in Sri Lanka aims to reduce information search costs throughout fresh produce supply chains through use of SMS, e-bulletin boards, price reporting screens in markets, and links with banks and extension services (de Silva and Ratnadiwakara, 2005).

Examples of additional information that could be provided include: input prices and availability (including seed, fertilizer, chemicals, credit, and irrigation and other equipment); early warning on pest outbreaks, including best response options; technical information on recommended seeds and inputs, with the latter being conditional on specific types of production problems (this would apply especially to pest control chemicals); and including health and environmental warnings on plant protection chemicals. The key constraints to exploiting this opportunity lay in conceiving the most useful information, generating it in a sustainable fashion, and packaging it in the most effective combination of SMS, bulletin board, radio, Internet and other dissemination channels. Literacy will also be a constraint in rural Africa. Work is underway by some NGOs to use SMS itself to promote functional literacy for these purposes (Jenny Aker, pers. comm.); learning from this and other initiatives for best approaches to scaling-up needs to be a top priority.

Two points should be kept in mind as efforts move ahead to capitalize on opportunities opened up by ICT. First, the spectrum of information available through SMS systems is likely to be substantially narrower than that on local and provincial radio. Second, despite their growing adoption, issues of literacy and cost mean that cell phones are not likely for some time to be able to reach as many farmers as local and provincial radio broadcast in the local language. For these reasons, Weber et al. (2006) stress that modern ICT tools should be used, but that radio is likely to remain for some time the most effective means of “providing broad-based unbiased information to help improve the bargaining power of farmers...and in informing public decision makers about how markets function...”.

**Improved production environments**

Improving production environments starts with improved crop varieties that promise larger, more diverse and more reliable harvests. Realizing this promise then requires broader access to seed and other inputs, improved technical knowledge among farmers, and improved phytosanitary seed quality.

**Improved germplasm** – There is a critical need for genetic resources and quality seeds adapted to the developing world production environments where many inputs, including fertilizers and water, are limited (Chrispeels and Sadava, 2003). Simple screening of existing germplasm will be essential, both for performance under local conditions and management practices, and for potential under local conditions with (eventual) improved management. Yet there is also a need to develop new varieties, whether through traditional breeding or molecular techniques, both of which require considerable technical horticultural expertise.

The overwhelming importance of “exotic” species, such as tomato, onion, cabbage and kale, in African diets and production systems, and the very low yields of these crops compared to worldwide norms, means that improved yields in these crops will have the largest and most immediate positive effect on farmer incomes and consumer purchasing power. Yet indigenous vegetables such as African eggplant, amaranth, nightshades and others contribute to food and livelihood security for many resource-poor farmers (Cavendish, 2000; Weinberger and Msuya, 2004), have seen considerable recent growth in some countries (albeit from a very low base in terms of marketed output), and represent genetic resources and biodiversity that need to be assessed and conserved for the future (National Research Council, 2006; National Research Council, 2008).

**Broader access to seeds and other inputs** – Improved germplasm will do no good if farmers cannot reliably access it. It is also true that many varieties adapted to low input environments will do better with the application of fertilizers and plant protection chemicals. Post-harvest quality is also heavily influenced by farmers’ ability to control pests during the production process. Improving access to seeds and other inputs requires improved credit systems, policy reform to promote private input sector development, and innovative approaches...
to seed propagation and dissemination, such as community based seed production and other small-scale seed supply micro-enterprises [learning from experience in Tanzania and elsewhere; see Muendo and Tschirley (2004)].

Improved information also has a crucial role to play in improved access to credit and physical inputs. Information systems that reduce the cost to farmers of determining availability and comparing prices of inputs will lead to greater input use and higher yields; SMS-based cell phone systems are one promising approach.

**Improved technical knowledge among farmers** – Use of ICT to improve information on price and availability of inputs would represent a small, albeit important extension of the more common emerging use of such technology to improve information on output prices and quantities. Using the full range of ICT, including mobile phones, to improve technical information for farmers will require substantially more innovative approaches. The potential payoff to such approaches is high, because most African governments do not now and will not in the near future have the human or financial resources to operate conventional extension systems for fresh produce. Action research linked to experimental programmatic initiatives in this area, conducted in collaboration with farmer and trader organizations and input dealers, should thus be accorded high priority in future research and programmatic initiatives.

Feeding these systems with reliable information requires developing new, situation-specific information on agro-ecologies, sustainable production, resource management and cropping systems, especially for environments where inputs are limited, soils are poor or existing production practices have degraded or compromised current and future crop productivity. In addition to integrated water and nutrient management, integrated pest management (IPM) is very desirable for two reasons: (i) the presence of pesticide residues has significant trade implications, and (ii) fruit and vegetable production activities are the largest users of plant protection products per hectare, and the smallholder farmers involved in this production (or poor laborers working on larger farms) rarely use protective clothing and have little knowledge of environmental risks (such as the killing crucial pollinators). Improved knowledge on proper water management approaches in dry areas is also a priority.

**Improved hard infrastructure linked to better management models and improved coordination**

Rising incomes and rapidly growing urban populations in Africa mean that the already deplorable state of many marketplaces on the continent will become even worse if the accumulated deficit in hard marketing infrastructure – primarily wholesale and some retail markets with associated improvements in roads – is not confronted with urgency. Yet the planning and construction of new markets, if not informed by solid supply chain research and carried out in a framework that ensures input from a broad range of farmers, traders and end-users, can result in expensive new facilities that are little used and thus do little to improve system performance.

Several points therefore need to be kept in mind as attempts are made to address the accumulated hard infrastructure deficit. First, the private sector needs to be actively engaged in the process. In some cases, private investors may be able to take the lead, with only ancillary contributions by government, e.g., making publically owned land available in a suitable location and undertaking related improvements in road access. Most often, efforts will need to proceed on the basis of public/private partnerships. Second, making a public/private partnership live up to its name will often require modifications to existing legal frameworks and accompanying attitudes. Legislation in Africa frequently gives primacy to municipal authorities in the ownership and management of marketplaces; over time, the revenues from market fees have become important for city budgets and also the focus of rent seeking by some city officials. Conflict has become endemic, funds have not been reinvested in the marketplaces, and the cleanliness and efficiency of marketplaces has suffered. Finding ways to break out of this dysfunctional managerial relationship is imperative. Learning from successful examples (e.g., South Africa’s national system of fresh produce wholesale markets) should be one important element in this effort.

Third, improvements in services – primarily in the amount, quality, and flow of information throughout the system – need to be conceived jointly with the hard infrastructure. This starts with the provision of real-time information on transacted prices and quantities. Grades and standards developed in collaboration with the trade will improve the quality of this information and so deserve early attention. Traders often recognize differing qualities within some broad category of “standard quality”
produce, so capturing this (informally) recognized heterogeneity in the form of quality grades and incorporating them into reporting of market prices and quantities can be an effective way to make progress in this area. Moving beyond prices and quantities, real-time feedback to farmers on observed quality problems in the market (which can vary markedly over the season based on pest outbreaks on the farm) and technical solutions at the farm and post-harvest levels can be exceptionally useful. This kind of information properly originates in a wholesale market, which is where prices – and discounts for quality problems – are formed.

Finally, the public/private stakeholder groups that hopefully form the core of planning efforts in this area need to prioritize investment at the wholesale level. Typically retail markets receive most attention, due to their often chaotic expansion and replication in residential areas combined with the explosion in many cities of street vendors. These are legitimate and important issues, but cannot be resolved without improvements in the wholesale markets on which all these traders depend.

References


Growth in high-value export markets in sub-Saharan Africa and its development implications

Miet Maertens

Abstract
During the past decades the global food system changed dramatically with increased trade in high-value food products, increased exports from developing countries, increased consolidation and dominance of large multinational food companies, and increased proliferation of public and private food standards. As a consequence, global food trade is increasingly organized around vertically coordinated supply chains rather than around spot market transactions. While there is consensus that these structural changes are profoundly changing the way food is produced and traded, there is no consensus on the overall welfare implications of increased high-value food exports and supply chain restructuring in poor countries. In this paper we discuss the income and poverty implications of expanded horticulture exports and changing supply chain structures for rural households in Sub-Saharan African exporting countries. We put together the economic arguments, distinguish different channels through which rural households are affected, provide evidence from three comparative case studies on high-value horticulture exports, and derive implications for policy makers, private investors, and the development aid community.

Introduction
During the past couple of decades the integration of poor countries in global agricultural markets accelerated with increased food exports originating from developing countries. At the same time, there have been important structural changes in global agri-food markets. The structure of world food trade, and especially of developing countries’ exports, has changed dramatically with traditional tropical export products (such as coffee, cocoa, and tea) losing importance and non-traditional high-value commodities (such as horticulture and seafood products) gaining importance. In addition, food trade is increasingly consolidated with large multinational food companies (such as retail chains and processing companies) increasingly dominating global agri-food chains. Moreover, food standards (including, for example, food quality and safety standards) have been increasing very sharply and global agri-food trade is increasingly regulated through public as well as private standards.

These structural changes have had important effects on the agri-food systems of developing countries, especially in dynamic high-value export sectors such as horticulture. High food standards and foreign investments in developing countries’ food sectors have induced increasing levels of vertical coordination in the food chains of these countries, with important implications for smallholder farmers and rural households.

While there is consensus that the structural changes in global food supply chains are profoundly changing the way food is produced and traded in developing countries, there is no consensus on the overall welfare implications of these changes. Integration of developing countries in global markets is generally believed to stimulate economic growth in these countries but there is much less consensus on the impact of trade on income inequality and poverty (Dollar and Kraay, 2002 and 2004; Winters et al., 2004). There are different views on the effects of increased agri-food exports in terms of local-level development, rural income mobility and poverty reduction. On the one hand, stimulating agri-food exports, especially high-value exports, has been promoted as a pro-poor development strategy because of the direct link the sector has with the rural economy (e.g., Aksoy and Beghin, 2005; Anderson and Martin, 2005; Carter et al., 1996; World Bank, 2008). On the other hand increased globalization and the structural changes in global agri-food markets have been argued to be detrimental for global poverty reduction. The main concern is that because of increasing public and private food standards, increasing consolidation in global food markets and foreign direct investment (FDI) in the agri-food sectors of developing countries, smallholder farmers become increasingly marginalized in high-value export chains, either because they are excluded as primary producers in the chains or because they are exploited by large, often multinational, food companies (e.g., Weatherspoon et al., 2003; McCulloch and Ota, 2002; Dolan and Humphrey, 2000; Key and Runsten, 1999; Farina et al., 2005; Farina and Reardon, 2000; Reardon et al., 1999). The arguments are subject to debate and empirical studies — including case-studies from different sub-Saharan African (SSA) countries — have come to diverse conclusions about the effects of increased agri-food trade and structural changes in global agri-food markets on rural incomes and poverty.

1Division of Agricultural and Food Economics, Department of Earth and Environmental Sciences, K. U. Leuven, Belgium. Corresponding author (Miet.Maertens@ees.kuleuven.be)
In this paper we put together the arguments and empirical case-study evidence on how developing countries’ food systems have altered in response to the recent structural changes in global agri-food markets and what the implications have been for rural incomes and rural poverty reduction. The paper is structured as follows: In the next section we briefly discuss the recent structural changes that have been taking place in global agri-food markets. Following that we analyse in particular the developments in Sub-Saharan African export markets and discuss the implications for the governance structure of food supply chains. We then discuss the channels through which local households benefit from recent expansions in export markets and put together empirical case-study evidence that quantifies some of the effects. Finally, we draw some conclusions and discuss the implications of the findings in this paper for private investment priorities, donor strategies and government policies.

**Structural changes in global agri-food markets**

During the past couple of decades, global food and agricultural markets have experienced rapid structural changes. First, the structure of agri-food trade has changed significantly over the past couple of decades with non-traditional, high-value exports gaining importance and traditional tropical export products losing importance. Second, food multinationals increasingly dominate international food chains. Third, food standards have increased sharply since the mid-1990s. Fourth, these changes have had important implications for the way global food supply chains are governed. In this section we consecutively discuss each of these recent structural changes in global food markets.

**Changing structure of world agri-food trade**

World trade in food and agricultural products is increasing and has more than tripled during the past two decades; from US$ 220 billion in 1985 to US$ 720 billion in 2005 (Figure 1). Exports of high-value products – defined here as including fruits, vegetables, fish, seafood, meat and dairy products with a relatively high per unit or per weight value as compared to more bulky primary such commodities as cereals, coffee and cocoa – have been increasing even more rapidly. Their importance in total global agri-food exports has increased by 10 points, from 34% in 1985 to 44% in 2005.

---

1 Developing countries include all low- and middle-income countries in Africa, Central America, South America and the Caribbean; East Asia, South Asia, Southeast Asia and Central Asia.
have become the main export sector, constituting respectively 43% and 38% of total food exports from these regions (Figure 3). In Sub-Saharan Africa, the importance of high-value exports is slightly lower, constituting 30% of total exports, and traditional tropical exports still constitute the largest part of SSA agri-food exports. However, the shift towards high-value exports in the past decades has been most dramatic here. The importance of traditional tropical exports in total agri-food exports has decreased from 68% in 1985 to 46% in 2005, while the share of high-value exports more than doubled, from 14% in 1985 to 30.4% in 2005 (Figure 4). These are important changes for a region where many countries have for decades been heavily dependent on one or just a few export commodities.

Increased consolidation in food processing and retail
In the past decades global food supply chains have become increasingly concentrated, with large food companies and multinational firms dominating the chains. This is most apparent at the level of food retailing. The so-called “supermarket revolution” first emerged in industrial countries, where the food distribution sector is becoming increasingly concentrated around a few large super- and hypermarket chains. For example, in European countries the five-firm concentration ratio in food retail is particularly high, above 60% in many countries, reflecting the dominance of large retail chains (Figure 5).

More recently, this supermarket revolution has taken off in developing countries. Supermarkets have spread rapidly in most of Latin America, East and Southeast Asia and are starting to emerge in Sub-Saharan Africa and South Asia (Gulati et al., 2005; Reardon and Berdegué, 2002; Reardon et al., 2003; Weatherspoon and Reardon, 2003). For example, among Latin American countries, the share of food retailed through supermarkets has been estimated to range from 35% to 75% (Reardon and Berdegué, 2002). Also in Africa, supermarkets have started to emerge and, initially at least, a rapid spread throughout Africa was expected (Weatherspoon and Reardon, 2003). However, recent studies show that the supermarket revolution in Africa is progressing much slower than anticipated in earlier studies and that traditional wet markets will remain dominant in food retail in Africa for many years to come (Humphrey, 2007; Minten, 2008; Tschirley, 2004 and 2011; Traill, 2006).

Food processing consolidation is also taking place. For example, in the case of coffee the share of the five largest processors rose from 21% to 58% between 1995 and 1998, and three multinational trading companies dominate the trading stage. In the case of cocoa, the number of grinders in Europe fell from about 40 in the 1990s to 9 in 2000, and the three largest grinders account for over 50% of the market, with even higher levels of concentration in chocolate manufacturing (UNCTAD, 2005).
Increasing food standards

During the past decade food standards, including public regulations as well as private corporate standards, have increased sharply. Fresh food exports to the EU, for example, have to satisfy a series of stringent public requirements, including marketing standards, labeling requirements, conditions concerning contamination in food, general hygiene rules and traceability requirements. In addition, private standards established by large food companies, supermarket chains and NGOs play an increasingly important role in agri-food trade (Jaffee and Henson, 2005). Such standards increasingly go beyond food quality and safety specifications and include ethical and environmental concerns as well. Although private standards are legally not mandatory, they have become de facto mandatory because a large number of buyers in international food markets now require compliance with, for example, GlobalGAP standards (Henson and Humphrey, 2008).

A number of factors contribute to explaining the increased importance of standards in global food trade. A series of major food safety hazards in high-income countries has increased consumer and public concern about food-borne health risks and created an increased demand of food safety. In addition, rising income levels and changing dietary habits have increased the demand for high quality food. Consumers are also increasingly (made) aware of ethical and environmental aspects related to food production and trade, which has increased the need for specific standards related to these aspects. But in addition the increased trade in fresh food products such as fruits, vegetables, fish, and meat – which are prone to food safety risks and subject to specific quality demands by consumers – have increased the need to regulate trade through standards. Moreover, the increased dominance of supermarkets in food chains also contributes to explaining the increased importance of food standards. Large retail chains put much emphasis on freshness, product quality and food safety as a product differentiation strategy or to reduce food safety risks and the costs related to the risk of selling unsafe food (Henson and Humphrey, 2008).

Governance of global food supply chains

Large multinational food companies increasingly dominate global food supply chains and trade is increasingly regulated through standards set by these private companies or by national, regional and international authorities. This has led to changes in the structure and organization of global food supply chains.

Rather than being based on spot market transactions high-standards food supply chains entail varying levels of vertical coordination at different nodes in the chains. This is apparent in the vertical relationships between supermarkets and their specialized suppliers or food importers. In addition, the changing governance systems in global supply chains result in increased vertical coordination between developing country producers on the one hand, and exporters, food processors and supermarkets in these countries on the other. This is most apparent in the form of contract farming between agro-industrial firms and local primary producers. In the most extreme case, primary production is completely vertically integrated with upstream processing and trading activities.

As we will document in the next sections, the governance system in global food supply chains is crucial in understanding the local welfare implications of increasing high-value and high-standards agri-food exports in developing countries.

High-value export markets in sub-Saharan Africa

Horticulture exports

Exports of high-value and high-quality agricultural produce have been growing rapidly in many developing countries over the past two decades. Horticulture products are playing an especially dominant role in this (Weinberger and Lumpkin, 2005). Also in SSA, the region lagging most in integration in international markets, horticulture exports to high-income regions have almost tripled during the past 15 years, from less than 2 million tons in 1990 to 6 million tons in 2005 (FAOSTAT, 2008). From the early 1990s onwards, horticulture exports from SSA grew sharply and continuously while the export growth of other, more traditional agricultural commodities, such as coffee, sugar and cotton, was much smaller and less persistent (Figure 6). Several SSA countries, including very poor countries such as Ethiopia, Burkina Faso, Cameroon, Kenya, Uganda and Senegal, have become important suppliers of fresh fruits and vegetables to EU markets.
Public and private food standards have often been mentioned as barriers for food exports from developing countries, but it is remarkable that many poor SSA countries experienced accelerated growth in fresh produce exports, mostly to the EU, exactly during a period of sharply increased EU food quality and safety standards. Private standards for horticulture products have been increasing especially sharply. Some private standard-setting bodies and certification schemes have initially focused on fruits and vegetables, for example the EurepGAP standards set by a group of European retailers.

**Supply chain governance**

The growth in high-value agri-food exports from SSA countries has been associated with the spread of so-called modern supply chains in these countries. This modernization in SSA horticulture sectors entails important shifts in production and trade. High-value horticulture supply chains differ substantially from traditional marketing channels in SSA countries. While traditional marketing channels are based on spot market transaction and often involve a large number of buyers and sellers, the high-value horticulture supply chains are largely based on vertical coordination and contract farming, or on complete ownership integration in the most extreme cases. This is important for understanding the overall welfare implications of increased high-value trade and increasing food standards.

