

PROMOTING A VERSATILE BUT YET MINOR CROP: SOYBEAN IN THE FARMING SYSTEMS OF KENYA

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Abstract

Crop promotion is critical for market creation and rural growth in Africa. How to achieve this for crops other than major staples (e.g., maize) and traditional export crops (e.g., tea) remains a problem since most African countries tend to focus policy attention to major staples and traditional export crops. Using a three-tier-approach, developed based on successful soybean promotion strategies in Nigeria and Zimbabwe, this study assesses the effect of market development at household-level, community-level and linking farmers' groups to industrial processors on sustainable soybean promotion in Kenya. Result shows an increase in farmers' confidence to produce, process, and consume more soybeans than before. Trained farmers' groups are also developing new soybean products for cash income, a process that has proved to be very profitable. Net returns have been increased from four to 14 times from some products. Selected farmers' groups are supplying large-scale processors with soybean grains, substituting some imports.

Introduction

Agriculture is clearly failing to be the engine of economic growth and development in many parts of Africa. Many scholars have attributed this to the failure in linking agricultural growth with market opportunities to guarantee incentives and income growth that are central to sustainable poverty and hunger reduction in Africa (Diao et al.,

2003). Studies have shown that investments in non-traditional crops provide a profitable option for bringing about sustainable import substitution (in net importing countries) or for increasing export earnings (Diao et al., 2003). Experiences with soybean (*Glycine Max*) promotion in Nigeria and Zimbabwe confirm this finding. However, most past efforts aimed at promoting soybean in the farming systems of Kenya led to insignificant results. Domestic production still stands at about 5000 tons per annum (Karuga and Gachanja, 2004). Several food and feed processing industries using soybean as raw material are located in various parts of Kenya and have continued to import huge quantities of soybean. Varying estimates indicate that annual soybean importation in Kenya ranges from 50000 to 100000 tons (Karuga and Gachanja, 2004). Meanwhile biophysical conditions in many parts of Kenya can support domestic production for domestic consumption, import substitution, and overall rural growth.

This paper uses the reasons for successes in sustainable promotion of soybean among small farmers in Nigeria and Zimbabwe and the missing links that led to past failures in Kenya to develop and test a model (three-tier-approach) for sustainable soybean promotion in Kenya. The specific objectives are to: (a) give background information including (i) the basics of soybean, (ii) review the Nigerian soybean experience and reasons for success, (iii) review the Zimbabwean soybean experience and reasons for success, (iv) review the reasons for failure of past soybean projects in Kenya; (b) discuss the three-tier-approach (and the supporting pillars) for sustainable soybean promotion in Kenya; and (c) discuss results based on the application of the three-tier-approach.

Methodology

Data collection was based on: (i) literature review and other secondary sources, (ii) formal and informal interviews of stakeholders who participated in earlier soybean projects in Kenya using a checklist to collect data, and (iii) formal survey and farm-level data collection using structured data collection forms. Data analysis was carried out using Microsoft Excel and the Statistical Package for Social Sciences (SPSS).

Background information

The basics of soybean

Soybean is a small grain, creamy in color with a few black varieties. It is an important crop in the world and has been the dominant oilseed since the 1960s (Smith and Huyser, 1987). About 50 countries in the world grow soybean (Boerma and Specht, 2004). The USA accounted for 40 to 45% of the world's total of 189 million tons in 2003 (Boerma and Specht, 2004). Sub-Saharan Africa (SSA) accounted for 817 000 ha (1.1%) of 73 million ha planted with soybean in the world in 2000.

Soybean grows in all places where maize grows and to a height of 60–120 cm, maturing in 3 to 6 months (depending on variety, climate, and location). The pod is hairy and contains two to three seeds. Soybean grows best if planted in pure stands. It improves soil fertility by fixing nitrogen from the atmosphere (Kasasa *et al.*, 2000; Sanginga *et al.*, 2003). Some varieties fix 44 to 103 kg N ha⁻¹ annually (Sanginga *et al.*, 2003). Where rotated with other crops, the subsequent crop often benefits from the surplus nitrogen left in the soil after soybean has been harvested. In Africa, soils have become exhausted due to population pressure on land. Mineral fertilizers are too

expensive for the generally resource-poor farmers to afford quantities sufficient for sustainable agricultural intensification. Advantage must be taken of this nitrogen fixation ability of soybean. With the right variety, soybean yields could be over 3 t ha⁻¹. Soybean is a multipurpose crop and is used as human food, livestock feed, industrial purposes and, more recently, as a source of bio-energy (Myaka *et al.*, 2005). It is an important source of income. Unlike most other beans that contain about 20% protein, soybean contains 40% (Greenberg and Hartung, 1998). Soybean products are cholesterol-free, high in calcium, phosphorus, and fiber, and have one of the lowest levels of saturated fat (BIDCO, 2005).