**Development impacts**

The recent boom in African – and other developing regions’ – horticulture exports has brought about a broad dispute among academics, policy-makers and the development aid community on the overall welfare impact. Especially in SSA, the region most lagging in poverty reduction, the welfare implications of high-value horticulture trade are a pertinent issue. On the one hand, it is recognized that horticulture products entail an important potential for raising rural incomes and reducing poverty because of their high intrinsic value and labor-intensive production systems (Aksoy and Beghin, 2005; Anderson and Martin, 2005; World Bank, 2008). Many SSA countries therefore pursue the development of horticulture export supply chains as a specific poverty reduction strategy. Also, the World Bank and other international donors have invested heavily in increasing SSA countries’ capacity in horticulture exports based on the belief that this would contribute to poverty reduction.

On the other hand, developing country horticulture exports have been thought to exacerbate existing inequalities while failing to create direct gains for the rural poor. This would be the case because smallholders, and especially the poorest farmers, are either excluded from these high-value supply chains or exploited by large multinational companies (Dolan and Humphrey, 2000; Reardon et al., 1999). Increasing standards are said to result in increased smallholder exclusion from profitable export opportunities because they face financial and other constraints to comply with increasing standards. Vertical coordination and contract farming lead to the exclusion of the poorest households because food companies strive to reduce transaction costs and thus prefer to contract with relatively larger farms. In addition, increased consolidation in food supply chains and the increased power of large supermarket chains and multinational food companies lead to the exploitation of poor farmers who face unequal bargaining power vis-à-vis these companies.

Empirical studies concerning the welfare implications of increasing standards and high-value agri-food trade have come to diverse conclusions (Swinnen, 2007). Some studies have shown positive effects including increased rural incomes and reduced poverty rates (Maertens and Swinnen, 2009; Minten et al., 2007). Other studies have documented lower product prices (Neilson, 2008) and the increased exclusion of smallholders with negative effects on rural incomes (Danielou and Ravry, 2005; Minot and Ngigi, 2004).

To draw general conclusions on the overall welfare implications of the growth in high-value exports, the increase in food standards and the restructuring of food supply chains for rural households in developing countries, it is necessary to distinguish between different types of effects. In fact the growth in high-
value export supply chains has affected rural households in developing countries in two direct ways: through product markets and through labor markets. We discuss these effects in turn.

**Product market effects**

Local farm-households are affected by high-value export growth and the emergence of high-standards supply chains through product markets; more specifically through the production and marketing of high-value produce in contract-farming schemes. There are efficiency and distributional consequences related to these product market effects.

First, the welfare implications of high-value contract-farming schemes depend on whether farmers engaged in these schemes benefit from this. Contract-farming schemes in high-value supply chains usually entail the provision of inputs, credit and farm assistance to farmers by the contractor company. This enhanced access to inputs and credit results in reduced production and marketing risks, improved technology and productivity, and ultimately higher incomes for farmers; which has been empirically demonstrated by various authors (Birthal et al., 2005; Gulati et al., 2007; Minten et al., 2006).

Second, the implications in terms of poverty reduction and rural inequality critically depend on the distributional consequences of contract-farming schemes and the inclusion of the poorest farmers. If the poorest farmers are increasingly excluded from high-value supply chains because of increasing standards and increased vertical integration, then rural inequalities might be aggravated. Many authors argue that this is indeed the case and that companies prefer to contract with larger suppliers because of high transactions costs, the inability of smallholders to produce consistent and large volumes, the constraints smallholders face in complying with increasing standards, etc.

The extent of smallholder exclusion from high-value supply chains is a contentious issue and mainly an empirical question. In horticulture supply chains in SSA countries there is a wide variation in the share of produce that is procured from smallholders. For example the pineapple and banana sectors in Côte d’Ivoire, the vegetable sector in Ghana and Madagascar and the fruit sector in Kenya are largely based on smallholder contract-farming while other sectors rely on procurement from large commercial farms of own integrated estate production (Table 1). Some studies have documented that the share of

<table>
<thead>
<tr>
<th>Country</th>
<th>Commodity (group)</th>
<th>Year of survey</th>
<th>Share of export sourced from smallholders</th>
<th>Number of smallholder producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>Fruits &amp; vegetables</td>
<td>2006</td>
<td>45%</td>
<td>3,600</td>
</tr>
<tr>
<td></td>
<td>Pineapples</td>
<td>2006</td>
<td>10-15%</td>
<td>300 - 400</td>
</tr>
<tr>
<td></td>
<td>Papaya</td>
<td>2006</td>
<td>&lt; 30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetables</td>
<td>2002</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>Pineapple</td>
<td>1997</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mango</td>
<td>2002</td>
<td>&lt; 30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Banana</td>
<td>2002</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Senegal</td>
<td>French beans</td>
<td>2005</td>
<td>52%</td>
<td>600 - 900</td>
</tr>
<tr>
<td></td>
<td>Tomatoes</td>
<td>2006</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>Kenya</td>
<td>Fresh fruit &amp; vegetables</td>
<td>2002</td>
<td>± 50%</td>
<td>12,000 - 80,000</td>
</tr>
<tr>
<td>Madagascar</td>
<td>Fresh vegetables</td>
<td>2004</td>
<td>90-100%</td>
<td>9,000</td>
</tr>
<tr>
<td>Zambia</td>
<td>Vegetables</td>
<td>2003</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>Fruits &amp; vegetables</td>
<td>1998</td>
<td>6%</td>
<td>10</td>
</tr>
</tbody>
</table>

smallholder contract-farming in high-value horticulture supply chains in SSA is decreasing as a result of increasing standards (Dolan and Humphrey, 2000; Danielou and Ravry, 2005). Other studies have shown that among the smallholders it is mainly farmers with more land and non-land assets that are involved in high-value contract-farming while the poorest are excluded (Legge et al., 2006; Maertens and Swinnen, 2008; McCulloch and Ota, 2002; Minot and Ngigi, 2004).

However, the effects of smallholder exclusion in high-standards horticulture supply chains cannot be interpreted without considering the second mechanisms through which rural households are affected; this is through labor markets.

**Labor market effects**

A second mechanism through which rural households are affected by increasing high-value exports is through labor markets. The growth in high-value agri-food exports has been associated with increased employment in agro-industrial firms. Where high-value export supply chains have moved from being based on smallholder contract farming towards agro-industrial estate production, additional employment has been created in the fields of these companies. Moreover, employment has been created in post-harvest processing and the handling of high-value produce as the increasing requirements for sorting, grading, washing, labeling, etc., incorporated in public regulations and private standards have increased the need for labor intensive post-harvest activities.

We document the importance of these labor market effects in the case of SSA horticulture exports in Table 2, showing figures on the number of employees in horticulture agro-industries in several subsectors and countries. The figures show that in many poor SSA countries, thousands of people are employed in the horticulture agro-industry. Part of this employment might concern urban jobs in processing units and packinghouses, but the lion’s share is rural employment. Moreover, a major share of the thousands of employees in the SSA horticulture agro-industry is female.

These employment and labor market effects have received less attention in the empirical literature. Only a handful of studies have actually taken into account labor market effects in the analysis of the welfare implications of high-value export expansion in developing countries. For example, McCulloch and Ota (2002) show that employment in the Kenyan horticulture export industry is especially important for the poor. Barron and Rello (2000) find that the tomato agro-industry in Mexico provides jobs for the rural poor, thereby contributing to rising rural incomes in poverty-struck regions of the country. Weinberger and Lumpkin (2005) discuss the potential of horticulture production for poverty reduction, including effects that come through the creation of employment in these sectors. Also, our own case studies from Senegal, which are discussed in detail below, show the importance of labor market effects.

**Table 2: Employment in sub-Saharan African export horticulture supply chains**

<table>
<thead>
<tr>
<th>Country</th>
<th>Commodity</th>
<th>Year of survey</th>
<th>Number of employees in the FFV agro-industry</th>
<th>Share of female employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameroon</td>
<td>Banana</td>
<td>2003</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>Banana and Pineapple</td>
<td>2002</td>
<td>35,000</td>
<td></td>
</tr>
<tr>
<td>Kenya</td>
<td>Flowers</td>
<td>2002</td>
<td>40,000 - 70,000</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Fruits &amp; vegetables</td>
<td>2002</td>
<td>2,000,000</td>
<td></td>
</tr>
<tr>
<td>Senegal</td>
<td>French beans</td>
<td>2005</td>
<td>12,000</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Cherry tomatoes</td>
<td>2006</td>
<td>3,000</td>
<td>60%</td>
</tr>
<tr>
<td>Uganda</td>
<td>Flowers</td>
<td>1998</td>
<td>3,300</td>
<td>75%</td>
</tr>
<tr>
<td>Zambia</td>
<td>Vegetables</td>
<td>2002/3</td>
<td>7,500</td>
<td>65%</td>
</tr>
<tr>
<td></td>
<td>Flowers</td>
<td>2002/3</td>
<td>2,500</td>
<td>35%</td>
</tr>
<tr>
<td>South Africa</td>
<td>Deciduous fruit</td>
<td>1994</td>
<td>283,000</td>
<td>53%</td>
</tr>
</tbody>
</table>

Comparative case studies

In the remainder of this section we analyze and compare the insights from three original case studies on high-value horticulture exports in SSA countries: the vegetable export sector in Madagascar (from Minten et al., 2008), the bean export sector in Senegal (from Maertens and Swinnen, 2009 and Maertens, 2009), and the tomato export sector in Senegal (from Maertens et al., 2008). The combination of these case studies is particularly relevant because the three studies document the diversity in supply chain responses to increasing standards and the resulting varying levels of vertical coordination in the chains. The governance structure in the supply chains further determines the way rural households benefit from increased exports.

First, the vegetable export sector in Madagascar is dominated by one domestic exporting company that relies 100% on smallholder contracting for procurement of primary produce. In response to increasing standards in overseas markets the company has intensified its contract-farming schemes with smallholders. This has lead to a vertical coordination scheme including almost 10,000 smallholders, often very small farms of less than 1 hectare, in the hillsides of Madagascar. The company relies on an intensive on-farm monitoring system including 300 company agents who regularly visit the contracted farms to provide extension services and technical advice, to monitor adherence to contractual agreements, and to avoid “side-selling”. Moreover, the company supplies inputs on credit at the beginning of the growing season.

Second, in the Senegalese bean export sector increasing standards have induced a shift from smallholder contract farming towards vertically integrated estate production by the exporting companies. It is estimated that smallholder procurement decreased from 95% in 1999 to 52% in 2005. The largest companies in particular changed their procurement systems and started their own integrated estate farms as part of a strategy to become EurepGAP certified.

Third, the Senegalese tomato export sector is dominated by one multinational company that was established and started exporting tomatoes from Senegal to the EU in 2003. The export supply chain are completely vertically integrated. There is no procurement from smallholders, and production, processing, trade and distribution are completely integrated within the subsidiaries of the multinational companies.

Despite the differences in supply chain structure and governance across the sectors, the results of the case studies show that in all three cases there have been positive welfare effects. Yet, the channel through which households benefit differs across the sectors: product market effects are important in the vegetable sector in Madagascar, where 100% of the produce is supplied by smallholders on a contract basis; labor market effects are important in the tomato sector in Senegal where the chain is completely integrated with no procurement from smallholders; and both effects are important in the bean sector in Senegal, where there is a mixed strategy of procurement from contracted smallholders and integrated estate farming.

First, in the case of vegetable exports in Madagascar, rural households benefit substantially from contract farming with the export industry. The vegetables produced under contract contribute 47% of total household income. In addition, through technological spillovers from vegetable contract farming, rice productivity has increased some 64%. The overall result is an increase in rural incomes, an increase in the stability of rural incomes and a reduction in poverty, which is reflected in a reduced “hungry season” for households engaged in vegetable contract farming with the export industry (Figure 7).

Second, the shift from smallholder contract farming towards integrated estate farming observed in the bean export sector in Senegal has also shifted the way local households benefit: increasingly through agro-industrial employment and labor market effects rather than through contract-farming and product market effects. Although both effects result in significantly higher incomes (Figure 8), the shift in supply chain governance has resulted in a stronger poverty alleviating effect of high-value horticulture exports (Figure 9). The case study results show that the poorest households mainly benefit through agro-industrial
employment, while contract farming is biased towards relatively better-off households with more land and non-land assets. Agro-industrial employment is found to benefit rural households directly through increased income from wages, and indirectly because these wages are partially invested in the households’ own farm business, leading to higher outputs and farm incomes.

Third, in the tomato export sector in Senegal rural households only benefited through labor market effects, as there is zero procurement from smallholder farms. This case study also shows that it is mainly the poorest households who benefit from the labor market effects of increased high-value horticulture exports. Households employed in the tomato export industry, either in the fields or in the processing units of the company, have incomes that are more than double the incomes of other households in the region. Initially, before the multinational company started to invest in tomato exports in 2003, they had lower land and non-land asset holdings (Figure 10). Increased tomato exports have resulted in increased employment, increased incomes and ultimately reduced rates of poverty and extreme poverty (Figure 11).

**Conclusion and implications**

The main conclusion of this paper is that increased high-value trade can bring about important positive effects for rural development and poverty reduction. Even with stringent standards, and consolidation and vertical coordination in supply chains, positive welfare implications can be found. Part of these effects comes through product markets, but employment and labor market effects are also important, particularly for the poorest rural households. This implies that strategies to improve the welfare effects of high-value trade need to include strategies
for creating inclusive food supply chains from which smallholders are not completely excluded, as well as strategies for the development and improved performance of rural labor markets.

There is a need to recognize the importance of private investment in agri-food supply chains, supply chain development and vertical coordination in agri-food chains, and for integrating these developments into policy thinking and program strategies. To stimulate the development of modern supply chains, to guarantee the participation of small farmers in the chain, and to assure an equitable distribution of rents in the chain, it is crucial to enable and encourage vertical coordination. In this respect some specific policy issues can be identified.

First, enabling and stimulating supply chain development and modernization of agri-food supply systems requires institutional changes to stimulate innovative vertical coordination schemes and to set the right juridical systems and supporting contract-enforcement mechanisms. Second, probably one of the most essential elements for the integration and development of high-value food supply chains, as well as vertical coordination in those chains, is to encourage private investment – domestic as well as foreign investment – in the agri-food industry through creating the right conditions for investment. Third, this involves ensuring macro-economic stability, attracting FDI in agro-industry, and so forth. In addition, enhancing efficiency and equity in high-value agricultural supply chains is a key point. Participation of poor farmers in the chains and an equitable distribution of the rents in the chains require several key elements. There is need for policies to focus on reducing transaction costs through, for example, investment in intermediary institutions, in infrastructure, and in farmers’ associations. Better empowerment of farmers can also improve their bargaining position in vertically coordinated food supply chains.

The insights from this paper that the poorest households tend to benefit from export market development through labor markets rather than through product markets implies that pro-poor export development strategies should pay attention to labor market and employment conditions as well. These insights have largely been ignored and the analogy with insights from the Green Revolution of the 1960s could be drawn. The Green Revolution triggered major productivity growth and increases in rural incomes in Southeast Asian countries, but was at first believed to benefit richer farmers while marginalizing poorer farmers because of the specific constraints they face in accessing and using Green Revolution inputs. However, David and Otsuka (1994) showed that poorer households did benefit from this technology-driven agricultural development because of labor market effects. The insights from this paper suggest that the same might hold for standards-driven (or supply chain-driven) agricultural development. At the same time, Carter et al. (1996) have argued for exports from Latin America, that poverty effects might strongly depend on the nature of the commodities, with poverty-reducing benefits more likely in labor-intensive rather than land-intensive production systems. Horticulture is generally a labor-intensive sector and the findings discussed in this paper validate the argument that labor-intensive export sectors strongly benefit poverty alleviation.

In this paper we have presented evidence from specific case studies related to success stories of high-value export market development in SSA. However, we need to mention that there is a large variation between countries in both integration in high-value international food markets and in progress relative to structural supply changes and modernization of food supply systems. Participation in high-value agri-food trade can be an engine of pro-poor growth for developing countries, but many countries face challenges in bringing about such export growth. Yet, international competition is moving beyond the capacity of supplying products at market prices. Agricultural products have to comply with food quality and safety requirements while many developing countries have substantial weaknesses in food safety capacity. Increasing the supply capacity for high quality and safe fresh food and creating the capacity to respond quickly to emerging food safety issues, changing legislation and a variety of private standards requires attention to key issues such as improvement in the administrative, technical and scientific capacity for food safety, public-private sector cooperation, farm and business assistance programs, attracting foreign direct investment, and demonstrating a capacity for producing high-standard food through labeling and certification.
References


Value adding and marketing food and horticultural crops in sub-Saharan Africa: Importance, challenges and opportunities

Omo Ohiokpehai1, Umezurike Linus Opara2, Henry Kinyua3, Kiringai Kamau4 and Lusike A. Wasilwa5

Abstract

The agricultural sector (including horticulture) plays a crucial role in the economy of sub-Saharan Africa. The development of agro-industries helps to reduce post-harvest food losses, adds value to products, creates employment opportunities and has many beneficial feedback effects on agriculture. This paper highlights the challenges and opportunities for agro-processing and marketing horticultural crops in the region. Case studies of value adding in sub-Saharan Africa agro-industry are presented using examples of agroprocessing activities in South Africa and Kenya. The agroprocessing and marketing value chain in the region presents a number of challenges and opportunities that can promote wealth creation and employment generation in rural areas. These case studies underscore the need to strengthen institutional support and infrastructure for marketing and value adding in Africa. The enabling policy issues which underpin successful agro-industrialization, including marketing and market infrastructure development, finance and access to micro-credit, enhancing the role of women, and sustainable capacity building are highlighted.

Introduction

The agricultural sector dominates most sub-Saharan African economies in terms of contribution to GDP, employment and income. The growth and development of this sub-sector is therefore essential for the overall process of socio-economic development in the region. The major challenge facing sub-Saharan African agriculture is to feed a population that is rapidly increasing. Von Braun (2008) reported that to bail out Africa from the factors impeding its development, three complementary policy actions must be taken: i) promote pro-poor agricultural growth, ii) reduce market volatility and iii) expand social protection and child nutrition. It is obvious that agriculture and agro-processing have a role to play in the second and third of these policy actions. The bailout of Africa can only be successful if transformation of food and horticultural crops takes place because as agriculture moves away from semi-subsistence farming to a more commercial mode, market chains become longer and the demand for value-added products increases due to urbanization, income growth and need for convenience. Seasonality of production and the perishability of most agricultural products further signify the need for agro-processing in a market-oriented production system. With half of the population living on less than US$1 a day, achieving the Millennium Development Goals (MDGs) will be difficult unless the poor in sub-Saharan Africa are targeted to benefit from the expanding market due to sustained economic growth of at least 6-8% in the next decade. The number of people receiving World Food Programme (WFP) food aid in the region more than doubled from 21.2 million in 1995 to over 43.04 million in 2005.

Agro-processing could be defined as a set of techno-economic activities carried out for conservation and handling of agricultural produce to make it usable as food, feed, fiber, fuel or industrial raw material. Hence, the scope of the agroprocessing industry encompasses all operations from harvest till the material reaches the end user in the desired form, packaging, quantity, quality and price (Figure 1).

A useful classification of agroprocessing industries is based on upstream and downstream industries. Upstream industries are engaged in the initial processing of agricultural commodities. Examples are rice and flour milling, leather tanning, cotton ginning, oil pressing, saw milling and fish canning. Downstream industries undertake further manufacturing operations on intermediate products made from agricultural materials. Examples are bread, biscuit and noodle making, textile spinning and weaving, paper production, clothing and footwear manufacturing, and rubber manufacturing. Agroprocessing plays a number of vital roles beyond income generation. It can reduce the food insecurity of the 1.3 billion people who do not have enough to eat by reducing food losses, increasing the range of food products and making food safe to eat.

The development of agro-industries also has many beneficial feedback effects on agriculture itself. The most direct one is the stimulus it provides for increased agricultural production through market expansion. Indeed, the establishment of
processing facilities is itself an essential first step towards stimulating both consumer demand for the processed product and as well as assuring adequate supply of the raw material. The provision of transport, power and other infrastructure required for agro-industries also benefits agricultural production. The development of these and other industries provides a more favorable atmosphere for technical progress and the acceptance of new ideas in farming itself.

Agroprocessing operations (such as sun-drying) can preserve food for longer than its fresh shelf life and can salvage waste food. For some basic foodstuffs (rice, for example), it is essential that before the food can be eaten it must be de-husked. It can help raise the nutritional value of poor people’s diets and contributes to important cultural practices by providing foods with a more interesting taste than the daily staples. Today, however, it is becoming even more difficult to provide a precise demarcation of what should be considered an agro-industrial activity. The impact of innovation processes and new technologies suggests a widening of the range of agro-industry inputs that could be considered, including biotechnological and synthetic products. Corresponding to this growing complexity of inputs is an increasing range of transformation processes, characterized by physical and chemical alteration aimed at improving the marketability of raw materials according to the final end use. All these factors – the growing complexity of inputs, the impact of innovation processes and new technologies, the sophistication and the growing range of the transformation processes – make it increasingly difficult to draw a clear distinction between what should be considered strictly industry in the broad sense and what can be classified as agro-industry.

Many poor people in sub-Saharan Africa depend on agriculture for a living and it is important that this sector is well funded to enable continuous growth. An assessment of Africa’s productivity potential indicates that only 10% of the land is prime quality, 7% is of high potential and 28% is of medium to low potential.

<table>
<thead>
<tr>
<th>FIGURE 1: AGROPROCESSING VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESEARCH AND DEVELOPMENT</td>
</tr>
<tr>
<td>STAGES 1 &amp; 2 (FARM GATE)</td>
</tr>
<tr>
<td>TECHNOLOGY INDUSTRIES</td>
</tr>
</tbody>
</table>

- Field Crops
- Horticultural Crops
- Livestock
- Forestry
- Fermenting
- Fortification
- Livestock Issues
- Packaging
- Cutting
- Milling
- Molding
- Agriculture
- Agroprocessing
- Bakery & Confectionery
- Fresh, Dried, Canned & Frozen Fruits
- Processed, Dried, Frozen & Canned Vegetable
- Beverages
- Sugar
- Processed, Value Added Meat & Meat Products
- Inputs for Bio Fuel
- Inputs for Chemical

<table>
<thead>
<tr>
<th>LOGISTICS</th>
<th>MACHINERY</th>
<th>QUALITY ASSURANCE AND STANDARDS</th>
<th>INVESTORS</th>
</tr>
</thead>
</table>
The remaining land (55%) is unsuitable for production and is considered to be fragile, easily degraded because of bad management, and in general not productive or does not respond well to soil amendments. To improve food and nutrition security, the prevailing developmental view of agriculture in the region, which focuses mainly on production, must be expanded to include processing. The development of the agro-processing industry (Figure 1) is needed to improve fortification, nutrition and health through better diet. Furthermore, to harness the full potential of agroprocessing there must be a parallel growth of the other sub-sectors in the agribusiness system that includes the input, production, marketing and support sub-systems for maximum profit.

The traditional view in most African countries is for the government to focus first on the agricultural sector in terms of policies, programs and resources, and then shift its emphasis to the industrial sector later when the former has become more efficient. The Food and Agriculture Organization (FAO) considers agroprocessing as a subset of manufacturing that processes raw materials and intermediate products derived from the agricultural sector between harvesting and final use (Gallat, 2007; FAO, 1998). It is also a means to alleviate poverty and address food security. However, special attention must not only be given to policies (and their sustainability) that affect the prices of inputs and outputs to producers, processors and consumers – such as policies regarding taxation, subsidies, direct support and tariffs in the short and the long term – but also to policies that contribute to the creation of an environment suitable for business and investment growth. Access to appropriate technical processes, machinery and equipment, technical inputs and markets must be carefully developed and maintained.

Furthermore, the “production chain” must be a continuum from the raw material producer through to the processor, distributor and buyer, with each link being strengthened and improved in the process through research and development (Figure 1). Cooperative production chains and their administration are a key component in the development of agroprocessing. Furthermore, enterprise and business must be at the heart of poverty eradication, not just aid, trade and debt (Shell Foundation, 2008).

The overall goal of this paper is to highlight the challenges and opportunities for agro-processing and marketing horticultural crops in Sub-Saharan Africa. In the preceding section, we have highlighted the scope for agroprocessing in the region. In the following sections, we provide a general overview of processing as a value-adding in agro-industrial enterprise, and review case studies of value adding in Sub-Saharan Africa agro-industry. Finally, we outline some of the enabling policy issues which underpin successful agro-industrialization, including marketing and market infrastructure development, finance and access to micro-credit, enhancing the role of women in food and agro-industry, and sustainable capacity building.

Case studies of value-adding activities in sub-Saharan Africa agro-industry

Case study 1: Agroprocessing in South Africa
Agroprocessing is well developed in South Africa and contributes about 10% of South Africa’s GDP and it is the third largest manufacturing sector. Agroprocessing is the second most labor-intensive sector and in 2006 provided exports valued at up to 23 billion Rand (~US$ 2.5 billion) (Department of Trade and Industry-DTI, 2006). Fruit and wine are the largest export products by volume and value. There are many food-processing companies and the top 10 are responsible for about 70% of the industry’s turnover. These top 10 companies include: Nestlé, National Brands, Premier Foods Nabisco, and Unifoods/Best Foods; five of these food companies are listed on the South Africa Stock Exchange – AVI Ltd., Tiger Brands, Illovo Sugar Ltd., Toongat-Hullet Group and All Joy Foods Ltd. There are also smaller food companies that show strong potential, which produce health beverages, indigenous teas, traditional and exotic meats, dried fruit products, nuts, fruit juices, etc. In the case of South Africa, all food companies receive support (incentives) from DTI.

Case study 2: Agroprocessing in Kenya
Various factors may constrain the ability of small-scale enterprises to effectively manufacture and market processed food products. On a macro level, many policies hinder the development of small-scale industries. At the firm level, limited access to credit, lack of appropriate technologies, unreliable supply of raw materials, poor managerial skills and poor quality control constrain the development of small-scale industries. Although crops may be produced throughout the year in Kenya, they tend to be available only part of the year (Muhammad and Kiilu, 2004). Moreover, they are perishable commodities whose shelf life depends on how they are handled after harvest. Technologies to extend shelf life (or storage) or processing to increase availability during the year will be beneficial (Wasilwa,
Agricultural exports and recently surpassed tea and coffee to become the largest merchandise export. Kenya is the second largest horticultural exporter in the region (after South Africa) and the second largest developing country supplier of vegetables to the European Union (after Morocco). Approximately 135,000 people are now directly employed in the sector. Processing in Kenya is undertaken on a large scale by 23 horticultural processing factories or on a small scale at the community level (Mungai et al., 2000). Most processed horticultural products in Kenya are targeted for the export market. Very few processors process food products for the local market, such as jams, juices and sauces. High post-harvest loss of fruit and vegetables is a problem, particularly during periods of glut (Muhammad and Kiilu, 2004). While it is important to process for the export market, it is also important to process for the local market (Mungai et al., 2000). An example of a success story in the horticulture business is Sunripe Ltd. Founded by the Shah family and its partners in 1969 to market vegetables, Sunripe Ltd. is one of a half dozen family companies that have played a major role in Kenya’s growing horticultural industry. It now supplies over 17 countries annually. Sales growth has averaged about 20% annually over the last 15 years, reaching US$ 13 million in 2003. The company employs 1,200 full-time and 1,000 part-time workers. In addition to large farm suppliers, it buys from about 1,000 smallholders, including many women, predominantly through contract farming.

Horticultural processing – Horticulture contributes directly to the Kenyan GDP and indirectly through linkages with other sectors. It accounts for 50-80% of rural employment, and a significant amount of export earnings and annual government revenue. However, development of horticultural value addition has been hindered by several structural and institutional deficiencies in the Kenyan economy. Some of the challenges facing value addition initiatives include high and multiple taxes that have hindered the establishment of value addition ventures for primary commodities. This constrained entry, and the concomitant high cost of doing business, make products from Kenya uncompetitive in regional and international markets. The resultant high prices hinder expansion of local consumption that would support value addition. Factors that limit growth include poor infrastructure, such as roads, electricity, water and telecommunications.

The agricultural marketing information system (for prices and related to market entry requirements) is poorly organized, leading to cyclical supply of produce and territorial disparity in prices and availability of farm produce. The formal banking
system has not developed credit facilities suitable to small-scale agroprocessing enterprises. Due to frequent droughts (most crops are grown under rain-fed conditions), supply of primary commodities as raw material to agroprocessors is not stable. High costs of production are attributed to the high cost of transport, labor, energy, inputs and poor infrastructure. Often high costs of inputs constrain optimal utilization and encourage their adulteration for cheap sales, leading to reduced productivity. High costs thus reduce competitiveness of products produced in Kenya in regional and international markets.

Summary
The challenges facing the horticulture processing sub-sector include competition from other exporters, low yields and inaccessibility to new varieties, low quality produce, poor infrastructure, lack of development and investment, lack of adequate market promotion abroad, and regulatory constraints (local council fees and charges, export licenses, quality inspection and standards), duty/VAT remission scheme and cumbersome procedures of issuing necessary forms and other certificates of origin (Mungai et al., 2000). Manufacturing plants in Kenya that process horticultural produce are either small or micro-enterprises. Although many products could be processed from horticultural produce, only a few are processed in Kenya, which could be attributed to lack of demand for processed products in the local market. The majority of Kenyans prefer fresh horticultural produce. If demand for processed foods were high, entrepreneurs would source the appropriate technologies to process them. The lack of appropriate technologies for processing horticultural produce leads to the processing of inferior products that are also poorly packaged. Problems encountered by these enterprises include lack of markets for processed products in Kenya, poor adaptation of borrowed technology, poor infrastructure, poor storage facilities, lack of electricity, lack of skilled labor in processing, lack of technical support services (especially in quality control and marketing), and the lack of affordable credit.

Strategies recommended to improve this sector include: increasing the quality of production; market and product diversification/added value; judicious use of pesticides/protection of the environment; adhering to codes of conduct and practices; using alternative (cheaper) means of transport to reach a wider clientele; providing support to horticultural research; addressing adverse publicity, and providing support to small-scale producers. The private sector (local processors) should be encouraged to invest in modern processing technologies for horticultural produce, particularly for fresh fruit juices. Locally fabricated modern equipment that cheaply preserves raw materials to avoid fluctuation in supply would be advantageous. To stimulate a vibrant processing industry, Kenya should encourage production in all areas of the country to meet food needs, export and create employment, and develop efficient rural production and marketing systems through the private sector and local authorities. There is an urgent need to encourage contracted local production and marketing arrangements to reduce waste and maintain a fair return to farmers, as well as encourage financial institutions to make credit available to farmers. Farmers need to be trained to improve yields by adopting appropriate technologies and maintaining quality. Steps need to be taken to ensure the protection of the environment and safe use of chemicals, encourage investments in modern technology through duty exemption on equipment and inputs (such as greenhouses, shed netting, PVC, cold storage and soluble fertilizers), and encourage sea-freighting of less perishable produce to widen clientele overseas.

Case study 3: Post-harvest handling of horticultural crops in Tanzania
The post-harvest sector in Tanzania is crucial to ensuring food security. A large part of the country’s food supply is produced under rain-fed conditions, which means that there is one major harvest that has to meet the food needs of both the urban and rural areas throughout the year. Fruit and vegetables not only provide nutritional and healthy foods, but also generate considerable cash income for growers in Tanzania. Utilizing improved post-harvest practices often results in reduced fruit and vegetable losses, improved overall quality and safety, and higher profits for growers and retailers.

A wide range of fruits and vegetables are produced in Tanzania, including mangoes, bananas, oranges, avocados, peaches, papaya, passion fruit, lemon, pineapples, watermelon, plums, peas, tomatoes, cabbage, carrot, eggplant, okra, onions, amaranth and many others (Prof. Linus Opara, pers. comm.). Most of these crops are produced on small-scale farms and orchards, and in specific areas of the country. Anecdotal evidence suggests that post-harvest losses of fruits and vegetables can be very high during the peak season, and losses may occur at any point in the marketing process, from the initial harvest through assembly and distribution to the
final consumer. The lack of proper transportation and storage structures are considered to be major causes of post-harvest losses. Although there is no definitive data on the magnitude of losses in the agri-food sector, policy experts, consultants, farmers, and marketers in the country agree that the level of losses and quality degradation is unacceptably high at all links in the value chain. It is suggested, that “overcoming technological bottlenecks and sustaining the rural environment and biodiversity” and “investments in marketing infrastructure and storage” are essential (Tibaijuka, 1996). Sokoine University of Agriculture (SUA), the University of Dar es Salaam, and the Ministry of Agriculture in Tanzania have tried to reduce these bottlenecks under a development assistance project entitled: “To increase the quality, supply, and profitability of the fresh fruit and vegetable industry in Tanzania by improving post-harvest handling practices for fresh fruit and vegetables.” The approach was to introduce appropriate total quality management procedures and practices through the implementation of a series of in-country training programs, developed in collaboration with local agribusinesses, farmers and extension agents involved in the supply of fresh produce to local and international markets.

Improvements to post-harvest handling systems have the potential to i) improve the quality of produce available on the local market; ii) increase the opportunities for developing international markets; iii) reduce losses and thereby reduce urban organic waste disposal problems; iv) increase the quantity of edible products available to urban markets; v) increase the cash return/profit to growers/farmers; and vi) stimulate the development small and medium enterprises (SMEs) which provide such support services as packaging, storage, transport and logistics, printing and labeling, advertising, quality control, and information systems.

A survey of wholesalers and retailers at the Kariorkor Central Market showed a high incidence of post-harvest losses in quantity (physical wastage) and quality downgrading affecting all major types of produce. The reported magnitude of physical losses ranged between 0-33% for fruits and 0.4-35% for vegetables, while quality loss (downgrading) affected 0.5-60% of the total quantity of vegetables and 5-80% of fruits traded. Most of the losses occurred during the peak harvest period.

A high incidence of post-harvest losses was also reported by supermarkets and street vendors. One supermarket (Shoppers’ Plaza) reported fresh produce losses ranging from 16% for onions, 20-30% for bananas and mangoes, 30-40% for oranges, and 50% for tomatoes. These losses were attributed mainly to inadequate cool chain management. Street vendors are important suppliers of fresh produce in selected middle class parts of Dar es Salaam, such as the suburbs where government ministries and staff residential quarters are located. The average amount of losses reported by these fruit and vegetable vendors ranged from 10-25% of the total quantity purchased from wholesalers. According to one experienced vendor, “If I buy 50 pineapples during the week, I usually dump about 10 fruits because they spoil before I can sell them”.

Observations at supermarkets and street vendors kiosks showed that the application of simple and innovative post-harvest handling and packaging technologies (such as grading and modified atmosphere packaging) appear to reduce losses as well as enable the traders to sell their products at much higher prices (and presumably profits!). For instance, shrink-wrapped lettuce was sold at a 25% higher price compared to that which was not shrink-wrapped, while the price of shrink-wrapped “English” cucumbers was about 180% higher than that of unwrapped local varieties.

Packaging is vital in successful post-harvest handling, processing and marketing of agri-foods and raw materials (Rossi and Ohiokpehai, 2006). The functions of packaging include:

1) Protection of the produce against physical damage and adverse environmental conditions, which may lead to contamination and spoilage;

2) Containment of the produce in desired units (small, medium, large) to facilitate handling;

3) Communication to inform, advertise and educate the end-user about the product; and

4) Retail display during marketing, for example, the use of retail display trays in fresh fruit marketing.

These functions highlight the importance of packaging as a value-adding activity in fresh horticultural produce supply chain management. For instance, communication through labeling allows the end-user to know the origin or source of the produce, and increasingly, many consumers are willing to pay a premium for fresh produce from certain geographical locations or that has been produced using specific methods, such as organic versus conventional. Similarly, packing produce in a wide range
of container sizes allows the marketer to meet the needs of a broader range of end-users such as individuals, families and restaurants.

Types of packaging commonly used in the horticultural supply chain include jute bags, cardboard boxes, and plastic or wooden crates. The use of new innovative and emerging packaging for fresh produce, such as modified atmosphere packaging (MAP) to extend shelf life and maintain quality, is practised in a few countries like South Africa for high-value, top-end markets. The selection of appropriate packaging depends on several factors, including type of produce, intended end-user, type of existing handling system, and cost.

Successful deployment of innovative packaging in horticultural produce marketing in sub-Saharan Africa is exemplified by the farmers’ cooperative in Lushoto, Tanga (Tanzania). Over the years, farmers have primarily sold their produce to middlemen in the local markets at very low prices. When some farmers came together and formed a cooperative that was facilitated by the local government, one of the obstacles they faced when their produce arrived in Dar es Salaam was the high incidence of physical damage, which resulted in downgrading and lower prices. Fresh produce, such as tomatoes, cabbage, apples, pears, plums and oranges, were packed in big sacks (usually > 50 kg) and literally thrown into the back of trucks and transported to the Central Market in Dar es Salaam. When they used wooden or plastic containers, it cost the farmers a lot of money to return the re-usable containers to Lushoto. To reduce losses and improve their returns, the cooperative invested in “collapsible” plastic crates. During an in-country training workshop conducted by Dr Linus Opara and his colleagues, the farmers reported significant reductions in the incidence of physical damage and losses during transportation, as well as higher returns, in part due to reductions in total transport costs because the collapsible containers occupied less space on their way back from Dar es Salaam to Lushoto.

Case study 4: Cassava processing in Nigeria

Cassava (Manihot esculenta), is one of the most widely grown food crops in the tropics and provides livelihoods for over 500 million people. In the past three decades considerable progress has been made through research towards promoting increased cultivation of cassava. Today Nigeria is the world leader in the production of cassava (IFPRI, 2008), due to the intervention and interest of the government to promote this staple countrywide. Cassava has great potential as a major food security crop for countries in sub-Saharan Africa, but this has been hampered by its poor nutritional and food safety quality. It is also a highly perishable root and can deteriorate within two or three days after harvesting. Sweet varieties of cassava may be consumed directly but bitter varieties, due to their toxicity, are traditionally processed into a wide variety of products with different local names. Cassava has very high starch content, typically 65-70% (Dziedzoave et al., 2007). Research shows it is an excellent raw material for various industries, including the manufacture of convenience food that can be sold to the urban middle class in supermarkets and restaurants. But the roots deteriorate quickly and the traditional processing methods often produce poor products. It was therefore not popular as an industrial raw material in eastern and southern Africa. This situation has now changed through adaptation of innovative techniques developed through research for the transformation of cassava into high-value and shelf-stable primary industrial raw materials that attract premium prices. The adaptive technology transfer project aimed at integrating high-quality cassava products like cassava flour and chips into the processing industry in Mozambique, Tanzania, Uganda and Zambia.