Review of the Nigerian soybean experience

Soybean promotion in Nigeria was largely successful, driven by increased domestic demand and import substitution. A three-phased project by the International Institute of Tropical Agriculture (IITA) and Canada's International Development Research Center (IDRC), 1987–1999, was supported by public policy fostering soybean–cereal–livestock agricultural intensification, and linkage with the existing domestic market, earlier mostly supplied by imports. Soybean production increased by 166% from 150 000 t (1988) to 405 000 t (1998) (FAO STATS, 2001) and there was widespread incorporation of soybean into cereal-based cropping systems and local dishes and diets. Over the same period, average yields of soybean doubled, from 340 to 740kg ha⁻¹; area cultivated increased by 24%. Between 2000 and 2003, the number of farmers cultivating improved varieties in the dry savanna increased by 228% (Sanginga *et al.*, 2003). More women got involved in soybean production, previously a man's crop and the rate of adoption of some soybean processing technologies was as high as 99% in some communities (Sanginga *et al.*, 1999).. A survey in Ibadan (one of Nigeria's largest cities)

revealed that soybean was sold in two markets (1987), in 42 markets (1994), and in over 100 markets (2000), with soybean retailers expanding from four (1987) to over 1500 (1999). Presently, Nigeria produces about 850 000 t year⁻¹, still insufficient to satisfy domestic demand and attenuate soybean importation.

The benefits realized at the end of Phase III (1999) included increased production with over 500 000 farmers growing soybean in Nigeria and neighboring countries (Côte d' Ivoire and Ghana); over 5 000 persons trained on production and inclusion of soybean in local diets; development and fabrication of processing machines for domestic and commercial uses (by IITA and its partners); emergence of local fabricators of soybean mills; increased awareness on the benefits of soybean (through conferences; training workshops, trade fairs, field days, demonstrations, and use of media); health institutions joined soybean promotion; and transfer and application of experiences, equipment, and methods developed in Nigeria to neighboring countries (IITA, 1999).

Reasons for success in Nigeria

A combination of methods and approaches was responsible for the success of soybean promotion in Nigeria (facilitation, incentives, assistance, collective action and full scale community involvement and ownership, capacity building and training, various ways of market development, creation of new products and new demand, processing and value addition, development of cottage industries, incorporation of soybean into local dishes and diets, information exchange, good agronomy, trade and credit facilities, subsidized mineral fertilizers, import substitution agreement, etc.). Involvement of all stakeholders (hospitals, schools, supermarkets, etc.) expanded both the market and domestic demand.

Soybean production, processing, product development, marketing, and incorporation in family diets were effectively supported by intensive training of all stakeholders. Over 47 000 persons (including 30 000 women) had been trained at the end of 1998 (Sanginga *et al.*, 1999). Adaptation and successful incorporation of soybeans into the maize-based cropping system (Smith *et al.*, 1993; Otuyemi, 2001), local dishes and family diets were instrumental to the increase in soybean production in Nigeria. Development of simple methods of soybean processing for home consumption played a key role (Osho, 1989; IITA, 1999) just like the response to the needs of local markets, supported by profitability (Shannon and Mwamba, 1994; Kormawa, 1996).

Proper coordination (engendered by public policy support and incentives) ensured that processors and producers got along on mutually beneficial terms on issues of contracts, volumes, market clearing prices, guaranteed markets and import substitution, and desired product qualities among others. The use of improved soybean, mostly sourced from certified seed companies and research institutes, immensely contributed to rapid increases in production. The phasing of the IITA/IDRC project enabled the application of lessons learnt from previous phases to improve the execution of subsequent ones, guaranteeing steady and phenomenal increase in adoption (Kato, 1991; Sanginga, 1998).

The problem of getting processors to guarantee a market for smallholder soybean producers and increase their confidence to invest in production was overcome through mediation by IITA and its collaborating national and international NGOs such as Sasakawa Global2000 (SG2000), with IITA facilitating the negotiation. The smallholder farmers received assistance in forms of subsidized mineral fertilizers (from the State

Agricultural Development Projects ADPs) and credit (especially the Union Bank of Nigeria Plc.). These helped the farmers to increase their production and supply to the processors at mutually agreed prices for different product standards, including premium qualities. The processors agreed on import substitution, paying the import parity prices (a little lower than average prices in local markets) but clearing the market.

Review of the Zimbabwean soybean experience

Soybean promotion success story was also reported in Zimbabwe following smallholder farmer-focused intervention led by the University of Zimbabwe. The project started with 55 smallholder farmers in 1996. The government of Zimbabwe supported the project by creating a Soybean Promotion Task Force (SPTF). Over 50 000 individual smallholder farmers (working in various sizes of groups) are presently participating in the project, producing over 40 000 tons of soybean annually (Mpeperekwi, personal communication). The soybean farmers' groups have also been trained to process and sell various soybean-based products (soy milk, soy yoghurt, soy bread, soy egg, soybean beverages, etc.). Some groups have expanded into establishing village banks that perform various banking functions (accept deposits, give credits, etc.). Proceeds from soybean-based enterprises are deposited in these banks. Zimbabwe has well-developed capacity for oil extraction and livestock feed formulation using soybean earlier sourced solely from the large-scale farmers (Mharapara et al., 2005). However, following the activities of the new SPTF, Olivine Industries (OI) Ltd, a private company, guaranteed to buy all soybean grains produced by smallholder farmers at a given price and to pay premium prices for premium qualities. OI Ltd is in the forefront of local sourcing of soybean for making cooking oil, margarine, and soap and has lived up to their promise of clearing the

market to the satisfaction of the small farmers. Prior to the intervention by the University of Zimbabwe, soybean production in Zimbabwe was mostly by large-scale farmers with adequate input-output market information and access and well-developed marketing and value-addition channels.

Reasons for success in Zimbabwe

Since the overall aim was to improve the welfare of smallholder farm families, the focus in the Zimbabwean soybean promotion was not just on production. Equal attention was given to processing, development of new products, marketing (of grains and processed products), and the development of other agencies (e.g., village banks) in support of the whole process. Proper incorporation of smallholder soybean farm households into the soybean supply and value chain was the overriding goal. Linking smallholder soybean producers to market was a key factor and shows the great market clearing role of private food processing companies, such as the Olivine Industries Ltd. Household and community-level processing were used to effectively develop other levels of the soybean market to increase the benefit of the smallholder farmers. Soybean producers were encouraged to consume soybean products in order for them to also enjoy the goodness in soybean consumption. Public policy and institutional support played, characterized by the creation of SPTF, played a key role in the success of soybean promotion in Zimbabwe. There was also a strong support from the media used by SPTF members to spread soybean-related information.

Review of the reasons for failure of most past soybean projects in Kenya

Lack of awareness on processing, lack of market, low yield, and lack of policy support were among the main reasons for the failure of most past projects aimed at

promoting soybean in Kenya (Karuga and Gachanja, 2004). Besides, although most of the projects were small, isolated, and limited in scope, there was a general lack of coordination which was apparent among the promoting agencies, farmers, service providers (traders, input dealers) and consumers. It led to lack of market information (e.g., on needs of various potential buyers, local availability of soybean, etc.) and linkage of soybean producers and processors. In commercial agriculture, assembling products for easy marketing is essential. Buyers indicated that they have difficulties knowing where to source soybean. Farmers do not operate organized marketing with low transaction cost to attract buyers. Some limited effort aimed at assembling soybean produce from small-scale farmers has only recently been made by the Farmers Own Trading Limited (FOTL) through contractual arrangements to sell to BIDCO. The quantities involved were, however, small. Most past projects only emphasized establishing a strong production base without much thought about markets. There was no market clearing commitment to guarantee markets for the farmers. Home consumption would, to some extent, have mitigated the problems but soybean is not usually cooked and eaten like traditional grain legumes such as common beans (*Phaseolus vulgaris*) and cowpea (*Vigna unguiculata*).

Experiences in Nigeria and Zimbabwe on home-level promotion of processing indicated that success requires extensive promotion. Apart from incorporating soybean into local dishes and diets, entirely new recipes and products were developed and fitted into local food habits. In Kenya, our interviews indicate that most households that knew anything about soybean processing were aware of insignificant uses, inimical to widespread consumption since they were not broad-based and could hardly lead to expansion of domestic demand. Cottage industries and other commercially viable small

and medium-scale enterprises that would have sprang up in support of widespread processing failed to do so. Lack of appropriate and affordable processing technology at all production levels compounded the problems.

Extension service plays a lead role in promotion of new technologies. The Kenya Ministry of Agriculture (MoA) provides extension and home economics services. Inadequate technical capacity and resources constrained the ability of extension and home economics staff to effectively train and guide households on soybean processing and utilization. Some NGOs and Faith-Based Organizations also rendered extension services, but their involvement sometimes led to delivery of conflicting or outright wrong information.

Soybean production in Kenya competes with low priced (often subsidized) imports. The CIF Mombassa (Kenya) price of soybean meal is about US\$ 280 t⁻¹ (or KShs. 22.4 kg⁻¹) (Karuga and Gachanja, 2004). Although expected to increase in line with the current rise in world food and oilseed prices, this price is far lower than the farm-gate price (35 to 45 KShs. kg⁻¹) and the open market price of 50 to 60 KShs. kg⁻¹ for soybean grains in Kenya (Karuga and Gachanja, 2004), depicting a wide disparity between the import parity price and the local market prices. This difference creates incentives for processors to continue to import soybean meal. High local market prices are, however, not market clearing and are unlikely to alleviate poverty since only small quantities could be sold. The turnover effect of the relatively lower market clearing prices offered by the large-scale industrial processors might offer better opportunities for increased farm income and poverty alleviation since farmers can sell all produce.