One of the technologies adapted to rural communities to improve farmers’ livelihoods is the rapid conversion of freshly harvested cassava roots into dry flour with a virtually unlimited shelf life. The technology employed involves the separation of the starch granules from the tuber in as pure a form as possible. The granules are locked in cells together with all the other constituents of the protoplasm (proteins, soluble carbohydrates, fats and so on), which can only be removed by a purification process in the watery phase. Processing the starch can therefore be divided into the following stages:

1) Preparation and extraction – Crushing of the cells and separation of the granules from other insoluble matter (i.e., adhering dirt and cell-wall material) including the preparatory operations of washing and peeling the roots, rasping them, and straining the pulp with the addition of water.

2) Purification – Substitution of pure water for the aqueous solution surrounding the starch granules in the mash obtained in the first stage, as well as the operations of sedimentation and the washing of the starch in tanks and on flour tables, silting, centrifuging, and so on.
3) **Removal of water by centrifuging and drying.**

4) **Finishing** – Grinding, bolting and other finishing operations.

**Starch production** – This method of processing is essential in the preparation of any kind of starch. For cassava, however, because of the relatively small amount of secondary substances, the separation at each stage is performed with great ease. Whereas with maize and other cereals the grinding of the seed and the mechanical separation of the germ and the pericarp from the grain present special problems in stage 1, and the separation of protein and other constituents in stage 2 can only be accomplished with the aid of chemicals, these operations can be reduced to a minimum in cassava preparation. It is indeed possible to obtain first-rate flour from the cassava root without special equipment by using only pure water. This makes the processing of cassava flour particularly suitable for rural industries. This technology is easy to adopt by farmers.

**Gari production** – In west and central Africa, cassava is often processed to produce gari (a gelatinized, granular fermented flour commonly eaten as a staple or snack). Its good storage ability and its acceptance as a convenience food have led to the growing popularity of gari in urban areas across the rest of Africa and among many immigrants from this region around the world. Consequently, exports of gari from West Africa to Europe and North America have steadily increased in recent years.

The traditional production of gari involves peeling, grating, fermenting at ambient temperature and pressing, sieving and roasting (garification). Fermentation is said to be responsible for the flavor of gari and also improves the product’s quality, hygiene and safety. It also contributes to cassava detoxification, especially in the case of un-grated cassava. Cassava roots are very rich in carbohydrate and are an excellent source of energy. However, the nutritional value of cassava is poor because of the lack of protein and vitamin A. Various attempts have been made in the past to increase the nutritional value of gari by fortification of the cassava with soybean or palm oil. The results have been limited as a result of various problems associated with the fermentation process.

**Case study 5: Processing of field crops**

**Soybean processing and nutrition promotion** – Soybean contains about 40% protein and 20% oil. Soybean is both food and a source of nutrition that can support human wellbeing. The soybean promotion project at CIAT-TSBF addresses the utilization of soybeans through sustainable and participatory capacity building in soybean processing, nutrition, hygiene and sanitation, basic business management and mentoring in its processing to act as an incentive to boost production of soybeans at the grass-root levels (Ohiokpehai and Kingolla, 2007).

Adequate and appropriate nutrition, which can be achieved through the consumption of a balanced healthy diet (consisting of locally available foods and fortified food and/or micronutrient supplementation when needed), is vital for the health and wellbeing of all individuals (regardless of HIV status). Nutritional support helps to maintain the immune system and to sustain healthy levels of physical activity. The provision of access to know-how, technologies and credit is the key to enhancing women’s opportunities, and hence our position in industry and the economy. Upgrading women’s technological capabilities and enhancing their entrepreneurial and business skills, whether in simple artisanal production or in high-technology industries, will enable them to advance to more rewarding positions in the food industry.

In the case of the soybean promotion, the methodology focused on the UNIDO method of training women entrepreneurs in Africa that has been tested in several countries (including Zimbabwe, Mali, Ethiopia and Botswana). The promotion of soybean in western Kenya started with a needs assessment of the area (each district is made up of several villages). This is carried out using desk studies, field research, and interviewing stakeholders, especially women farmers and entrepreneurs. During visits to the villages, special efforts were made to use the information gathered and the results of the interviews with the stakeholders that focused on food/nutrition security, level of business in the area and the interest in gender issues.

Our methodology included visiting farmer associations and ‘living positive’ groups and giving short talks on the goodness of soybeans and allowing question and answer sessions to ensure that our clients had a voice. Also training of trainers (ToT) for five days and training of farmers (ToF) for two days in processing and utilization of soybeans, hygiene, sanitation, basic business management, and nutrition education were involved. Soybean was also incorporated into several locally eaten foods with taste tests carried out and analyzed to determine the degree of quality improvement. We incorporated or replaced soybeans in locally eaten dishes such as **maandazi, ugali, porridges, chapati** and **omushenye** or potato dish to increase their protein content.
without changing taste. The groups trained were mainly women, and the training of youths and men will start soon. When the household-level training had been popularized, soymilk-processing machines were introduced to demonstrate milk production at the community level. We also showed how to solve scaling-up problems at this stage. First, VitaGoat was bought and introduced by Malnutrition Matters, Canada (VitaGoat, 2005). It operates without the need for electricity. Later for comparison SoyCow – an electrically operated machine – was introduced. SoyCow is 30% better in throughput than VitaGoat. At the same time, machines were being introduced through some large-scale food processing companies (NUTRO, BIDCO and others), which drew the attention of some farmers that good quality soybeans can be sold to large-scale processors, e.g., BIDCO or NUTRO. This was an incentive to encourage the farmers to organize into groups to enable them access this technology.

**Nutro’s roasting technique (micronization)** – The Nutro plant is exceptionally versatile and is specifically designed to produce mixes of cereals (such as sorghum, wheat, maize and millet); legumes (such as soya or dry beans), milk powder and sugar. In addition the plant is capable of producing quick-cook rice and pasta, and traditional African drink powders and beer powders, with the ability to add further ingredients at a later stage. In addition, Nutro Manufacturing is working with partners on other new product lines, for example: high-energy biscuits, therapeutic relief foods, UNIMIX with higher energy levels and products designed specifically for geographical areas for school or blanket feeding using nearly any legume or grain (www.nutro.co.ke).

This flexibility, unique to Africa, creates the opportunity to design foods that are custom-made to the actual need. Nutro is therefore well positioned to supply school feeding programs, hospitals and institutions in need of high-quality fortified foods. Nutro’s manufacturing plant has a capacity of 35,000 tons per annum and employs infrared roasting technology, the application of which results in high capacity, high flexibility, and an ability to accelerate delivery of a full range of foods used in relief food programs. Nutro’s plant was commissioned in January 2005 to manufacture pre-cooked fortified maize-soy blends according to published recipes and methodologies. The flexibility of the plant, together with first-class quality control measures, enables Nutro to develop food products tailor-made to meet specific nutritional needs.

**Botswana UNIMIX: “Tsabana” (soybeans and sorghum) processing** – Protein malnutrition is the most common malnutrition among children in Botswana (Ohiokpehai et al., 1998). To ameliorate this problem the government distributed relief food donated by WFP before 1992. The government embarked on strategies to tackle the malnutrition problem. The use of specially processed low-cost nutritious foods in complementary feeding programs has been recognized as one of the most effective means of tackling malnutrition in children. It is in this line that the Government of Botswana engaged in the development of Tsabana, which is a complementary food composed of a 3:1 mixing ratio of sorghum and soybeans.

Tsabana was produced for children 6-36 months of age (Ohiokpehai et al., 1998). Complementary foods of an adequate macro- and micro-nutrient density are needed for optimal growth and development after six months of age when breast milk can no longer fully satisfy infant nutritional requirements. Between 6 and 24 months, the requirements for iron and zinc are particularly difficult to satisfy in the absence of fortified foods or supplements. As a result, the prevalence of anemia is higher in this age range than at any other time during the life cycle. The use of iron-fortified complementary foods led to the elimination of iron deficiency anemia as a public health problem in the United States. The fortification of milk distributed through social programs reduced the prevalence of anemia in Chile by over 60%, stimulating the implementation of similar programs in other Latin American countries. The development of the complementary food was undertaken very cautiously in order to arrive at nutritionally sound and safe products (Figure 2). The following quality control procedures were adhered to:

1) Raw material testing and control;
2) Determination of the quality analysis for nutrient composition (microbiological and physical hazards were controlled);
3) Routine analyses were carried out to determine the safety of the weaning food;
4) Quality controls on the manufactured food were put into place to ensure that all specifications were met;
5) The quality systems were periodically audited to ensure that the manufacturer adhered to the regulations;
6) All aspects of the quality assurance system were documented and produced for discussion; and

7) Good distribution control was put in place to ensure that the fortified food was not adulterated and that nutrient loss was minimized.

Although Tanzania is endowed with favorable agro-climate for successful production of a wide range of horticultural produce, the lack of proper transportation and storage structures has resulted in high incidence of post-harvest losses and poor quality produce. These factors have mitigated the efforts of farmers in linking to the potentially lucrative domestic (mainly in Dar es Salaam), regional, and international export markets. However, when the farmers’ cooperative in Lushoto invested in collapsible plastic crates and replaced the wooden or plastic containers that were used for fruit, post-harvest handling and marketing losses were reduced, which in turn improved their returns.

Through local research efforts, it has been demonstrated that cassava is an excellent raw material for various industries, including the manufacture of convenience food that can be sold to the urban middle class in supermarkets and restaurants.
Through various innovative agroprocessing techniques, cassava is now readily transformed into high-value and shelf-stable primary industrial raw materials that attract premium prices in the industries.

Experiences gained in the post-harvest handling sector in Tanzania, particularly the cooperatives in Lushoto, have highlighted the need for interventions to develop technology hubs or centers to assist in promoting access to enabling technologies and infrastructure for small-scale farmers. Post-harvest handling facilities for quality control and storage will enable farmers to meet quality assurance requirements for market access.

It was demonstrated that through the manipulation of the traditional brewing method (the barley malt method), sorghum-based brewing could be developed. This can reduce the use of foreign exchange in the purchase of barley malt.

Also, the production of UNIMIX has been improved recently by using a roasting technique to increase and ameliorate the heat effect on the grain, thus producing better quality foods.

**Institutional support and infrastructure for marketing and value adding**

**Marketing, markets and market infrastructure**
Marketing is the management process responsible for identifying, anticipating and satisfying customer requirements profitably. This definition assumes the creation of products and value with defined customers. Where marketing is applied to enterprises in rural areas, the starting point is to assess the terrain of the enterprise in general then evolve the mechanism within which marketing can be applied. It is for this reason that programs supported through our initiatives promote agro-enterprises in rural areas. In seeking to intervene from a marketing perspective, we note that agro-enterprises are created with a view to eliminating poverty and improving food and nutrition security.

Efforts that seek to realize value adding and marketing of food and horticultural crops in Sub-Saharan Africa need to take cognizance of the individualized nature of smallholder farming. This can be addressed through produce aggregation and institutional formation in order to tap potential market opportunities. Indeed, the efficiency of conversion of the agricultural produce directly to cash or to processed products, then to branded products that are presented for sale in the marketplace, and finally to cash is very important. Activities involved in the continuum – from production to the market, or the value chain – present the opportunities that must be tapped within an institutional formation.

All marketing efforts need to start with the identification of crops, or produce-based services, that when aggregated create the basis of attracting buyers. With value addition being the key focus in most development efforts in Sub-Saharan Africa today, the need to create institutions that revolve around agricultural produce is high. Arising from the foregoing therefore, and in order to promote access to markets and well-defined customer segments, marketing efforts need to be centered on the formation of value-adding Common Interest Groups (CIGs). These groups are created around what farmers produce and, with support, graduate into formal institutions that pool investment resources to procure processing equipment for value addition. We propose the institution creation process that runs parallel to the capacity building efforts in entrepreneurship.
and nutrition so that after the capacity building efforts, the enterprises have branded value-added products for the marketplace (Figure 3). However, in seeking to address the foregoing it is necessary to take note of the institutional and operational constraints that this effort may encounter.

Agri-food markets, and more specifically horticultural markets, exhibit specific characteristics that vary from one category to the other. The markets can be divided into four categories based on size, players and the produce on offer – local, national, regional and international. As one moves from the local category to other categories, the level of sophistication increases in terms of products, transactions, infrastructure, business management and logistics. This increases the costs of doing business and forces non-complying players to drop off and thus the numbers decrease from one category to the next.

The role of cooperatives
The creation of a cooperative as the institutional vehicle for share-based marketing and investment provides a vital marketing channel for small-scale farmers. The benefit of the produce aggregation through this collective action achieves the desired economies of scale and promotes the convenience for processors to collect the produce and deliver to their factory from a centralized location. The collective action promotes the realization of better prices from the raw produce marketing. The successful development of the Kenya dairy industry provides a very good illustration of the potential role of cooperatives in agro-industry development in sub-Saharan Africa. The Kenya dairy industry is perhaps one of the most developed in the region and ranks second after South Africa in terms of revenue. For example, Githunguri Dairy Farmers Cooperative Society (GDFCS) is a successful milk-marketing cooperative, which presents the near ideal model for adoption in the marketing and institutional formation that is considered suitable for any other commodity (Figure 4). With capacity building support, the need to engage collective action in the marketing of the raw milk enabled the farmers negotiate better prices from the Kenya Cooperative Creameries and Brookside, which were the only processors that bought milk from the cooperative in the late 1990s. It is noted that the key to the success of GDFCS was the innovation to produce small quantity (200 ml) milk packets using low-cost packaging. This allowed them to capture low-income urban consumers, who formerly bought raw milk.

Financing the agricultural value chain
Agriculture has suffered from lack of investment or products that are suited to attract investment. Value addition calls for capacity building at the various levels of the value chain, and therefore there is need for financial grants to organized community groups so that they can pay for the services that add value to the chain. The arrangement that needs to be put in place to ensure that farmers demand extension can follow the model implemented by the Kenya Agricultural Productivity Programme, where service providers flag opportunities and then get the community to pay for the services based on a framework created between the

---

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>KSh / litre</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>28</td>
<td>1</td>
<td>4</td>
<td>50</td>
</tr>
</tbody>
</table>

![Figure 4: Overall dairy value chain](image-url)
Programme and community institutions. Financing value addition investments is similarly supported and this model has proved successful for adoption. Microfinance institutions also need to be supported to identify the opportunities along the value chain so that there is certainty for lending in agriculture. With organized markets, financial institutions such as banks (e.g., K-Rep, Equity, etc.) can be co-opted as partners/collaborators and important stakeholders, thereby enabling them to provide finance to farmers, entrepreneurs and other players along the value chain.

Enhancing the role of women in sub-Saharan Africa food and agro-industry

In sub-Saharan Africa, women contribute 60-80% of the labor in food production activities for household consumption and for sale. A survey of national sectoral reports for Benin, Burkina Faso, the Congo, Mauritania, Morocco, Namibia, Sudan, Tanzania and Zimbabwe found that women’s contribution to household food production ranges from 30% in Sudan to 80% in the Congo, while the proportion of women in the economically active labor force in agriculture ranges from 48% in Burkina Faso to 73% in the Congo (FAO, 1994).

Many studies in Africa show that the poor achievement of the agricultural goals on the continent in terms of efficiency, sustainability and equity is due to the predominant practice of directing training and resources to men only (FAO, 1993). This realization has brought about a growing concern about gender issues. The focus of many African governments now is to increase the productivity of the agricultural sector by improving the condition of women, especially those in the rural and semi-urban areas. In Ghana’s Medium Term Agricultural Development Strategy (MTADS) and the country’s Vision 2020 Development Plan, the strategies are to: i) bring services physically closer to women; ii) involve women in the formation and management of programs affecting them; and iii) make women (individually or as groups) the contact point in the delivery of services directly to the beneficiaries and to receive feedback (Ministry of Food and Agriculture, Ghana, 1990).

Food processing contributes to food and nutrition security through reducing food losses, contributing to more diverse diets, and supplying important vitamins and minerals. In addition to the time-consuming tasks of grinding and pounding staple grains, and smoking fish and meats, women process and preserve the fruit and vegetable produce from their home gardens and from the forests. Moreover, women are almost universally responsible for preparing food for their households and thus for the nutritional well being of household members. It is the belief of many that if women in Africa are given the opportunity, they will contribute substantially in the development of the food processing industry and solve the persistent problem of malnutrition and poverty in the rural and semi-urban communities.

Capacity building and information dissemination at all levels

The manufacturing industry in Africa is mainly for the domestic and to a certain extent the regional markets. Its participation in global trade remains limited, mainly due to its inability (lack of technology and know-how) to meet market demands and requirements in terms of quantity and quality (supply-side constraints) and overcome non-tariff barriers for trade. To effectively compete in these markets, African countries have to strengthen the present limited supply capacity (build competitive suppliers) and develop a reliable food safety and quality assurance system based on a food chain approach, risk analysis and traceability, especially for large-scale businesses.

The improvement of agroprocessing in Sub-Saharan Africa hinges on the fact that capacity building at all levels and the development of incubator (hub) model processing and marketing centers must be placed as an integral part of the strategy to promote agroprocessing. A training analysis of the post-harvest horticulture sector in Tanzania, for example, highlighted the need to build awareness and sensitize all key stakeholders on the problems (and opportunities) facing the sector vis-à-vis its growing importance in supporting the government’s ongoing efforts to improve food security in the country, as well as to create new employment opportunities, particularly in the rural sector (Prof. Linus Opara, pers. comm., 2008). Successful examples of such centers are Clayuca at CIAT headquarters, Cali, Colombia, and Agri-Business Incubation at ICRISAT headquarters in India.

In the promotion of soybean processing in Kenya, a training of trainers method was engaged. This is an effective way of disseminating information if properly applied. It was used to impart knowledge to a few individuals (10-15 participants) on soybean nutrition, processing and health issues, who in turn conveyed the same information to other community members. The approach has been used extensively and forms the basis of our capacity building (Ohiokpehai and Kingolla, 2007). Attention was given to radio as a cheap means of information
dissemination to communicate with farmers about the goodness of soybeans. The aim was to reach all key stakeholders through the best and cheapest possible means of communication and to ensure multiple-way communication. Also, community learning was evolved through the use of monthly or bimonthly school nutrition and hygiene talks in the local languages.

In addition, documentation and publication of easy-to-read junior journals was facilitated and dissemination of scientific and extension materials at national, regional and international levels, especially to primary schools. The most important means of national and regional level communication is through books, manuals, technical handouts, flyers, brochures, posters and leaflets for use by farmers and extension staff, and dissemination materials were done in English and local languages. Azam-Ali (2008) reported that the inappropriateness of training material was one of the constraints faced by small-scale agroprocessors.