Legumes, including soybean, are not new in Kenya. Common beans and cowpea are well established in the farming systems and households consume them, derive income from them and know their soil fertility functions. Soybean is relatively new and can receive favourable resource allocation only if its various superior attributes over other grain legumes and common sources of protein (meat, fish, etc.) are clearly demonstrated. Most past projects did not focus on the whole soybean sub-sector but concentrated on production, paying little attention to processing, recipe development, and home utilization. Marketing was more or less left out, even in GTZ-Soybean Project (1993–1998) implemented in 13 districts. Possibilities of farmers working together (collective action) to reduce transport and other transaction costs (economies of scale) in soybean produce marketing were largely not explored.

Soybean in Kenya, like all other oilseeds, has had little or no policy attention, unlike maize and the traditional export crops such as tea and coffee (Karuga and Gachanja, 2004). The only aborted attempt to develop oil seeds policy was initiated under the World Bank-funded, MoA-coordinated Agricultural Sector Management Project, leading to “National Oilseeds Development Policy Paper of 1998”.

Farmers’ incessant use of saved seeds or seeds sourced from the open markets (sometimes mixed varieties) contributed to the problem. Unfortunately, good seed deteriorates, season after season, in the hands of all but the very best farmers – the few who grow “certified” seed (Gressel, 2006). These problems that also led to high cost of soybean production (compounded by low plant density, low fertilizer application, and inefficient use of farm resources among others) and low competitiveness and low profitability were neglected by the entire past soybean projects in Kenya. Added to these

is the generally poor soybean statistics (hectorage, production, yield, demand, consumption, importation, etc.) in the country (Karuga and Gachanja, 2004; Riungu, personal communication).

Three-tier-approach for sustainable soybean promotion in Kenya

Under a new project supported by the Rockefeller Foundation, we developed a “three-tier approach” for sustainable soybean promotion in Kenya. This model is supported by three pillars: (i) Strategic Alliance (SA) of stakeholders along the soybean supply and value chain, (ii) widespread awareness creation, and (iii) capacity building/training.

The *first tier* focuses on household-level production and also aims at training household members on various methods of soybean processing for home consumption and sales for improved welfare. Key aspects are participatory recipe development and inclusion of soybean in local dishes and diets prepared using locally available utensils. Farm level productivity is strengthened by linking farmers’ groups to agro-inputs and credit.

The *second tier* focuses on community level. Surpluses from soybean production and consumption at household-level are absorbed and processed into other products (e.g., soymilk, soy yoghurt, soy mandazi, soy chin chin, etc). VitaCow or Vitagoat milk making machines could be used here. Farmers’ groups can afford VitaCow via collective action since its delivery and installation costs range from 435000 to 637500 KShs (5800 to 8500 USD) depending on importation source. Vitagoat is cheaper but performs at 70% of the capacity of the VitaCow which converts 2.5 kg pre-soaked soybean grains into 15

litres of soymilk in 22 minutes. The by-product (residue) from soymilk production is used in making other products (e.g., soy bread, cakes, livestock feed). This tier avoids produce glut at household-level, preventing potential disincentive to further production. Several marketing functions (produce bulking, grading, storage, etc) are undertaken here in preparation for the third tiers. Farmers' groups are trained on business skills and linked to transporters and market information service providers. The focus is to adequately empower farmers' groups on profitable soybean enterprises.

The *third tier* is industrial level soybean market development. It links farmers to large-scale processors for import substitution and to clear the market at prices determined in SA meetings for different product qualities. This tier involves interacting with (i) the industry to find out what is needed, (ii) the farmers to evaluate their ability and the assistance they need to deliver products that meet industrial specifications and (iii) other stakeholders in the soybean value chain to secure their commitments.

Pillars for the three-tier approach

(i) Strategic alliance of all stakeholders

Kenyan processors are not interested in local supply at current volumes and prices and soybean farmers will not invest in increasing production and productivity without guaranteed market. A strategic alliance of stakeholders brings both groups together and agreements brokered on the way forward. The alliance recognizes that successful development of viable value chain requires the cooperation of all stakeholders. Pooling research, technology, production, equipment, transport, and support services, as well as working out clear delivery timetables with customers, yields economies of scale that put

money directly into producers' pockets (CIAT, 2005). The essence of the SA includes to: (a) create an opportunity for integrated resource mobilization, (b) solve a problem in its entirety, (c) put each stakeholder within the larger framework in solving a problem of interest to it, (d) provide assistance in the analysis of different perceptions of different actors, (e) facilitate and support trade, and (f) deal with the problems of duality. The SA has eight distinct and complementary arms [soybean farmers' groups; input suppliers; NGOs and social workers; large-scale and cottage industries and food processors; communication and information agencies, organizers and disseminators; Government institutions and quality controllers; donor organizations; and researchers, coordination and management]. Representatives of each group articulate the views of all members, present these at SA meetings and consultations, and feedback their members the outcome of meetings. For successful import substitution, Kenyan soybean producers need to sell to large-scale processors at prices similar to the CIF (Mombassa) price of imported soybean.