In the case of Tanzania, hands-on training programs on techniques and procedures for improved post-harvest handling were carried out in Dar es Salaam, Morogoro and Lushoto. These cities represented important horticultural production and marketing areas in Tanzania. Prior to implementing the training sessions, a series of consultations and study visits were carried out to identify critical technical and marketing issues facing growers and marketers and other stakeholders in the horticultural industry. Trainees included fruit and vegetable growers, wholesalers and retailers, trainers (mainly research and extension personnel) and representatives of other stakeholders in the horticultural industry. Topics covered in the training included assessing crop readiness to harvest, cool-chain management, reducing physical damage, quality control, packaging, storage, and transportation. Based on surveys conducted prior to and after the training programs, trainees reported significant improvements in their understanding of the principles and practice of improved post-harvest handling (Opara et al., 2005).

**Challenges and opportunities for food product innovation**

The agroprocessing and marketing value chain presents a number of challenges and opportunities that can promote wealth creation and employment generation in rural areas. The challenges have been discussed in the preceding section; the following are potential opportunities:

Development and promotion of incubator or hub model processing and marketing in Africa agroprocessing industry to boost agribusiness entrepreneurship. This provides farmers and other agro-entrepreneurs with easy access to information and transacts their input/output business. The importance of the incubator model hinges on the fact that the small-scale processors need a range of information that includes topics like food processing, marketing, quality control, basic business management, credit issues, storage issues, packaging options and packing equipment, and technical know-how.

Research opportunities will be created by increased demand at the crop and livestock levels, thus increasing sustainable creation of new knowledge and technologies to support adoption.

Extension services will be created to disseminate research findings to the rural areas. Multidimensional perspectives in the capacity building of extension personnel in both private and public institutions will be provided, both to extension service providers and to researchers.

Linkage of agricultural production will ensure that increased demand for tillage or livestock farming will mean that manual work is available to many not-so-literate rural people.

Value addition and the aggregation of agro-produce will mean creating enterprises that will need management and operational personnel. Demand for learning in institutional support will grow.

Marketing and promotion of value-added produce will create yet more opportunities for individuals in the promotion area.

Farmers will need inputs and hence trading will be supported and promoted, which means creating opportunities along the supply chain.

Financing of enterprises in rural areas will mean the creation of appropriate financing and insurance services. Institutions to supply these will need to be created and more personnel to run them will be required.

With increased production there will be need for online marketing and support, meaning more data will need to be processed. This will drive creation of high-tech data solutions and service provision at institutional and farm levels, which in turn will take technology learning institutions to rural areas and help reduce rural-to-urban migration.
The production, processing and packaging of food creates the need for movement of items and materials between enterprises, opening opportunities for transport and new linkages between enterprises.

References


Kyanuhangire W. and R. Pehrson. 1999. “Conditions in banana ripening using the rack and pit traditional methods and their effect on juice extraction.”


NEPAD-CAADP. 2002. Africa Comprehensive Africa Agriculture Development Programme


An assessment of the potential efficiency and profitability of value-addition and marketing innovations involving smallholder farmers under a pilot system in Tanzania*

A.B. Abass1, S.S. Abele2, N. Mlingi3, V. Rweyendela4 and G. Ndunguru5

Abstract
An assessment of four pilot processing centers in Tanzania, established for processing cassava to high quality cassava flour, chips and starch based on IITA technologies, was carried out from 2003 to 2005. We followed the value chain analysis approach, looking in detail at processing efficiency and relating it to market dynamics, in particular of the fresh cassava or raw material market. Locations with large volumes of fresh cassava were found to be very favorable for such enterprises, as prices are likely to be low and surplus production ensures a steady flow of fresh cassava as raw material. Locations with little cassava available are not suitable, even if prices are low. Sourcing fresh cassava either on-farm or in local markets during the last quarter of the year was potentially difficult and very expensive. Trade margins of fresh cassava were significantly higher in markets with obvious scarcity, but relatively low in higher volume markets. Potential profitability of the infant processing sites was remarkably influenced by capacity utilization. At 100% capacity utilization, at Chisegu (a high quality cassava flour site) profitability was US$ 1,876, NPV was US$ 6,402, and IRR was 77%. At the high quality cassava flour site in Zogowale, operated at 48% capacity utilization, profitability was US$ 1,640 and NPV was US$ -9,429. At Bungu, a cassava chips site, even though operated at 59% of its capacity the profitability was US$ 2,126, NPV was US$ 8,698, and IRR was 135%. When the Zogowale operations were adjusted to 100% capacity, the NPV increased substantially, to US$ 11,013, and IRR also notably increased, to 177%. Although starch production is the most capital-intensive production technology of the three technologies studied, the starch site at Mtimbwani, when operated at 100% of installed capacity, had total profitability of US$ 4,482, an NPV of US$ 15,958, and an IRR of 91%. Other factors, including infrastructure such as roads and water, cultural attitudes of smallholder processors/farmers towards work, and their business outlook also affected the performance of the processing enterprises.

Introduction
Sub-Saharan Africa has the largest number of poor people in the world (World Bank, 2008). Despite the remarkable progress made in increasing food production at the global level, approximately half of the population in Sub-Saharan Africa does not have access to adequate food supplies. Agriculture, accounting for 70% of the labor force and 40% of exports, is very fragmented, lacks commercialization and is performing poorly in global trade (World Bank, 2005). African farmers have not succeeded in the application of value chain strategies to gain access to profitable markets to increase incomes. Both quantitative and qualitative food losses of highly variable magnitudes occur at all stages in the post-harvest system from harvesting, through handling, storage, traditional processing, and marketing, to final delivery to the consumer. Huge food losses in the post-harvest and marketing system, particularly in those countries where the need for food is greatest, are made worse by poor infrastructure, such as roads and transport facilities, and lack of knowledge in processing and preservation of crops to meet market requirements (AMCST, 2008). Experts estimate that between 25 and 50% of crop yields – particularly perishable crops such as fruits, vegetables, roots and tubers, milk, plantain/banana, and fish – produced by smallholder farmers in Africa are lost through post-harvest spoilage; the time, labor and money invested in such production are all lost. Hence, many small farmers are not able to recover costs, let alone make a profit.

The coping strategy for this is to produce just as much as necessary to secure family food needs, resulting in a vicious circle of subsistence agriculture, risk, food insecurity and poverty. Such loss of opportunities to increase incomes and improve livelihoods contributes to wide socio-geographic poverty differences in which rural dwellers are extremely poor and city dwellers are better off (ECA, 2004). Reduction in post-harvest losses through preservation or processing of excess production to shelf-stable food products of higher commercial value would be of great economic significance to Africa. However, the solution often sought by many governments, international development agencies and the donor community for solving food supply shortages in Africa has been food aid. In the area

*We acknowledge the financial support provided by the Common Fund for Commodities (CFC) and the United States Agency for International Development (USAID), which enabled IITA and other collaborating national and international institutions to implement the various pilot processing projects in Tanzania from 2003 to 2007.

1International Institute of Tropical Agriculture (IITA)
2International Institute of Tropical Agriculture (IITA)
3Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania
4International Institute of Tropical Agriculture (IITA)
5Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania
of research needs for increasing food supply in Africa, post-harvest preservation and processing of excess production are recognized to have the potential to contribute significantly to agricultural development. However, research on processing of the most important perishable staples of Sub-Saharan Africa, such as cassava, plantain, banana and sweet potato, are often given little or no priority for international research funding (CGIAR, 2005). Many years of production-oriented research on the most perishable African food crops have not led to significant improvements in yields. Indeed, cassava yield per hectare has either stagnated or even decreased in many countries of east and southern Africa.

Rationale of the study

To develop the income-generating potential of cassava as a cash crop, there are a number of simple market-oriented technologies that can be used to transform highly perishable fresh roots into stable market-grade intermediate products, such as chips or flour for sale as food and as raw materials to various industries. However, potential private investors often have inadequate understanding of the microeconomics of the cassava subsector. They face unfamiliar technologies with unknown investment and transaction costs, and input and output market uncertainties. Research on the economics of cassava production, processing and its marketing has received limited attention, probably because of the widely held perception that cassava is a low-value food security crop with limited prospects for large-scale commerce compared to the traditional export crops. This may be one of the reasons why cassava, despite substantial research aimed at increasing its productivity, has not been able to lift a substantial number of farmers out of poverty.

Wide application of value-adding technologies and improved market outlets will simultaneously increase the adoption of improved varieties developed through research, improve food security and farm incomes, and create employment opportunities in rural areas. One of the benefits of such an approach to cassava producing communities is a reduction in imports of cassava products and their substitutes, such as wheat flour and starch.

To introduce already developed, novel processing technologies for transforming cassava into products of higher market value into cassava-dependent communities, it was necessary to supply the technologies and provide opportunities for local entrepreneurs to learn the art of cassava processing by doing it themselves. Such pilot enterprises are also expected to provide vital data for developing investment guidelines for prospective entrepreneurs.

Methodological framework

Site selection and setup of processing centers

Six locations were identified for pilot testing based on development domains for cassava. Maps of market access were intersected with maps of cassava production potential (Figure 1). The indices for market access were population density, road networks and market locations, while the indices for production potential were soils and climate/rainfall/temperature. The locations were traditional cassava producing communities. Participating groups of smallholder farmers/processors within the communities were selected through the collaborative efforts of the Tanzania Food and Nutrition Center (TFNC), the Ministry of Agriculture, Food Security and Cooperatives (MAFSC), the International Institute of Tropical Agriculture (IITA) the International Centre for Tropical Agriculture (CIAT) and other partners in Tanzania. Pilot processing facilities were set up with the selected groups. Model processing machines were provided on loan to the communities, while they contributed the land and buildings where the machines were installed. The characteristics of the pilot centers and the groups of pilot farmers are shown in Table 1.
Figure 1. Six experimental sites for cassava value addition in Tanzania.

<table>
<thead>
<tr>
<th>Location</th>
<th>Dominant cropping system</th>
<th>Processing and marketing history</th>
<th>Proximity to market/access to infrastructure</th>
<th>Pilot group composition</th>
<th>Processing technique introduced/capacity of installed machinery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bungu, Rufiji District</td>
<td>Cassava, cashew, and coconut</td>
<td>Sells roots but unattractive prices offered by traders.</td>
<td>150km south of Dar es Salaam, Lack electricity and water</td>
<td>3 men and 4 women farmers</td>
<td>Chipping technology introduced by IITA few months earlier; 800kg fresh roots/h</td>
</tr>
<tr>
<td>Chisegu, Masasi District</td>
<td>Cashew and cassava.</td>
<td>Exported chips to the EU in the 1980s; markets traditional dried chips</td>
<td>Low population density area; 600 km south of Dar es Salaam, Lack electricity and limited access to potable water</td>
<td>5 men and 10 women farmers</td>
<td>High Quality Cassava Flour (HQCF); 800kg fresh roots/h</td>
</tr>
<tr>
<td>Mtimbwani, Muheza District, Tanga</td>
<td>Cassava</td>
<td>Moderate production &amp; insignificant market access</td>
<td>370 km north of Dar es Salaam; near Mombasa-Kenya; Electricity and potable water are available</td>
<td>6 men and 18 women farmers</td>
<td>800kg fresh roots/h</td>
</tr>
<tr>
<td>Zogowale, Kibaha District</td>
<td>Cassava</td>
<td>Minimal village-level trade in fresh roots and flour</td>
<td>70 km east of Dar es Salaam, good quality water supply, no electricity supply, very good road to Dar es Salaam market</td>
<td>8 men and 15 women farmers</td>
<td>High Quality Cassava Flour (HQCF); 800kg fresh roots/h</td>
</tr>
</tbody>
</table>
The pilot centers gave unique opportunities to introduce 1) new or improved technologies, such as high-yielding and disease-resistant varieties and improved management techniques, as well as novel methods developed by IITA (Abass, 2006) for processing cassava to intermediate shelf-stable products, such as chips, flour and starch; 2) supportive institutional arrangements, such as national standards for the intermediate cassava products, credits, and capacity building, and 3) market innovations, including market information, and linkages to both expanding and dormant markets for the primary cassava products, as well as the improvement of institutional arrangements like access to credit and supportive policies (Figure 2).

The pilot centers were managed by groups of smallholder farmers/processors, and various end-use products were produced, such as chips for food and feed, starch for industrial use, and high quality cassava flour (HQCF) for food and industrial use. To produce HQCF, roots are weighed, peeled, and washed using potable water. The peeled roots are grated using a motorized grating machine. The grated mash is immediately pressed to remove water and cyanide. The pressed cake is granulated and then spread thinly on raised polythene sheets for drying. The dried granules are milled to flour and then packaged. To produce chips, the peeled and washed roots are run through a chipping machine before spreading them thinly on raised polythene sheets for drying. The chips and flour are supplied to consumers, traders or industrial end-users.

The pilot centers were used to understand the constraints and risks linked to private-sector investments in cassava processing and the potential impact on the economies of farm households. They were also used to test whether sustained links between small-scale cassava farmers, processors and industrial users of cassava products would lead to faster uptake of new production technologies (such as varieties that are high yielding or disease/drought resistant, better agronomic methods, etc.). They also shed light on whether farmers’ livelihoods could be improved, and whether the private sector could be motivated to invest in cassava production, processing and marketing by adopting new production, processing, and marketing innovations as a single package, compared with the usual efforts to deliver different technologies to farmers at different times and locations.

**Analytical framework**

The concept of value chain analysis is based on Porter (1985), who suggests disaggregating an enterprise into different interlinked sections in order to analyze them and determine their contribution (or constraint) to competitive advantages. It is important to look in detail at the components of the value chain, as well as at the linkages between them, and disaggregation and linkage analyses are two important criteria that determine the quality of a value chain analysis.

While there are a number of chain analyses on cash crops, there is little such research on cassava. Although both food technology
and socio-economic research goes back as far as the 1970s, for example in the engineering design and development of a cassava peeling machine (Odigboh, 1976), there is a strong research focus on agronomy and pest management (Hahn et al., 1979) and, more recently, on agro-ecological and socio-economic assessments of cassava production distribution in Sub-Saharan Africa (Carter and Jones, 1993). The impact of technology innovations in the primary production sector on food security in Southern Africa is also a recent focus of cassava research (Rusike et al., 2009). Analyses of cassava markets and marketing, as well as some analyses of processing are found mainly in literature from South America, especially Colombia, possibly due to the long-term and ongoing research schemes of the CGIAR in this region (Pachico et al., 1983; Janssen and Wheatley, 1985; Cock et al., 1990).

Value chain descriptions for various cassava products exist for West and Central Africa (Nigeria and the DRC), yet they fall short of quantitative analyses (Wheatley et al., 2003). The same holds for emerging schemes in China, where cassava is used to produce bio-ethanol (Jansson et al., 2009).

Value chain analyses of cassava enterprises support the identification and understanding of micro-level determinants of cassava production, which in turn are important for increasing market-led supply. Issues investigated include:

- How to best organize the supply of raw materials by assessing possible input sources, both on-farm or from local markets;
- Optimization potentials for the plants in terms of turnover, seasonality of processing, and optimizing quantity and quality of outputs;
- The conditioning factors of profitability borne from input and output markets (demand in terms of quantity, timing and quality); and
- The optimal business setup/investment schemes for SME cassava processing.

A business performance analysis, based on cost-benefit and financial analyses of the new processing enterprises, was used to potentially compare the internal rates of return (IRR) and net present values (NPV) with other enterprises, e.g., fresh cassava trading vs. processing or cassava farming vs. processing. Comparisons were made of profitability under “optimal” conditions and the status quo, which has been seen often as suboptimal because the processing sites operate below their installed capacity. Farmer interviews were conducted to establish the reasons for observed suboptimal levels of operation. It also allows for optimizing the technology level through adjustment of the processing structure, yield efficiency, and scale to optimize economic profits for small resource-poor processors, in addition to dealing with other product quality and environmental protection issues.

Results of three categories of business performance appraisal (BPA) are described in this paper, one for flour in two sites (Zogowale and Chisegu), one for chips at the Bungu site, and one for starch at the Mtimbwani site. The basic structure of the BPA follows the same scheme for all sites. It is based on data regarding:

a) Overhead costs, which are costs of investment, depreciation, interest for investment, maintenance of machinery and equipment, and working capital (working capital is composed of fixed labor costs and other fixed and variable costs);

b) Variable production costs consisting of the costs of raw materials, casual labor, fuel and energy. Capacity load was calculated as the ratio of actual annual raw material inputs and the maximum possible raw material inputs at each site; and

c) Revenues, which are the product of the output volume and price per unit output.

Input and output markets were assessed both locally and regionally to determine the product types (fresh roots, chips and flour) traded on rural markets, comparing market prices with farm-gate prices, measuring the seasonal price fluctuations, and the potential for a processing enterprise to source fresh cassava (volume and price) from the open market. This was done by collecting data on prices of fresh roots on-farm and at the local marketplaces, as well as the prices and quantity of traditional products traded in the traditional products markets. Relevant local markets for each processing site were surveyed. The market in Mlandizi was surveyed for the Zogowale processing site, the Chisegu market for the Chisegu site, Mtimbwani market for the Mtimbwani site, and the market in Jaribu Mpakani (Jaribu) for the Bungu site.
Cost-benefit analysis takes into account the above three mentioned positions, including gross margin analysis (revenues minus production costs). Break-even points were calculated as the unit of output equivalent at which overheads are covered by gross margins. Cash flow analyses, which are assessments of cash inflows (revenues) and outflows (investment, overhead and production costs) over a pre-defined ten-year period, were also done for each site.

Financial analysis, using MS-Excel Version 2003, contains the computation of the net present value (NPV), which denotes the equivalent of capital investments at a given interest rate that is justified by the cash flow, as well as the internal rate of return (IRR) that is gained through the respective cash flow. At an NPV of zero, the investment yields exactly the IRR at the capital market interest rate. IRR can either be compared with the market interest rate, or with other IRR from similar enterprises.

The NPV is computed as follows:

$$NPV = -INV + \sum_{i=1}^{N} \left[ \frac{P_i}{(1+i)^i} \right] + \left[ \frac{VN}{(1+i)^N} \right]$$

where:

- NPV = net present value of the investment alternative
- INV = initial investment
- $P_i$ = net cash flows attributed to the investment in period $i$ to $N$
- $VN$ = terminal salvage value of the investment
- $N$ = length of the planning horizon (10 years in this case)
- $i$ = interest rate

$I$ is the internal rate of return (IRR), marginal efficiency of capital, yield or discounted rate of return at which the NPV is zero.

### Results and discussion

#### Analysis of factors of processing operations

There were variations in the amount of cassava processed and the frequency of processing activities by the various groups (Table 2).

The chips-processing site at Bungu processed the largest amount of cassava and used least labor. Chips processing involves the least mechanization as it requires only one chipping machine, and a drying facility of 137 m², which will accommodate up to one t/day of cassava. These factors could help in achieving a lower processing cost and better profits. Labor use varied widely at the sites, partly because of the nature of the processed products. Starch has the most unit operations to go through and thus requires more labor input; chip processing requires the least labor. It became obvious during the study that the quality of labor was lowest in one of the high-quality cassava flour sites (Zogowale).

<table>
<thead>
<tr>
<th>Pilot site type</th>
<th>Site location</th>
<th>Average amount of cassava processed (kg/day)</th>
<th>Labor use: man-day/processing-day</th>
<th>Average peeling loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chips</td>
<td>Bungu</td>
<td>731</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Flour</td>
<td>Zogowale</td>
<td>392</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Flour</td>
<td>Chisegu</td>
<td>122</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Starch</td>
<td>Mtimbwani</td>
<td>172</td>
<td>8</td>
<td>26</td>
</tr>
</tbody>
</table>

Peeling losses during processing varied significantly among sites. The variation was due to the variety grown, root maturity, peeling methods and/or the extent of caution taken by the people peeling. Flour production in Zogowale was highest in the period from April to June, the period during which the pilot plant mill became operational. Otherwise, the same observations as for chips production hold. Flour production seems to be of interest in the low root price season in Zogowale. The peels of some varieties are easier to remove than others. Small or immature roots are more difficult to peel, resulting in high peeling loss, particularly if the peelers do not take adequate caution. Over-aged, spoiled roots and those with high levels of infection from disease, such as Cassava Brown Streak Disease (CBSD), will result in high peeling losses and long peeling time.
Raw material market assessment
For the purpose of developing a business plan for an agroprocessing enterprise or analyzing the performance of existing enterprises, the local market potential for processed cassava products has to be known; the local prices of roots available for processing including seasonal fluctuations in prices, production and sales for roots and the products need to be established. The sales and purchases, or the balance thereof respectively, of the group member farmers determine the potential to source additional raw material beyond the contracted volume, and the respective prices. Beyond direct sourcing from farmers or at the farm gate, raw material can be sourced from markets, which requires knowledge of markets and the respective prices and seasonal fluctuations.

Market dynamics were assessed to determine the farm-gate prices, the seasonal fluctuations in prices, as well as the potential for a processing enterprise to source fresh cassava (volume and price) from the open market. This was done by collecting data on prices of fresh roots on-farm and at the local marketplaces. For local markets, the relevant market for each of the processing sites was surveyed. The market in Mlandizi was surveyed for the flour processing site in Zogowale, in Chisegu town for the flour processing plant in Chisegu, in Mtimbwani town for the starch-processing site in Mtimbwani, and in Jaribu Mpakani (Jaribu) for the chips processing plant in Bungu.

Farmers’ marketing pattern around the flour pilot sites in Zogowale and Chisegu
In Zogowale, the farm gate purchase price is significantly higher than the farm gate price (94 US$/t vs. 21 US$/t), with average quarterly farm gate volumes being about half the tonnage of the market retails (3 t vs. 6 t). The high purchase price is explained by the nearby competing cassava market of Dar es Salaam, whereas the comparatively low farm gate sales price is a result of market margins and the fact that there is not much demand for the produce due to better opportunities for the regional traders elsewhere. Chisegu seems to be a major export spot for cassava, with farm gate prices averaging US$ 90 per ton through the year, with a quarterly sale of 63 t of cassava on the local market. Purchase prices are lower, with an average of US$ 40/t, with about 33 t of cassava being purchased quarterly. While Chisegu seems to be an excess supply area, this supply seems to be mainly going into higher priced markets and to a lower extent back into the local households. Households seem to optimize their purchases through paying low prices and possibly buying from other households whatever is available at low prices (Table 3).

Farmers’ marketing pattern around the chips pilot site in Bungu
Cassava farm gate prices are US$ 25 per ton (the annual average), while purchase prices are US$ 66/t. Farm sales per quarter (three months) average 25 t, whereas purchases average 5 t per quarter. This indicates that farmers sell relatively frequently, whereas they only buy small amounts, probably to cover their deficits. The price differential between farm gate sales and market retail prices is explained by margins on local markets as well as the costs of importing cassava from elsewhere, and of course by the excess supply of cassava at the farm gate level, depending on seasonal fluctuations (Table 3).

Farmers’ marketing pattern around the starch pilot site in Mtimbwani
Farm gate prices are higher than purchase prices, at US$ 55/t and US$ 13.7/t respectively, whereas the purchased volume is almost five times the amount of the farm gate sales volume (107 t vs. 22 t per quarter). This could be explained by a steady inflow of and demand for cassava imported from other regions, whereas production seems to be low and marketed volumes are small and only traded at peak prices from farms.

Overall assessment
As stated above, the farm gate marketing patterns determine the potential to source raw material from farmers beyond their group-contracted volume. Such additional sourcing has to be optimized in terms of volumes and prices. For Bungu, for example, the lowest costs of sourcing raw material would be from April to June, with a balance of 25 t available at a price of about US$ 21/t. In Zogowale, it should be difficult to source additional raw material from the farmers, as the region seems to be in supply deficit with a negative balance available. The same holds for Mtimbwani, while Chisegu is a surplus area. Yet, the surplus in Chisegu obviously goes into a higher price area, so that sourcing from farmers would be quite costly.

Marketing patterns in local markets
The market situation reflects the findings at the farm gate. In particular markets in Zogowale were high-priced, which underlines the costs of sourcing raw material other than from the contracted farmers. The Bungu-related market was in the middle position in terms of price, with lower prices in the other markets (Table 4).
In summary, it can be said that Zogowale has a difficult raw material market situation, both due to high prices of fresh cassava and to a deficit in cassava trade. This indicates a shortage of raw materials, which possibly hampers supply to the processing site at reasonable prices. The flour site in Chisegu has a surplus at varying prices. The second flour site in Bungu, although at a medium market price level, has a cassava surplus that supports raw material supply to the processing plants. The starch site in Mtimbwani has low prices but a deficit in cassava trade at the farm gate.

Business performance appraisal (BPA)

BPA for flour processing
Cassava flour is produced in Zogowale and Chisegu. The two sites, based on the same technology, machinery type and cost structure, were compared according to their efficiency of operation, capacity utilization, potential of income sourcing and cost structure. Basically, flour production uses a grating machine, a press for dewatering, drying racks, and a mill. Other equipment items are scales and water pumps. Working capital is composed of permanent labor costs and other costs.

The total cost of equipment for small-scale, high-quality cassava flour processing is estimated at US$ 2,344 – the costs of a grater, press, drying racks, milling machine, water pump, storage tank, and weighing scale. Accounting for cost of depreciation and maintenance over a maximum of 10 years, total fixed costs for machinery were US$ 925, while total working capital and overhead cost were US$ 3,938 and US$ 4,836, respectively.

Production costs and revenues – Production costs include the costs of raw material, water and fuel costs, as well as costs for additional/casual labor. Casual labor is required when the person-days needed for processing exceed the permanent labor force of 20.

Table 5 depicts the different cost structures at the two sites. It is assumed that both sites have an initial capacity of 170 t/yr fresh roots processing, equal to 850 kg/day. The “full capacity scenario” of the BPA assumes that the processing site would source all the cassava needed for 100% capacity utilization from farmers on contract and from the market. Hence the efficiency of operation, capacity utilization, income sourcing and the cost structure could be mostly attributed to the extent to which the

<table>
<thead>
<tr>
<th>Site</th>
<th>Period</th>
<th>Jan-March</th>
<th>April-June</th>
<th>July-Sep</th>
<th>Oct-Dec</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flour site-Zogowale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm-gate sales price (US$/t)</td>
<td></td>
<td>20.5</td>
<td>17.1</td>
<td>29.1</td>
<td>19.7</td>
<td>21.4</td>
</tr>
<tr>
<td>Sales volume (t)</td>
<td></td>
<td>2.0</td>
<td>1.0</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Farm gate purchase price (US$/t)</td>
<td></td>
<td>93.2</td>
<td>94.9</td>
<td>95.7</td>
<td>93.2</td>
<td>94.0</td>
</tr>
<tr>
<td>Purchase volume (t)</td>
<td></td>
<td>6.3</td>
<td>8.2</td>
<td>7.1</td>
<td>1.1</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>Flour site-Chisegu</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm-gate sales price (US$/t)</td>
<td></td>
<td>94.9</td>
<td>n.a.</td>
<td>82.9</td>
<td>n.a.</td>
<td>88.9</td>
</tr>
<tr>
<td>Sales volume (t)</td>
<td></td>
<td>70.0</td>
<td>n.a.</td>
<td>55.0</td>
<td>n.a.</td>
<td>63.0</td>
</tr>
<tr>
<td>Farm gate purchase price (US$/t)</td>
<td></td>
<td>34.2</td>
<td>30.8</td>
<td>38.5</td>
<td>52.1</td>
<td>39.3</td>
</tr>
<tr>
<td>Purchase volume (t)</td>
<td></td>
<td>26.0</td>
<td>61.0</td>
<td>20.0</td>
<td>25.0</td>
<td>33.0</td>
</tr>
<tr>
<td><strong>Chips site -Bungu</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm-gate sales price (US$/t)</td>
<td></td>
<td>32.5</td>
<td>20.5</td>
<td>23.9</td>
<td>n.a.</td>
<td>25.6</td>
</tr>
<tr>
<td>Sales volume (t)</td>
<td></td>
<td>14.0</td>
<td>32.0</td>
<td>51.0</td>
<td>2.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Farm gate purchase price (US$/t)</td>
<td></td>
<td>42.7</td>
<td>53.0</td>
<td>115.4</td>
<td>50.4</td>
<td>65.8</td>
</tr>
<tr>
<td>Purchase volume (t)</td>
<td></td>
<td>5.8</td>
<td>6.9</td>
<td>6.2</td>
<td>2.7</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Starch site - Mtimbwani</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm-gate sales price (US$/t)</td>
<td></td>
<td>56.4</td>
<td>54.7</td>
<td>50.4</td>
<td>55.6</td>
<td>54.7</td>
</tr>
<tr>
<td>Sales volume (t)</td>
<td></td>
<td>27.0</td>
<td>20.0</td>
<td>21.0</td>
<td>19.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Farm gate purchase price (US$/t)</td>
<td></td>
<td>12.8</td>
<td>13.7</td>
<td>15.4</td>
<td>12.8</td>
<td>13.7</td>
</tr>
<tr>
<td>Purchase volume (t)</td>
<td></td>
<td>37.0</td>
<td>90.0</td>
<td>152.0</td>
<td>149.0</td>
<td>107.0</td>
</tr>
</tbody>
</table>

Table 3. Farm gate sales and purchase prices according to pilot site
have positive gross margins; this implies that if the overheads are not accounted for, they are operating profitably at variable costs. This is, in fact, a decision-making factor for maintaining production at sites with even negative overall profits. Break-even points are at around 122 t/yr for both sites, which again indicate that 48% is much below the capacity utilization requirements for breaking even under the Zogowale cost structure.

Cash flow and financial analyses – Cash flows are composed of cash inflows (revenues) and cash outflows (costs and investments) over a given period of time. Normally, cash flows are calculated over a period of ten years, given the fact that depreciation and therefore investment needs are ten years for many capital items; most credit schemes also run over ten years. The cash flow of the two sites, based on the “base run” scenarios described above, is also shown in Table 6. Cash flows are calculated from the year “zero”, where the investments have been made (which is a necessary set for the computation of IRR and NPV). The breakdown of cash flow in the two sites shows that investments occur in the year zero, as well as after three, six and nine years, as some of the equipment have to be replaced.

There are few differences in the cost structure at the two sites. Casual labor costs and water are cheaper in Chisegu, whereas raw material costs less at Zogowale. The main difference lies in the capacity load. Chisegu can exploit its full capacity by sourcing additional raw material from the market, but Zogowale operates at only 48% of its capacity. This severely affects potential revenues and gross margins.

Cost-benefit analysis – The cost-benefit analysis includes the computation of profitability, as well as an assessment of gross margins and break-even points in terms of raw material processing and final flour output. Break-even points denote the capacity load that is required to cover the overhead costs by the gross margin. Gross margins are defined as revenues minus variable production costs. An assessment of costs and benefits based on the percentage capacity utilization (CU) of the sites is depicted in Table 6. Overall profits are negative at 48% CU (in Zogowale), but positive at 100% CU (in Chisegu). Both sites have positive gross margins; this implies that if the overheads are not accounted for, they are operating profitably at variable costs. This is, in fact, a decision-making factor for maintaining production at sites with even negative overall profits. Break-even points are at around 122 t/yr for both sites, which again indicate that 48% is much below the capacity utilization requirements for breaking even under the Zogowale cost structure.

Cash flow and financial analyses – Cash flows are composed of cash inflows (revenues) and cash outflows (costs and investments) over a given period of time. Normally, cash flows are calculated over a period of ten years, given the fact that depreciation and therefore investment needs are ten years for many capital items; most credit schemes also run over ten years. The cash flow of the two sites, based on the “base run” scenarios described above, is also shown in Table 6. Cash flows are calculated from the year “zero”, where the investments have been made (which is a necessary set for the computation of IRR and NPV). The breakdown of cash flow in the two sites shows that investments occur in the year zero, as well as after three, six and nine years, as some of the equipment have to be replaced.

<table>
<thead>
<tr>
<th>Market/time period</th>
<th>Purchase price (US$/t)</th>
<th>Sales price (US$/t)</th>
<th>Margins (US$/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mlandizi market for Zogowale flour site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan-Mar</td>
<td>93.2</td>
<td>170.9</td>
<td>77.7</td>
</tr>
<tr>
<td>Apr-Jun</td>
<td>94.9</td>
<td>170.9</td>
<td>76.0</td>
</tr>
<tr>
<td>Jul-Sep</td>
<td>95.7</td>
<td>170.9</td>
<td>75.2</td>
</tr>
<tr>
<td>Oct-Dec</td>
<td>93.2</td>
<td>154.7</td>
<td>61.5</td>
</tr>
<tr>
<td><strong>Chisegu market for Chisegu flour site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan-Mar</td>
<td>34.2</td>
<td>67.5</td>
<td>33.3</td>
</tr>
<tr>
<td>Apr-Jun</td>
<td>30.8</td>
<td>77.8</td>
<td>47</td>
</tr>
<tr>
<td>Jul-Sep</td>
<td>38.5</td>
<td>114.5</td>
<td>76.1</td>
</tr>
<tr>
<td>Oct-Dec</td>
<td>52.1</td>
<td>77.8</td>
<td>25.6</td>
</tr>
<tr>
<td><strong>Jaribu market for Bungu chips site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan-Mar</td>
<td>42.7</td>
<td>107.7</td>
<td>65.0</td>
</tr>
<tr>
<td>Apr-Jun</td>
<td>53.0</td>
<td>144.4</td>
<td>90.6</td>
</tr>
<tr>
<td>Jul-Sep</td>
<td>115.4</td>
<td>147.9</td>
<td>32.5</td>
</tr>
<tr>
<td>Oct-Dec</td>
<td>50.4</td>
<td>105.1</td>
<td>54.7</td>
</tr>
<tr>
<td><strong>Mtimbwani market for Mtimbwani starch site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan-Mar</td>
<td>12.8</td>
<td>48.7</td>
<td>35.9</td>
</tr>
<tr>
<td>Apr-Jun</td>
<td>13.7</td>
<td>48.7</td>
<td>35</td>
</tr>
<tr>
<td>Jul-Sep</td>
<td>15.4</td>
<td>47.9</td>
<td>32.5</td>
</tr>
<tr>
<td>Oct-Dec</td>
<td>12.8</td>
<td>27.4</td>
<td>14.5</td>
</tr>
</tbody>
</table>
after three and six years of use. It can be seen that operating at 48% of the installed capacity has a negative cash flow over ten years, whereas Chisegu, operating at 100% installed capacity, has a positive cash flow during the same period.

The role of farmers’ knowledge, work attitudes, and socio-cultural factors on performance of flour processing sites – The disparity in potential profitability at the two flour processing sites gives a picture of the effect of socioeconomic and cultural factors on rural processing enterprises managed by small groups of rural farmers or processors. To verify what influence farmers’ knowledge, work attitudes, and other socio-cultural factors had on the processing efficiency and profitability of Zogowale pilot site, the farmers’ group was reorganized and a new scheme of work was introduced. The cooperative group members were each allocated one day, in turn, to process their cassava while employing paying labor directly. The minimum amount of fresh roots that should be processed daily was fixed at 600-800 kg (71-100% capacity utilization) while the maximum number of workers to be employed was fixed at eight.

In a Scenario 2 (Table 7), the analysis was done at full capacity utilization of the Zogowale plant when operated by the individual farmers in the new arrangement; the technology used remained the same as for the “base run”, but the capacity utilization was 100% as for the second flour site at Chisegu; input/yr became 170 t, about 50 t more than the break-even point.

This led to a sharp increase in total revenue, profit, and to a higher NPV and IRR than in Chisegu. In this situation, although

<table>
<thead>
<tr>
<th>Table 5. Costs and revenues at the two flour-processing sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity (fresh root t p.a.)</strong></td>
</tr>
<tr>
<td>Capacity load (t)</td>
</tr>
<tr>
<td>Capacity load in % of total capacity</td>
</tr>
</tbody>
</table>

**Costs**

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Zogowale</th>
<th>Chisegu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sourced from farmers at contract (t)</td>
<td>48</td>
<td>40</td>
</tr>
<tr>
<td>Average price (US$/t)</td>
<td>17</td>
<td>42</td>
</tr>
<tr>
<td>Sourced from farmers out of contract (t)</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Average price (US$/t)</td>
<td>23</td>
<td>n.a.</td>
</tr>
<tr>
<td>Sourced from market (t)</td>
<td>22</td>
<td>130</td>
</tr>
<tr>
<td>Average price (US$/t)</td>
<td>94.</td>
<td>36</td>
</tr>
<tr>
<td><strong>Average price of total raw material</strong></td>
<td>44</td>
<td>43</td>
</tr>
<tr>
<td><strong>Total raw material costs</strong></td>
<td>3,179</td>
<td>6,444</td>
</tr>
<tr>
<td>Casual labor costs per man-day (US$)</td>
<td>0.86</td>
<td>0.17</td>
</tr>
<tr>
<td>Excess labor costs</td>
<td>0</td>
<td>188</td>
</tr>
<tr>
<td>Fuel costs/t raw material (US$)</td>
<td>0.004</td>
<td>0.004</td>
</tr>
<tr>
<td>Fuel costs at capacity load</td>
<td>280</td>
<td>581</td>
</tr>
<tr>
<td>Water costs/t raw material (US$)</td>
<td>0.8</td>
<td>0.30</td>
</tr>
<tr>
<td>Water costs at capacity load</td>
<td>63</td>
<td>49</td>
</tr>
<tr>
<td>Bagging and handling costs/t raw material (US$).</td>
<td>2.30</td>
<td>2.30</td>
</tr>
<tr>
<td>Bagging and handling costs of final product</td>
<td>185</td>
<td>394</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td>3,748</td>
<td>7,646</td>
</tr>
</tbody>
</table>

**Revenues**

<table>
<thead>
<tr>
<th>Flour produced (t)</th>
<th>Zogowale</th>
<th>Chisegu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (US$/t)</td>
<td>256.4</td>
<td>256.4</td>
</tr>
<tr>
<td>Revenues</td>
<td>6,938</td>
<td>14,385</td>
</tr>
</tbody>
</table>

Monetary figures are in US $, unless otherwise indicated.
the fixed capital for Zogowale remained the same, the relative overhead costs were tremendously reduced. The lower raw material cost in Zogowale than in Chisegu contributed to the higher profit. This shows that the likelihood of increasing profitability of the processing enterprise at the rural level depends on the ability of smallholder farmers and processors to increase the efficiency of the processing operations in addition to an increase in primary production of cassava in a way that ensures a regular inflow of raw materials.