(ii) Extensive awareness creation

This is with respect to soybean agronomy, postharvest activities, marketing, nutrition, health, competitiveness, profitability, natural resource management and cost savings. Emphasis was on the various benefits (production, consumption, marketing, etc.) and awareness on how all (not just minors) stand to gain. A component based on evidence and demonstrations corrected wrong ideas (myths) that could undermine the initiative.

(iii) Capacity building and training

This ensures the sustainability of the concept and approaches in all tiers. Training, using many methods, on how all can obtain the various benefits is an important component.

Results from field studies on application of the three-tier-approach

Tier 1: (i) Growth in soybean farmers' groups

Male and female farmers' interest has been stimulated. Between the long rainy season of 2005 and the end of the short rainy season of 2007 (i.e., after 6 cropping seasons), the number of farmers' groups (15–130 members) growing soybean has increased from seven (Long Rains 2005) to 105 (Short Rains 2007) across the original action sites (*Migori-Rongo* and *Butere-Mumias* districts) and soybean farmers' groups outside the action sites. Action sites refer to our initial areas of concentration. The corresponding area planted to soybean by the farmers' groups increased from 5.7 ha to 83.4 ha (**Table 1**). About 30 farmers' groups completely outside the action sites are currently very active in collective action in soybean production, processing, and marketing and are mostly from *Kisumu Rural*, *Teso*, *Busia* and *Kakamega* districts.

Tier 1: (ii) Profitability of soybean production

The result of economic data [on all inputs (seeds, labor, and fertilizer) and their costs and on soybean grains output and its market price] collected from soybean plots of four farmers' groups and two individual farmers is presented in **Table 2**. Soybean yield ranges from a low value of 445 kg ha⁻¹ to a high value of 1245 kg ha⁻¹ with a mean of 715 kg ha⁻¹. Cost of production varied from 9662 KShs. ha⁻¹ to 26943 KShs. ha⁻¹ with a mean

of 18343 KShs. ha⁻¹. These variations also led to variations in net returns ranging from–258 KShs. ha⁻¹ (loss) to 42685 KShs. ha⁻¹ with a mean of 17401 KShs. ha⁻¹. Data from the four farmers' groups (**Table 2**, rows II–V) indicate that unadjusted labor cost accounted for 75–84% of the total cost of production. This goes down with the adjustment of labor inputs since the plots from which data were collected were small in size. This result shows that net returns depends basically on two things, grain yield and labor use. This knowledge (that a judicious and efficient application of labor is a sure way of increasing the net returns) has informed our subsequent activities in crop management practices.

Tier 1: (iii) Household processing and consumption of soybean

Over 90% of the households interviewed in 2005 were not processing and consuming soybean on a regular basis. They lacked soybean processing knowledge and skill. The few that indicated they processed consumed soybean on a regular basis were only able to process it into either roasted soy nuts or soy beverages. Most of these belonged to the Seventh Day Adventist Church Christian denomination whose members hardly drink the regular tea or coffee for religious reasons. However, recent field data shows a tremendous increase in soybean processing and consumption in the action sites and neighboring areas. Over 75% of the households have been trained on various methods of soybean processing. Most of them can now make soy flour, soymilk, soy *mandazi*, soy *chapati*, soy *chin chin* and soy *puff puff* to mention a few. Some of the farmers' groups have already perfected in producing and selling these products for cash generation.

Tier 2: (i) Profitability of soymilk production using VitaCow

We carried out economic analysis of soymilk production using the *VitaCow* under two price scenarios. In the optimistic scenario (Column II, **Table 3**), the price of soymilk imported from Thailand and sold in Nairobi supermarkets was used. In the pessimistic scenario (Column III, **Table 3**), based on the understanding that soymilk is relatively new and must compete with dairy milk, we applied a price (KShs. 40 l⁻¹) that is two-thirds the price of dairy milk (KShs. 60 l⁻¹). The price of soybean grains (KShs. 40 kg⁻¹) applied under both scenarios was conservative since local market price for soybean grains ranges from 40 to 70 KShs. kg⁻¹. The salary of the operator was generously fixed at 2.5 times the minimum wage in Kenya (KShs. 4000). The salary of the packer/sealer was fixed at well above the minimum wage. Miscellaneous cost was fixed at 10% of all operation costs.

A net benefit per month of KShs. 145 979 under the pessimistic price scenario and of KShs. 530 171 under the optimistic price indicates that soymilk enterprise is highly profitable and shows how value-addition creates an attractive channel for smallholder farmers' groups to profitably diversify income sources. With the net returns even from the pessimistic scenario, the cost of the *VitaCow* milk maker can be recovered in four to five months, all things being equal. Since the total variable costs are the same in the two scenarios, results show the effect of high price on profitability. The analysis did not take into account the residues from soymilk production which could be used in making other products (earlier indicated). If accounted for, the financial returns will increase further.

Apart from creating direct employment for the operator and the packer and indirect employment to the staff of companies that provide certain services utilized in the soymilk enterprise (packing sachets suppliers, electricity company, etc), this analysis has

demonstrated how value addition can increase returns from KShs. 38 400 (from sale of the 960 kg of soybean used as grain) to either KShs. 145 979 (pessimistic scenario) or KShs. 530 171 (optimistic scenario) (converting the 960 kg soybean into soymilk) – an increase of four to 14 times. In view of the high level of profit from soymilk production, we are stepping up all efforts to ensure that the soymilk produced by the farmers’ groups in Kenya can favorably compete with both the locally-produced dairy milk and soymilk imported. Issues of packaging are being addressed through linkage with Tetra pack (a company that specializes in developing packaging materials for processed products).

Tier 2: (ii) Farm-level economic returns from processing of other products

We evaluated the economic returns from the processing of soy *mandazi*, soy *chapati*, soy *chin chin*, and soy *puff puff* taking into account the costs of all inputs and the prices of all products (**Table 4**). Opportunity cost approach was used to estimate labor cost. Village-level prices of products were applied. The time (minutes) taken to process the recipes evaluated was 15 for *mandazi* and *puff puff*, 25 for *chapati*, and 30 for *chin chin*. Result shows that net benefits (in KShs.) for the products produced within the estimated time frames were 51 for *chapati*, 159 for *puff puff*, 204 for *mandazi*, and 508 for *chin chin*. The returns to each KShs invested were 0.43 for *chapati*, 1.2 for *mandazi*, 1.6 for *puff puff*, and 2.4 for *chin chin*. These analyses show that soybean processing and sales of processed products have promise in market creation and poverty alleviation in Kenya.

Tier 3: (i) Interactions with various stakeholders

Results underscore the importance of interacting with various stakeholders (listed in the SA). The interactions showed that different stakeholders had different viewpoints.

Interactions with the leaders of industries reveal the importance of (i) negotiating for import substitution, (ii) understanding the grain qualities they desire, (iii) ascertaining the price the industries are ready to offer for different soybean grades, and (iv) the other mutually beneficial collaboration in soybean promotion between producers and the industries. Revelations from the interactions with all stakeholders actually led to the formation of the SA.

Tier 3: (i) Sale of soybean grains to large-scale processors

Notwithstanding that most of the large-scale processors want supplies in minimum quantities of 5 tons at a time, some of our farmers' groups, especially those from *Busia* and *Teso* districts have supplied to *Bidco* oil processing company. Many others are presently collating their produce, in readiness to supply the processing companies, through the three soybean resource centers created by federations of farmers' groups in *Migori-Rongo*, *Butere*, and *Mumias*.

Conclusion

This paper has contributed to debates on how to promote crops other than the major staples (especially maize) and traditional agricultural export commodities (e.g., cotton, tea, coffee), which tend to be the focus of policy attention in most African countries. Using evidence from a case study based on a model developed from a strategy that led to successes in Nigeria and Zimbabwe, the paper has also shown that addressing issues of market is a key element of sustainable development and rural growth in Africa. This experience underscores the importance of the "whole soybean" approach (production-to-consumption), instead of focusing only on production. Finally, the paper

demonstrated the importance of collective action and value-addition in increasing net returns and making the poor benefit from market opportunities. The outcome of this paper should be of great interest to African agricultural policy makers and planners since it provides some important elements that can increase the benefits from agriculture that could further be promoted through policy.