**Equipment and working capital costs for cassava starch producing site** – Starch production in Mtimbwani is the most capital-intensive production technology of the three processing technologies studied. The total cost of equipment for small-scale starch processing is estimated at US$ 4,757, which includes the costs of a cassava grater, starch settling channels, drying racks, steel sieves, a milling machine, and a weighing scale. By making financial provisions for depreciation and maintenance of the equipment over a maximum of 10 years, total fixed cost for machinery was US$ 1,581 while total working capital and overhead costs were US$ 1,972 and US$ 3,553 respectively.

**Equipment and working capital costs for cassava chips producing site** – Chips production requires a chipper and drying racks. Other facilities include scales and water supply systems. The total investment in these equipment and facilities is estimated at US$ 1,492. The cost of depreciation and maintenance of the equipment, when accounted for over a maximum of 10 years, was US$ 457, while total working capital and overhead costs were USD 49 and US$ 506, respectively.

Table 8 shows the different cost structure at the Mtimbwani site. It is assumed that the site has an initial capacity of 170 t/yr fresh roots processing, which equals 850 kg/day, and at 100% capacity utilization, profitability is positive despite the high investment costs. It is assumed that the Bungu cassava chips processing site has an installed capacity of 170 t/yr fresh roots processing, which equals 850 kg/day. The BPA assumes that the processing site absorbs all the cassava available at the site from farmers on contract and then from the market. Bungu operates at only 59% of its capacity, yet its revenues are high, since costs are moderate and the prices for chips are high.

An assessment of costs and benefits is depicted in Table 8. The site has a positive gross margin, as well as a positive overall profit. Break-even point is about 75 t/yr fresh roots processed. Similarly, Bungu had a positive gross margin, as well as a positive overall profit. The break-even point is at around 18 t/yr.

### Table 6. BPA summary for flour processing (Zogowale and Chisegu)

<table>
<thead>
<tr>
<th>Item</th>
<th>48% CU (Zogowale)</th>
<th>100% CU (Chisegu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fixed costs/yr.</td>
<td>4,839</td>
<td>4,863</td>
</tr>
<tr>
<td>Total production (variable) costs/yr.</td>
<td>3,746</td>
<td>7,646</td>
</tr>
<tr>
<td>Total revenues/yr.</td>
<td>6,938</td>
<td>14,385</td>
</tr>
<tr>
<td>Total gross margin</td>
<td>3,192</td>
<td>6,739</td>
</tr>
<tr>
<td>Flour production (t)</td>
<td>27.06</td>
<td>56.10</td>
</tr>
<tr>
<td>Gross margin/t flour</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Gross margin/t fresh root equiv</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td><strong>Profits (overall) at present possible capacity load</strong></td>
<td>-1,647</td>
<td>1,876</td>
</tr>
<tr>
<td><strong>Break even point</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In flour equivalent (t)</td>
<td>41</td>
<td>40</td>
</tr>
<tr>
<td>In fresh roots equiv (t)</td>
<td>124</td>
<td>123</td>
</tr>
<tr>
<td>In capacity load ratio</td>
<td>0.73</td>
<td>0.72</td>
</tr>
<tr>
<td><strong>Cash flow and investment analysis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net cash flow over 10 years</td>
<td>-20,314</td>
<td>14,916</td>
</tr>
<tr>
<td>NPV (10 years)</td>
<td>-9,806</td>
<td>6,402</td>
</tr>
<tr>
<td>IRR (10 years, percent)</td>
<td>n/a</td>
<td>77</td>
</tr>
</tbody>
</table>

Monetary figures are in US $ unless otherwise indicated.
explains the high profitability of Bungu. It should be noted that the relatively low break-even point is because of the low investments required for chips production, compared to the other intermediate cassava products.

Cash flow and financial analysis – The Mtimbwani starch plant shows positive cash flows throughout the ten-year investment period. The same picture is reflected in the NPV and IRR. The investment has an NPV of US $15,958 and an IRR of 91%. However, because starch processing is water intensive, an additional investment of US $450 on a water pump and storage tank to improve quality of the starch would reduce the NPV and IRR to US$ 14,897 and 81%, respectively. However, the quality of the starch would increase. The Bungu chips plant shows positive cash flows throughout the ten-year investment period (Table 9). The investment has a positive NPV of US $8,698 and an IRR of 135%.

Table 8. Costs and revenues at the Mtimbwani starch processing and Bungu chips processing sites

<table>
<thead>
<tr>
<th>Item</th>
<th>Starch site</th>
<th>Chips site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (fresh root t/yr)</td>
<td>170</td>
<td>170</td>
</tr>
<tr>
<td>Capacity load (t)</td>
<td>170</td>
<td>100</td>
</tr>
<tr>
<td>Capacity load in % of total capacity</td>
<td>100</td>
<td>59</td>
</tr>
<tr>
<td>Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sourced from farmers on contract (t)</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>Average price (US$/t)</td>
<td>17.1</td>
<td>25.6</td>
</tr>
<tr>
<td>Sourced from farmers out of contract (t)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Average price (US$/t)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sourced from market (t)</td>
<td>130</td>
<td>0</td>
</tr>
<tr>
<td>Average price (US$/t)</td>
<td>12.8</td>
<td>0</td>
</tr>
<tr>
<td>Average price of total raw material (US$/t)</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>Total raw material costs</td>
<td>2,406</td>
<td></td>
</tr>
<tr>
<td>Casual labor costs/t fresh roots processed (US$)</td>
<td>0.51</td>
<td>0.26</td>
</tr>
<tr>
<td>Casual labor costs at capacity load</td>
<td>872</td>
<td>256</td>
</tr>
<tr>
<td>Fuel costs/t raw material (US$)</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Fuel costs at capacity load</td>
<td>2,034</td>
<td>120</td>
</tr>
<tr>
<td>Water costs/t raw material (US$)</td>
<td>0.38</td>
<td>0.13</td>
</tr>
<tr>
<td>Water costs at capacity load</td>
<td>654</td>
<td>128</td>
</tr>
<tr>
<td>Bagging and handling costs/t raw material (US$)</td>
<td>0.68</td>
<td>0.24</td>
</tr>
<tr>
<td>Bagging and handling costs of final product</td>
<td>384</td>
<td>239</td>
</tr>
<tr>
<td>Total costs</td>
<td>6,349</td>
<td>3,308</td>
</tr>
<tr>
<td>Revenues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starch/chips produced (t)</td>
<td>56.1</td>
<td>35</td>
</tr>
<tr>
<td>Price (US$/t)</td>
<td>256.4</td>
<td>200</td>
</tr>
<tr>
<td>Revenues</td>
<td>14,385</td>
<td>5,983</td>
</tr>
</tbody>
</table>

All monetary figures are in US $ unless otherwise indicated.
The role of farmers' knowledge, work attitudes, and socio-cultural factors on performance of chips and starch processing sites – Unlike the Zogowale flour processing group, the Bungu group had a business attitude and members were paid based on the amount of work done (kg of cassava processed). It therefore follows that in entrepreneurship development, it is vital for research to recognize the effects that low enterprising culture, group spirit, group motivation, commitments within members and group management (leadership structure, qualities, tenure, accountability and decision making, motivation etc.), could have on project success.

Table 9. BPA summary for the starch (Mtimbwani) and chips (Bungu) processing sites

<table>
<thead>
<tr>
<th>Item</th>
<th>Starch site</th>
<th>Chips site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fixed costs p.a.</td>
<td>3,553</td>
<td>563</td>
</tr>
<tr>
<td>Total production (variable) costs p.a.</td>
<td>6,349</td>
<td>3,308</td>
</tr>
<tr>
<td>Total revenues p.a.</td>
<td>14,385</td>
<td>5,983</td>
</tr>
<tr>
<td>Total gross margin</td>
<td>8,035</td>
<td>2,675</td>
</tr>
<tr>
<td>Flour production (t)</td>
<td>56.1</td>
<td>35</td>
</tr>
<tr>
<td>Gross margin/t starch or chips</td>
<td>140</td>
<td>80</td>
</tr>
<tr>
<td>Gross margin/t fresh root equiv</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Profits (overall) at present possible capacity load</td>
<td>4,482</td>
<td>2,11</td>
</tr>
</tbody>
</table>

Break even point

<table>
<thead>
<tr>
<th>Item</th>
<th>Starch site</th>
<th>Chips site</th>
</tr>
</thead>
<tbody>
<tr>
<td>In starch/chips equivalent (t)</td>
<td>24.81</td>
<td>7,369</td>
</tr>
<tr>
<td>In fresh roots equiv (t)</td>
<td>75.17</td>
<td>22.31</td>
</tr>
<tr>
<td>In capacity load ratio</td>
<td>0.44</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Cash flow and investment analysis

<table>
<thead>
<tr>
<th>Item</th>
<th>Starch site</th>
<th>Chips site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net cash flow over 10 years</td>
<td>36,503</td>
<td>18,775</td>
</tr>
<tr>
<td>NPV (10 years)</td>
<td>15,968</td>
<td>8,698</td>
</tr>
<tr>
<td>IRR (10 years, percent)</td>
<td>91</td>
<td>135</td>
</tr>
</tbody>
</table>

Other socioeconomic and cultural factors affecting rural processing enterprises managed by groups of farmers or processors include the effect of social orientation, the cultural attitude toward work, and business orientation.

Further observations of the other factors that affected the pilot processing enterprises managed by the cooperative groups of rural-based smallholder farmers or processors are that, due to lack of exposure to urban business environment, low commercial outlook, and entrepreneurial culture and experience, many rural farmers were unable to independently take advantage of available market opportunities. While most of the pilot farmers felt the markets for their products were not sufficient for the plant production capacity, the output market survey showed there was a huge dormant demand for all the intermediate cassava products (starch, flour, chips). Group dynamics and group organization have a great cost implication on cassava processing enterprises when processors are operating in groups. It was found that Bungu group, being smaller (Table 1), is highly organized, and was able to reduce their costs, unlike Mtimbwani and Zogowale groups.

A major factor that requires consideration for small-scale processing enterprises of this nature is the state of the support infrastructure needed for the enterprises to flourish. Some of these relate to the lack of access roads and poor transport systems in most rural areas for easy delivery of fresh roots to processing plants. Farmers transport fresh cassava on their heads or bicycles to the pilot sites. This mode of raw material delivery to the processing sites is slow, tiring and inefficient. This contributed to the inability of the groups to source the quantities of raw materials necessary to attain high capacity utilization and profitability. Costs of transporting both raw material to the sites and final products to the market were high, thus eroding the gross profits.

The general lack of potable water for processing affects both the quality of final products as well as processing capacity. Poor quality cassava products are not acceptable to end-users, and a
lack of sufficient water would reduce processing outputs, such as amount of starch extractable from cassava roots. The fact that chips production is not water-intensive was a major contribution to the higher profitability exhibited in the Bungu farmers’ operations. At the time of study, the group was making more chips for the animal feed industry than for the food sector.

Conclusions

The above discussion shows that business planning and financial analysis of enterprises – here called business performance appraisal – is a strong tool to assess infant industries under economic, financial and even managerial or social criteria. In summary, the determinants of profitability and overall success of processing plants were found to be:

- Ability to operate the plants at a high capacity utilization;
- Efficient use of inputs such as labor;
- Ability to maintain quality of products;
- Availability of sufficient and steady raw material at low cost and stable prices;
- Access to product market;
- Good managerial skills and good group organization; and
- Efficient support infrastructure (water, roads and transport systems).

There was a strong seasonality in root harvesting and marketing practices as well as a variation in prices across sites. Farmers sell the highest volumes of cassava roots during the last quarter of every year. However, high levels of marketing of roots appear to result from access to market for fresh roots particularly within 150 km of a city, which might also be a potential disadvantage to a processing plant situated in such location, as the plant might have to compete for roots with the more profitable fresh root market. On the other hand, locations with limited fresh root production are less suitable for any processing enterprise. The right balance of sellable quantity of fresh roots must be established at a location being considered for a processing enterprise. Rural processing plants might have difficulties in sourcing enough raw materials throughout the year, hence maintaining own farm to augment supplies during the period of shortfall is inevitable. Although the raw material was cheapest in Bungu and most expensive in Chisegu, the enterprise in Chisegu was profitable while it was not in Zogowale. It is clear that high market prices for the final product and efficient management of a processing plant are essential in making cassava processing enterprises profitable. Although the high quality cassava flour production process is easy to adapt and apply, the profitability of processing enterprises may differ, depending on how the processors organize their daily production. A change in the processing plan could have a tremendous effect on profitability as well.

Earlier observations at the pilot processing centers showed that the skills of the operating groups, group organization, and dynamics in the groups had an impact on the number of people deployed and their efficiencies. Profitability may be affected if processors do not have a specific and efficient work schedule. In situations where individual members or a rural processing group to whom some tasks are allocated do them as and when they wish, the efficiency of the whole operation will be affected. From the viewpoint of the involvement of rural farmer groups in externally supported agriculture enterprises such as processing, it is important to highlight that without a substantial financial contribution from the group members, there is little possibility for sense of ownership and a general lack of motivation for profit. Such groups might always rely on subsidies and would not be likely to run any processing enterprises profitably. In Zogowale, for instance, most of the group members were more than 50 years old. Despite the training in business management to improve their business managerial skills, the group members retained the impression that any work at the processing center was a social endeavor. These findings clearly illustrate the strong influence that social and business orientation and people’s cultural attitude to work can have on the success or failure of rural agro-based enterprises.

Analysis has shown that, operating at full capacity, all the cassava processing plants would be highly profitable. Optimal location depends on the availability of raw material and inputs (such as water) to perform at their maximum potential. That said, the steady throughput of raw material has to be insured, which implies a certain independence from volatile markets and thus the inclusion of primary production schemes into the processing setup.

Another major constraint identified during the study is sun drying, as it requires large investments in sun-drying racks, without which the drying stage can be a major bottleneck in the production process.
References


Integrating informal actors into the formal dairy industry in Kenya through training and certification

Amos Omore and Derek Baker

Abstract
This paper reviews current thinking on the role of informal agribusiness in pro-poor development, and reports on the example of a recent dairy development project (the Smallholder Dairy Project) in Kenya. The project featured collaborative and participatory research, along with training and certification in milk handling practices as a practical mechanism optimizing milk quality and addressing regulatory barriers. It also targeted and helped achieve policy change, which enabled wider piloting of the training and certification activities incorporating a business development service approach by national authorities. Substantial welfare gains were achieved, as demonstrated in a recent impact assessment reviewed in the current paper. Current extensions of the project are described, and subsequent work outlined. Coherence with received wisdom is discussed along with future research topics.

Introduction
Throughout the developing world, informal or traditional agro-industry is the dominant avenue for delivery and processing of smallholders’ products. It is also the principal food source for the great majority of poor consumers. It employs very large numbers of people as traders and service providers. However, agro-industrial policy has historically promoted “development” almost synonymously with the displacement of the informal sector by a formal sector featuring capital-intensive production and marketing, and the associated scale of operation. Second, support to collective action and services has addressed smallholders’ needs largely by mimicking the organizational requirements of large-scale production. Other policy concerns, such as public health and municipal planning, have further selected against informal agribusiness, and livestock’s informal agro-industry has been particularly targeted in this regard. Vested interests at several levels of formal agro-industry and government tend to reinforce policy bias against its informal counterpart. The basis for more widespread agro-industrial development has thus been stultified or left without policy support.

Background
The objectives of this paper are to present dairy policy change as a means of addressing poverty, and to illustrate this with examples from interventions in the Kenyan informal milk industry that ensued. Interventions employed include training and certification associated with the delivery of improved product quality throughout the value chain. The paper argues that poverty alleviation is well served by recognizing and embracing informal agro-industry and its gradual transformation into a formal one. Further, it will present evidence that the informal dairy industry is capable of recognizing and responding to consumer demand for quality, particularly for safe food. Based on recent impact assessment, it presents evidence on welfare impacts when unjustified policy barriers are removed, and when price alone becomes the basis of competition.

This paper has seven parts. In the following section, poverty as a central theme in the agricultural development discourse is briefly reviewed. Informal agribusiness is then profiled as a substantial economic and social engine of poverty alleviation and associated pathways out of poverty. The third section profiles the Kenyan dairy industry and the fourth presents the Smallholder Dairy Project (SDP). The fifth section describes the impacts of the SDP and presents recent analyses. The sixth lists the lessons learned and the final section reviews consequential extensions and developments, and presents conclusions.

1Veterinary Epidemiologist, Improving Market Opportunities, ILRI. Corresponding author (a.omore@cgiar.org).
2Team Leader, Changing Demand and Market Institutions, ILRI.
recently, the 2008 World Bank Development Report cites evidence that investment in agriculture is critical to the process of ensuring a decline in poverty, and that the poor’s involvement in markets offers pathways out of poverty at the household level. Barrett (2008) identifies non-participation in markets as a rational choice by households characterized by scarcity of certain resources and inputs, and facing barriers to market entry at a number of levels. While welcoming market participation as a mechanism for pro-poor development, the World Bank (2008) proposes several relevant mechanisms: households’ orientation may be toward employment in processing and service provision for the agricultural sector, or conversely exit from the sector altogether, along with production and sales by entrepreneurs. Hence, the role of the value chain in poverty reduction is complex and is deserving of further research.

Before the MDGs, it had been noted that livestock programs had – with few exceptions – little impact on the poor (LID, 1999). However, few were designed to do so: they typically aimed to increase aggregate national production of livestock products. Most were focused on cattle and promoted technologies (e.g., industrialized dairy) and associated institutions that were often intrinsically inappropriate to local situations (de Haan et al., 2001). Failure to reach poor producers in this context was therefore unremarkable. However, interest in pro-poor livestock development has since grown, and livestock-oriented development portfolios have diversified their approaches in acknowledgement of past failures and in recognition of growing evidence with respect to the importance of livestock in the livelihoods of the poor. Aside from the World Bank-sponsored PRSPs, an increasing number of international agencies and projects are now looking at livestock-mediated poverty alleviation more favorably (see Ashley et al., 1999; Dolberg, 2001; Ahmed 2000; ILRI, 2003; and IFAD, 2004).

The great majority of such systems operate within the informal sector, featuring smallholder production, small-scale trader accumulation and distribution, and small-scale processing and retail. A new sphere of development effort targets the informal sector’s capacity and performance (e.g., see FAO, 2007), little of which is concerned with its connection to the large-scale formal sector. Although supermarket-type retail development and export of selected high-value crops to the North are playing a part, they remain a very small part of the larger picture of the reliance of the poor on agriculture in Africa and less advanced developing Asian countries (Tsahirley et al., 2004; Humphrey, 2007).