References

- BIDCO (Business and Industrial Development Cooperation), 2005. BIDCO Oil Refineries Ltd, Thika, Kenya.
- Boerma, R.H., Specht, J.E. (Eds.). 2004. Soybeans: improvement, production, and uses, Third Edition, No. 16 in the series AGRONOMY, ASA, CSSA, and SSSA, Madison.
- CIAT (Centro Internacional Agricultura Tropical), 2005. CIAT in Focus 2004–2005. Getting a Handle on High-Value Agriculture. 2005 Annual Report, CIAT, Cali, Colombia.
- Diao, X., Dorosh, P., and Rahman, S.M. with Meijer, S., Rosegrant, M., Yanoma, Y and Li., W. 2003. Market opportunities for African agriculture: an examination of demand side constraints on agricultural growth. DSGD discussion paper No. 1. Development Strategy and Governance Division and Markets, Trade and Institutions Division, International Food Policy Research Institute, Washington, D.C.
- FAOSTATS. 2001. Food and Agriculture Statistical Database Internet: <http://apps.fao.org/page/collections? Subset=agriculture>.
- Greenberg, P and Hartung, H.N. 1998. The whole soy cookbook: 175 delicious, nutritious, easy-to-prepare recipes featuring tofu, *tempeh*, and various forms of nature's healthiest bean. Three Rivers Press, New York.
- Gressel, J. 2006. A forced abrupt end to food dependency: implications of high oil prices. Special Feature. Africancrops.net.
- IITA (International Institute of Tropical Agriculture). 1999. Soybean Processing and Utilization for Healthy Nutrition in West Africa, IDRC/IITA Soybean Utilization Project, Phase III Final Report, Ibadan: International Institute of Tropical Agriculture.
- Isham, J. 2002. "The effect of social capital on fertilizer adoption: evidence from rural Tanzania." *Journal of African Economies* 11 (1): 39–60.
- Karuga, S. and Gachanja, J. 2004. Soybeans development study: Final report prepared by market economies development for Japan International Cooperation Agency (JICA), Nairobi, Kenya.
- Kasasa, P., Mpeperekwi, S. and Giller, K.E. 2000. Quantification of nitrogen fixed by promiscuous soybean varieties under Zimbabwean field conditions. In: forum 4 working Document 1. Programme extended abstracts. Fourth regional meeting of the Forum for Agricultural Husbandry, Lilongwe, Malawi.

- Katoh, K. 1991. The Role of Soybean in Sustainable Agriculture in Africa. In: N. Russel and R. Doswell (eds.) *Africa's Agricultural Development in the 1990s: Can It be Sustained?* CASIN/SAA/Global 2000, Proceedings of a Workshop held in Ausha, Tanzania, 14-18 May, pp. 141-149.
- Kormawa, M.N.P. 1996. "Economic Potential of Production and Marketing of Soybean in West Africa". *Rural Development in Africa, Asia and Latin America*, Munster – Hambourg.
- Mharapara, I., Mataya, C., Siteo, A., Sibanda, S., and Lundall-Magnuson. 2005. Building sustainable livelihoods through Integrated Agricultural Research for Development. Malawi-Mozambique-Zimbabwe Validation Report. The Sub-Saharan Africa Challenge Programme.
- Myaka, F. A., Kirenga, G., Malema, B. (Eds). 2005. Proceedings of the First National Soybean Stakeholders Workshop, 10–11 November 2005, Morogoro, Tanzania.
- Osho, S.M. 1989. Soybean Processing for Household Use. In: B.N. Mbah and D.O. Nnanyelugo (eds.), *Food Crops Production, Utilization and Nutrition*, Proceedings of a course held at the University of Nigeria, Nsukka, 10-23 April, pp. 68-78.
- Otuyemi, B.T. 2001. Yield Determinants of Promiscuous Soybean and Response to *Bradyrhizobia* Inoculation and Phosphorus in soils of the Northern Guinea Savanna. M. Sc. thesis, Department of Agronomy, University of Ibadan, Nigeria.
- Owolabi, A.O., Mac-Inegite, J.O., Olowoniyan, F.O. and Chindo, H.O. 1996. "A comparative study of the nutritional status of children in village in northern Nigeria using and not using soybeans." *Food and Nutrition Bulletin* 17 (1): 42-48.
- Sanginga, P.C. 1998. Adoption and Social Impact Assessment of Improved Agricultural Technologies: The Case of Soybean in Benue State, Nigeria Unpublished PhD Thesis, Department of Sociology, University of Ibadan, Ibadan, Nigeria.
- Sanginga, P.C., Adesina A.A., Manyong, V.M., Otite, O. and Dashiell, K.E. 1999. Social impact of soybean in Nigeria's southern Guinea savanna. IMPACT, IITA, Ibadan, Nigeria, 32pp.
- Sanginga, N., Dashiell, K., Diels, J., Vanlauwe, B., Lyasse, O., Carsky, R.J., Tarawali, S., Asafo-Adjei, B., Menkir, A., Schulz, S., Singh, B.B., Chikoye D., Keatinge, D. and O. Rodomiro. 2003. Sustainable resource management coupled to resilient germplasm to provide new intensive cereal-grain legume-livestock systems in the dry savanna. *Agriculture, Ecosystems and Environment* 100: 305–314.

- Shannon, D.A. and K.M. Mwamba 1994. "Adoption of Soybean in Sub-Saharan Africa: A Comparative Analysis of Production and Utilization in Zaire and Nigeria." *Agricultural Systems*, 46: 369-384.
- Smith, J., J.B. Woodworth, and K.E. Dashiell 1993. "Government policy and farm level technologies: the expansion of soybean in Nigeria." *Agricultural Systems in Africa* 3: 20-32.
- Smith, K and W Huyser. 1987. World distribution and significance of soybean. In J.R. Wilcox (Ed.) *Soybean: improvement, production, and uses*. Third Ed. Agron. Monograph. 16. ASA, CSSA, and SSSA, Madison. Pp 1-22.

Table 1: Growth in the number of farmers' groups participating in soybean promotion in Kenya: 2005-2007

Reference period	<i>Migori Site</i>	Action	<i>Butere-Mumias Action Site</i>	Action	<i>Outside Site</i>	Action	Total
	No. of zones/ groups	Area (ha)	No. of groups	Area (ha)	No. of groups	Area (ha)	No of groups Area (ha)
Long Rains 2005	3	4.1	4	1.6	-	-	7 5.7
Short Rains 2005	6	16.3	16	6.2	-	-	22 22.5
Long Rains 2006	7	16.3	26	14.3	8	11.7	41 42.3
Short Rains 2006	7	16.3	38	22.3	30	36.3	75 74.9
Long Rains 2007	7	17.2	68	31.0	30	33.0	105 81.2
Short Rains 2007	7	19.3	68	33.1	30	31.0	105 83.4

Source: Field data: 2005-2007

Table 2: Cost and returns analysis of soybean production in western Kenya: Long rainy season 2005

Farmers' group or farmer	Plot size (acres)	Yield (kg ha ⁻¹)	Cost of all inputs*(Ksh ha ⁻¹)	Gross returns (@ Ksh50 kg ⁻¹)	Net returns (Ksh ha ⁻¹)
Jitolee Women	0.25	741.3	26021.05	37065.00	11043.95
Itako Women	0.25	533.7	26943.38	26685.00	-258.38
Shishebu Farmers	0.25	1245.0	19565.22	62250.00	42684.78
Emabole Farmers	0.25	771.0	14525.69	38550.00	24024.31
Richard Aringo	0.25	553.4	13339.92	27670.00	14330.08
Boaz Kivanda	1.00	444.8	9661.48	22240.00	12578.52

* Labor cost was reduced to 33% because of the small size of the plots.

Source: Field data.

Table 3: Economic returns on soymilk production using VitaCow – optimistic soymilk price scenario

Budget item	Kenya Shillings (KShs.) ^{&}	Kenya Shillings (KShs.) ^{&}
5 760 liters of soymilk @ 106.7 KShs./liter	614 592.0	-
5 760 liters of soymilk @ 40 KShs./liter (2/3 of the price of dairy milk)	-	230 400.0
Total revenue/month	614 592.0	230 400.0
960 kg soybean grains @ KShs. 40/kg	38 400.0	38 400.0
11 520 packaging sachets @ KShs. 1.05 each	12 096.0	12 096.0
Cost of electricity @ KShs. 7 500/month	7 500.0	7 500.0
Salary of Operator @ KShs.11 250/month	11 250.0	11 250.0
Salary of Packer/Sealer @ KShs.7 500/month	7 500.0	7 500.0
Miscellaneous expenses @ 10% of all the above costs	7 674.6	7 674.6
Total variable cost/month	84 420.6	84 420.6
Net benefit/month	530 171.4	145 979.4

[&] (US\$1 = KShs. 75)

Source: Computed using field and market data

**Table 4: Summary results of returns from processing of other soybean products:
*Mandazi, Chapati, Chin Chin, and Puff Puff***

Summary budget item	Soy <i>mandazi</i>	Soy <i>chapati</i>	Soy <i>chin chin</i>	<i>chin</i>	Soy <i>puff puff</i>
Total revenue [#]	369.0	170.0	720.0		260.0
Total variable cost ^{&}	164.7	118.6	211.7		101.3
Net benefit	204.3	51.4	508.3		158.7
Breakeven price	1.3	7.0	1.5		2.0
Returns to each KShs invested	1.2	0.43	2.4		1.6

[#] Derived as follows: 123 soy mandazis@KShs3 per unit (for soy mandazi), 17 soy chapatis@KShs 10 per unit (for soy chapati), 144 soy chin chin packets@KShs5 per unit (for soy chin chin), and 52 soy puff puffs @KShs 5 per unit (for soy puff puff).

[&] The items of cost were: soy flour (2 cups or 0.5 kg), wheat flour (6 cups or 1 kg), baking powder (8 tea spoonfuls), sugar (1 glass), salt (1 pinch), vegetable oil, fuel wood, and labor (15 minutes)(for *mandazi*); soy flour (2 cups or 0.5 kg), wheat flour (6 cups or 1 kg), cooking fat, salt (1 pinch), fuel wood, and labor (25 minutes) (for *chapati*); soy flour (3 cups or 0.75 kg), wheat flour (6 cups or 1 kg), egg, cooking fat, sugar, fuel wood and labor (30 minutes) (for *chin chin*); and soy flour (2 cups or 0.5 kg), wheat flour (3 cups or 0.5 kg), yeast, sugar, fuel wood, and labor (15 minutes) (for *puff puff*).

Source: Field data, 2007