The informal sector is frequently addressed as a set of problems and opportunities confronting urban development, in association with urbanization (FAO, 2003). However, extending into the countryside and with so many poor people depending on the informal sector, its recognition and embrace by policy, institutions and services are being promoted in poverty reduction (Morrisson, 1995). There is ample evidence that participation in the informal sector particularly favors welfare generation for women (Ahmed, 2000; Broutin and Bricas, 2006), and some marginalized social and ethnic groups (Simon, 2000). However, besides possibilities of better nutrition, impacts on children may be less favorable, and the informal sector is reckoned to be unattractive as a career for aspirant youth in many cultures (Simon, 2000). There are indications that the informal sector can deliver pro-poor growth at both extremes of the economic cycle: providing jobs and cheap food in recessions or during conflicts (Yasmeen, 2001), and serving growing demand among the poor in boom times (Simon, 2000).

It should be noted, however, that some researchers identify the former effect as a survival impact and shed doubt on the latter effect due to agents’ observed lack of skills and barriers to market entry (Lugalla, 1997). Moreover, the extent to which the informal sector competes with the formal, as well as the opportunities for synergy, have not been well explored (Vacin, 2000). Muller (2004) identifies a need for strong leadership by government in ensuring the informal sector’s performance in resource allocation à la competitive markets. Despite significant statistical shortcomings [not the least of which are the definitions of the constituent parts of the informal sector (Muller, 2004) and their cross-tabulation with sector, gender, employment, and industrial data], some of these hypotheses were tested in a systematic way by Charmes (2000), who delivered both mixed and limited conclusions. To the extent of the authors’ knowledge, no similar research has been done in the ensuing period.

1Current ILRI work in partnership with the World Bank seeks to clarify the linkages amongst market participation, poverty and project/program design (further detail is available from the authors).
Kenyan dairy

The structure of the Kenyan dairy industry is dictated largely by demand patterns. At over 100 kg/caput per year, Kenyans consume more milk than almost anyone else in the developing world⁴, and much of this is in liquid form (Sevo, 2008). Recent efforts by government and non-governmental agencies to promote milk consumption in all forms and increasing urbanization appear to be contributing to more sales of other forms, such as yoghurt and cheese, but the proportion represented by these is still small. Although dairy in most African countries is characterized by a patchwork of formal and informal market linkages (Ahmed et al., 2004), smallholders and informal raw milk market channels dominate the supply of marketed dairy products in Kenya. Imports and exports are negligible.

The line between what is considered “informal” and “formal” is often blurred. The term “informal” was coined originally to refer to people operating outside the law (particularly to avoid taxation), but it now commonly refers to small-scale traders operating legally (often with licenses) as well. In the dairy sector, “informal” refers to traders at variance with widely accepted international norms that emphasize cold-chain organization and pasteurization of marketed milk prior to sale. They may or may not have legal status, depending on the specific policy environment. Using this definition, an estimated 86% of all Kenyan milk sales are of this origin, while milk that reaches consumers after pasteurization and packaging accounts for just 14% in the early part of this decade (Omore et al., 2004a, b).

Although livestock numbers are uncertain in the absence of a recent census and due to political upheaval, it is estimated that 1.8 million cattle producers are involved in milk supply, most of whom keep 1-2 dairy cows and their replacements on small land areas (less than 2 ha).⁵ Marketed milk reaches retail points via several routes: direct milk sales from producers to consumers (42%) and from dairy farmer groups (24%), with the remainder sold via some 40,000 small-scale milk traders.

The policy and institutional approach to such informal sector dominance has pre-occupied Kenya’s public officials and other dairy stakeholders for the past decade: dairy’s management and performance have been one set of concerns; another has been the vested interests of large firms in the formal sector. Key opposing forces constituted on one side the few large and highly capitalized, highly organized, and well-connected producer-processors selling higher-priced milk, and on the other the myriad poor, often part-time, haphazardly organized, voice-less small-scale producer-traders selling lower-priced, raw unprocessed milk. Public health concerns were thrust to the fore: competition for market share between the two groups appeared to rest not on the basis of price differences, but on perceived differences in quality and safety. Sparse evidence supported these concerns, but those wishing to influence policy employed them widely.

The Smallholder Dairy Project in Kenya

Changing mindsets regarding milk from the informal sector, based on scientific evidence, was the key focus of the Smallholder Dairy Project (SDP), with the goal of catalyzing pro-poor policy shifts⁶. SDP was initiated in 1997 as a collaborative project between ILRI and research and development partners in Kenya, with funding from the UK Department for International Development (DFID). It was initiated as an integrated research and development project aimed at the sustainable development of Kenyan smallholder dairy. Key areas proposed for SDP research and development activities included: detailed characterization of the sector, from production to consumption and including the policy environment; analysis of factors constraining competitiveness of smallholder dairy farmers; analysis of social and economic benefits from smallholder dairy production; and testing of milk products’ quality and identification of factors affecting public health. There was to be participatory development of improved technologies for farmers and traders, together with dissemination of extension and training materials, and a spatial analysis of dairy systems for improved targeting.

However, during its life the focus of the project shifted, in particular towards supporting change in the policy and institutional environment, in order to better support dairy-dependent livelihoods. During its three phases, the project moved from a focus on development of “best-bet” technologies to overcome farmers’ problems and to improve their livelihoods (Phase 1) to their uptake across a broader geographic area (Phase 2). An evaluation indicated limited potential impact would

---

⁴SDP Brief 1 and 10, www.smallholderdairy.org
⁵SDP Brief 10, www.smallholderdairy.org
⁶See www.smallholderdairy.org
be achieved through a focus on technologies. Detailed studies initiated during this phase to assess milk-borne public health risks weighed against benefits such as income and employment generation formed the basis of the development of a strategy for the reform of dairy policy (Phase 3). An example of behavioral findings that were far-reaching was evidence relating to consumers’ predisposition to boiling milk before consuming it. Because public health risks associated with informal milk markets were demonstrated to be exaggerated, Phase 3 saw more active engagement with policy, particularly the need to allow small-scale milk traders or vendors (SSMVs) to be licensed. In an effort to change entrenched mind-sets, practical procedures to raise milk quality were demonstrated. A pilot program to train and certify SSMVs in basic milk testing, hygiene and handling using a new model of business development services (BDS) (see Box 1) was initiated with the active involvement of the regulatory authority, the Kenya Dairy Board.

Box 1. The training and certification intervention using BDS

The key components of the quality assurance pilot scheme involving BDS were:

**Accreditation of BDS providers:** The involvement of BDS providers in training and provision of other services was factored to ensure the sustainability of the intervention. Selected providers were assisted to provide their services for a fee, following their accreditation by a committee established to work on behalf of the KDB and induction on how to conduct the training of traders using approved training manuals and guidelines on milk quality control and entrepreneurship. Once induced, a public promotion campaign to stimulate demand for the BDS services was mounted. The BDS providers were empowered to issue certificates of competence in milk handling to trained milk traders on behalf of the KDB, and to report their activities regularly to the regulatory authority.

**Training of milk traders:** The training covered basic principles of hygienic milk production, milk handling and simple milk quality tests such as organoleptic, clot-on-boiling, alcohol and lactometer tests as elaborated in approved training guides. The guides include messages that reinforce the current common consumer practice of boiling raw milk prior to consumption because milk-borne pathogens, such as *Brucella*, can only be eliminated through appropriate heat treatment. Importantly, each training guide incorporates relevant information to pass on to suppliers of milk, thus ensuring improved quality of the milk traded along the whole chain. This is the compulsory component of the training. Additional skills imparted on demand include: business/entrepreneurship skills, mastitis testing, reproduction and animal feeding. All training and other services are provided at a fee to the BDS provider.

**The role of the regulatory authority:** In line with current legislation in Kenya, the KDB is empowered to register and license all traders in the dairy industry. An important criterion for issuing licenses is milk quality management, given high perishability of milk and potential zoonoses that can be passed through milk. The regulator therefore has a central role to play in mainstreaming the informal sector because hygiene standards and milk-borne health risks are usually a concern. The role of the KDB in the intervention was quality assurance by monitoring both the compliance of accredited BDS providers to approved trainers’ competence level and compliance of certified milk traders to approved minimum standards for milk handling. KDB revised its previous rigid licensing requirements to pave way for the implementation of this new approach to service delivery.

![Schematic representation of the quality assurance scheme involving BDS](image-url)
Impacts of the SDP

The research evidence generated and widely disseminated soon crystallized a “milk war” between those representing the formal dairy sector and those advocating practical mechanisms for bridging the regulatory gap and gradually transforming the informal milk market into a formal one (see details in Box 2). The SDP has been identified as one of the rare, highly collaborative research and development projects that achieved significant impacts mainly due to a between-phase shift to address policy constraints (Leksmono et al., 2006; Kaitibie et al., 2008).

Attribution of changes in poverty amongst participants in the Kenyan smallholder dairy sector, and in their empowerment and social advancement, to specific SDP interventions is difficult partly because this was not specifically monitored. We assume, however, that income correlates with poverty. Much of what follows draws on work by Kaitibie et al. (2008), which employed the impact pathway presented in Figure 1 in an ex post analysis: essentially linking research to impacts via changes in policy.

Source: Kaitibie et al., 2008

Figure 1. Pathway of research outputs to impacts
In December 2003, the Kenya Dairy Processors Association (KDPA), a coalition of milk processors and TetraPak (a packaging manufacturer), launched a “Safe Milk Campaign” against the SSMVs, using television, radio and newspaper advertisements and leaflets. While planned and funded by these private companies, the campaign was officially sponsored by the KDB and the Ministry of Health, and therefore perceived to be supported by government. The campaign was also co-funded by Land O’ Lakes. The campaign’s message was that the consumption of raw milk was dangerous. The informal milk traders were portrayed as criminals who added potentially dangerous substances to preserve or increase milk volumes in order to boost their profits. It was widely thought that the intention of the large processors in launching this campaign was to stamp out what they regarded as their “unfair” competitors – the SSMVs. The processors, however, argued that their intention was to warn consumers of the potential dangers of consuming raw milk. The campaign flagged public health concerns, especially zoonotic diseases such as brucellosis and tuberculosis. The processors claimed it was their corporate duty to warn consumers.

With its negative portrayal of informal milk traders as criminals, and the inaccuracy of the information released, the campaign was recognized by SDP and its civil society organization (CSO) partners as being potentially extremely damaging to large numbers of poor peoples’ dairy-dependent livelihoods. As a result, the CSO partners, Institute of Policy Analysis and Research (IPAR), ActionAid Kenya, Intermediate Technology Development Group (ITDG) East Africa and Strengthening Informal Sector Training and Enterprises (SITE), supported by SDP, held a press conference on 3rd December 2003 to contest the campaign. They issued a press statement using SDP evidence to show that the claim that informal milk traders adulterated milk was not true. They also used SDP evidence to show that unsubstantiated health concerns were likely to reduce overall milk consumption, reduce health benefits to low-income customers and destroy hundreds of thousands of farmers’ and traders’ livelihoods. The CSOs also raised the point that there was a need to engage with the SSMVs because of their substantial role in the milk market and the potential for job creation for the rural poor.

Core partner organizations implementing SDP, although actively engaged in the process leading to the press statement, were procedurally constrained from playing a leading role in policy advocacy processes, because of the institutions’ mandates. This awkward position left SDP unable to be directly involved in advocacy activities aimed at influencing policy, although the log frame required them to deliver on a policy change.

This press statement started what became popularly referred to as the “Milk War”, as the KDB and the processors tried repeatedly to challenge the CSO partners’ statement. But they were unable to produce any evidence to back their claims, while the robust evidence from SDP strongly supported the CSOs’ arguments. During the period of the Milk War, from December 2003 to March 2004, the newspapers were full of debate as the views of the opposing sides were put forward. The public also voiced their opinions, which mostly supported the CSO partners’ views. In the end, the processors decided to withdraw the Safe Milk Campaign, most probably because they saw the potential for negative publicity backfiring on them. In spite of the withdrawal of the campaign, the debate in the newspapers continued right up until the time of the Dairy Policy Forum in May 2004.
As a starting point, it can be authoritatively argued that Kenyan dairy policy and its evolution over the last 4-5 decades has had significant impact on the poor by way of production increases. Growth of dairy cattle numbers (pure exotic or crosses with local breeds) increased from 400,000 in 1961 to a current 6.7 million\(^7\). Kenya has become the dominant dairy producer in Eastern and Southern Africa, with over 70% of those regions’ dairy cattle (Muriuki et al., 2003; Muriuki and Thorpe, 2001). Although the distributional impacts of policy changes over the years are unknown, it has been argued that poverty has been widely alleviated through dairying due to the dominance of smallholders and SSMVs in production and marketing over the years.

Shortly after the policy change in September 2004, KDB – with the support of SITE and funding from DFID’s Business and Marketing Services Development Project (BMSDP) – embarked on a wider pilot of the scheme proposed under SDP. It is this intervention that is at the core of the benefits that Kaitibie et al. (2008) have documented (see Figure 3). As under SDP, the positive impacts of the scheme piloted by KDB on milk quality were demonstrated. These included significant increases in the proportion of traders adopting milk testing methods that they had been trained to use, among other associated benefits.

Assessment of impacts identified and measured by Kaitibie et al. (2008) entailed tracking the components of policy change precipitated by the above interventions and measuring their likely effects. Attribution was then achieved by establishing a counterfactual scenario, i.e., the situation likely to have prevailed in the absence of policy change, which was established by way of interviews with stakeholders. The conclusion was drawn that without SDP, key policy changes would have been delayed 20 years.\(^8\) The policy changes tracked include behavioral aspects of enforcement and compliance, and the associated impacts on transaction costs. These are in turn linked to price and margin changes, and eventually to welfare (see Table 1).

---

\(^7\)SDP Brief 10, www.smallholderdairy.org
\(^8\)This was tested by a series of sensitivity analyses.
Behavioral change among regulators  Engagement of SSMVs by the regulatory framework, and subsequent compliance Traced to September 2004 in response to SDP

Market margins and volumes  SSMVs’ margins declined, but profits rose as a consequence of increased volumes, implying an increased speed of turnover of milk.  Response to deregulated trading environment

Welfare  Increased welfare for all chain actors, particularly producers and consumers.  Higher prices, for higher volumes, are paid to producers, while consumer prices have fallen (relative to the counterfactual)

Corruption and related matters  Reduced payments due to corruption, and an enhanced social standing for SSMVs.  Engagement of SSMVs significantly reduced incidence of bribery in association with market access.

Within-chain impacts of the SDP, dynamics and sustainability of the welfare impacts, and deep implications of the different regional impacts revealed in the study, have all been deferred to future work. However, further impacts of SDP beyond the boundaries of the project have been identified. In addition, the changes in Kenya have had important regional knock-on effects, within the context of the Association for Strengthening Agricultural Research in Eastern and Central Africa’s (ASARECA’s) Policy Analysis and Advocacy Program on rationalization and harmonization of dairy policies in Eastern and Central Africa (ASARECA, 2007). The ASARECA program has been working with dairy regulators from Kenya, Uganda, Tanzania and Rwanda to promote uptake of the new institutional approaches to transform informal milk markets in the region. In 2006, the efforts culminated in an agreement by the regulators from these countries on basic requirements to rationalize and harmonize regional policy and standards, and to pilot the new approaches incorporating BDS, along the lines of the SDP in Kenya. The agreements emphasize the use of common training materials and approaches for capacity building of informal milk traders before their certification, which is to be recognized across borders in the region (ASARECA, 2007).

Lessons learned

Key lessons from the SDP have previously been reported by Leksmono et al. (2006). Those authors emphasize the combination of practical demonstration with generation and dissemination of robust evidence through research, and the collaborative and participatory approaches that enabled these.

The collaborative and participatory approach acknowledged the centrality of stakeholder decision-making to the process
of change, and eventual welfare generation. This process, as advocated by Barrett (2008) and Lugalla (1997), addressed skills and barriers to market entry.

Impact evaluation identified the role played by markets in the generation of welfare to producers, as well as to other market participants as outlined in the World Bank’s (2008) depiction of stakeholders’ various orientations to the market. Within the smallholder dairy value chain, markets were harnessed in an additional manner, by introduction of a commercialized supply of training and certification in milk handling. In turn, this training and certification generated direct benefits to stakeholders and so enabled sustainability of the SDP’s interventions.

KDB’s leadership through broad piloting of the trader certification scheme confirms the contention by Muller (2004) that leadership by government is an important component of change. However, evidence generated by research was the basis of the willingness of authorities to consider such alternative approaches in order to meet local needs and conditions, despite departing from international norms. Hence the potential role of research, and its collaborative implementation and dissemination, was a lesson learned.

The key to enhanced impact through policy change was understanding the Kenyan political context. This was enabled by appropriate choice of project partners, and by identification of key items of information and emphasis that were required. Similar strategies enabled changes in regional-level policies.

Conclusions, extensions, challenges

This paper identifies the informal agribusiness sector as fertile ground for the alleviation of poverty and for the targeting of vulnerable groups. A current example is examined in the form of the Smallholder Dairy Project in Kenya, which combined collaborative research with practical assistance at both individual (training) and system (certification) levels to influence policy. In turn, the policy change enabled market forces to deliver benefits to the poor, which then underpinned a sustained change process through business development service provision.

These achievements support much conjecture in the development literature about the centrality of markets, and access to them, for pro-poor development. Notably they cannot be separated from, and indeed rely upon, policy and institutional change – again as promoted in the literature.

Elements of the collaborative approach and training and certification in the SDP have been extended to a larger project across several East African countries, and to a project developing the informal dairy sector in Assam, India. Transfer of lessons into other informal commodity sectors in Africa and Asia is currently in design phase, embracing goats, beef cattle and pigs. The policy changes seen in the SDP have been adopted across the East African region.

Several research challenges remain. At a technical level, these include the improved definition and characterization of the informal sector beyond dairy as carried out early in the SDP. Such characterization is playing a major role in extending the SDP to other settings. At a policy and institutional level, the linkages between the informal sector and poverty reduction require examination, particularly among vulnerable groups and specifically in relation to market participation.

Re-examination of the exploratory work by Charmes (2000) on the informal sector is timely, and would ideally embrace the alternative uses of livestock, particularly those related to risk management. Following the World Bank’s classification, this would ideally examine sales, employment and emigration orientations and their relevance to effective use of pro-poor development resources. ILRI is currently pursuing such a study in partnership with the World Bank. Tracking impacts over time, specifically throughout the economic cycle and by comparing and contrasting formal and informal sectors’ persistence, performance and synergy, would be a further extension of such work.

In recognition of the importance of value chains in pro-poor development, chain development trends and drivers need to be identified with respect to stakeholder roles and the maximization of beneficial pro-poor impact of structural change. This requires improved methodologies for analysis of informal value chains, and is the subject of ongoing ILRI work with IFAD.

Identification of the means by which formal and informal sectors can co-exist, or preferably develop synergies, is a further research task. This recognizes the complex relationships between the sectors and the policy and economic drivers for their separate development. Pro-poor development actors must be informed of these relationships and the dynamics by which informal becomes formal, and vice-versa. Current ILRI work in southern Africa is examining the incentives surrounding the
efficient functioning of these linkages and their effect on welfare. Further work is needed to address the sustainability of such marketing systems in the light of examples such as SDP where certification and training were effectively endogenized in the pro-poor development process.

References


FAO. 2007. Promises and challenges of the informal food sector in developing countries. Rome, Italy.


