Processing as a driver of agricultural development: the case of Makerere University Food Technology and Business Incubation Centre, Uganda

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Introduction

It is estimated that 18-30% of cereals and pulses, 30-45% of tuber crops and 50-55% of fruits and vegetables produced in Africa, South Eastern Asia and Latin America goes to waste, with loss mainly occurring during postharvest handling, distribution and processing (FAO, 2011). Mycotoxin contamination is also a health risk and a constraint to market access, with levels as high as 50-100% (Kaaya *et al*., 2006; Atukwase *et al*., 2009). Agro-processing can contribute to a reduction of postharvest losses, enhanced food safety, nutrient content and quality, as well as stabilisation of food supply, increased shelf life and convenience by making foods easier to handle and prepare.

Developing capacity in food-processing technologies has been shown to catalyse crop and livestock production. Successful processing projects in Asia, Latin America and Western Africa have demonstrated that farmers can rapidly increase their production as new markets emerge and that by adopting a demand-driven approach to the production system, a sustainable development process can emerge (ASARECA, 1998). For example, mechanization of cassava processing in Nigeria has enabled farmers to transform the bulky perishable cassava root crop into a storable, low-cost food known as *gari*. This has popularised *gari*, increased cassava production and caused *gari* production technology to spread to neighbouring countries.

Food processing can also support the development of nutrient dense foods. For example, blending staples that are rich in carbohydrates, with foods of complementary nutritional value and applying suitable processing procedures, can lead to the creation of more nutrient-rich energy-dense foods, which can be used as supplementary feeding, especially for infants and young children. Legumes when blended with staples increase the nutrient density because they are high in protein, minerals and vitamins and lower in starch than regularly consumed staples (USDA, 2011). However, some legumes contain anti-nutrients such as enzyme inhibitors, phytic acid, polyphenols and flatulence factors (Ramakrishna and Ramaskrishna, 2006) that interfere with nutrient bioavailability. Some simple postharvest handling and processing technologies that can be used

to prepare safe, highly digestible, energy- and nutrient-dense inexpensive complementary foods include soaking, fermentation, germination and heat processing, which can reduce the level of anti-nutrient factors and improve bioavailability of nutrients (Hotz and Gibson, 2007 and 2013).

Processing also increases the economic value of agricultural commodities and could support income diversification for farming communities if properly implemented. Micro and small-scale processing may be of particular importance for smallholder farmers who can complement their food intake and other needs by extending the shelf life of commodities, especially when harvests are plentiful or markets are saturated. However, a planned programme for processing agricultural produce at the household level should be considered and implemented for households that are most at risk of malnutrition.

Constraints to the development of agro-processing industry

The development of the agro-processing sector in several African countries and perhaps in other developing countries is hampered by inadequate human capacity in food technology and equipment design and manufacture and related after sales services such as provision of spare parts and maintenance support. The cost of procuring processing equipment is generally very high, making it almost prohibitive cost-wise for setting up agro-processing enterprises, as most equipment has to be imported and is generally over-sized. Lack of appropriate packaging and absence of labelling standards also make it difficult for enterprises to produce highly acceptable and competitively-priced packaged products. Attractive presentation is critical for market penetration and consumer acceptability, especially in light of the availability of diverse, well-packaged imported foods.

Strong linkages between producers, processors, service providers and the market are critical to the success of agro-processing enterprises, but currently, such linkages are limited and weak. This is aggravated by subsistence agricultural production systems, characterised by farmers growing a variety of crops in limited volumes. This model does not support a strong agro-processing sector, which requires large quantities of a consistent supply of quality raw materials. Seasonal availability of raw materials is also problematic given the high dependence on rain-fed agriculture.

Local demand for locally processed food products is also rather limited because of the perception of low quality, insufficient marketing and lack of awareness in many cases of the nutrient content of such products. Recent socio-demographic and economic trends especially in Africa, including urbanisation, increased international travel and regional market aggregation point to a rising consumer demand for convenience and processed foods.

Makerere University Food Technology & Business Incubation Centre (FTBIC)

The purpose of Makerere University Food Technology & Business Incubation Centre (FTBIC) is to develop new value-addition food businesses based on research conducted at Makerere University and to support the University in training students in practical and entrepreneurial skills. FTBIC was established in 2008, with support from the Rockefeller Foundation and DFID (through the Association of African Universities). Since 2010, the Government of Uganda has provided support to the Centre through the Presidential Initiative.

Services and Facilities

The FTBIC offers a platform for students and recent graduates to venture into entrepreneurship. The incubatees (mostly new graduates) are offered access to processing facilities and provided with technical support to boost their capacity in production, marketing and business management. The services provided by the FTBIC to the interested graduate entrepreneurs and other food industry clients include product development, training in food processing, access to contract processing, food analysis and technical advice; especially on aspects of quality management, processing and packaging.

The FTBIC has basic processing facilities, which are available for use at a fee; hence contract processing services is a core element. These facilities include dairy, meat, baking and fruit and vegetable processing lines. The Centre also has a mobile fruit and vegetable processing plant, designed by Makerere University staff and manufactured by Alvan Blanch, UK. This has been deployed in different parts of Uganda to facilitate processing of mangoes and tomatoes, enabling crop stabilisation and value addition.

Fig. 1. Mobile fruit processing plant processing mangoes in Yumbe district, Uganda. Photo by Jane Anyango

Outcomes

The FTBIC has facilitated the development of 20 new food processing enterprises and expanded the variety of agro-based food products on the market. Forty-one (41) new products, including shelf-stable *bushera* (traditional non-alcoholic fermented millet- and sorghum-based gruel), traditionally smoked beef, banana juice and banana beer, a variety of wines from tropical fruits, soya milk, yoghurt, tofu, grain-amaranth-based flours and snacks, gooseberry juice, nutrient-enhanced cookies and wild-root-(*omulondo*)-flavoured liqueur have been developed. These predominantly traditional Ugandan foods have been introduced into modern market outlets including urban supermarkets through FTBIC support. Some products are available in neighbouring countries, although export is still limited and this has occurred generally through informal channels. The FTBIC has linked some incubatees to the Uganda Export Promotion Board to build their capacity for accessing export markets.

The project has also created over 120 direct jobs in production and marketing of value-added food products and jobs for about 400 raw-material suppliers. The graduate entrepreneurs running these firms generally earn more than contemporaries who enter formal employment. Through its efforts, a market for agricultural raw materials has developed, enhancing farmer incomes and stimulating agricultural production. For example, it has supported 2 enterprises to develop value-added products from grain amaranth (Box 1). This has helped to create a market for the crop, stimulating increased farm production and strengthening the forward backward linkages including traditional business enterprises. The private sector provides mentorship to incubatees and some private investors have shown interest in investing in incubatee firms.

Fig. 2. Value-added grain amaranth products developed at Makerere University. Photo by Dorothy Nakimbugwe.

Box 1: From lab to market: case of grain amaranth research in Uganda

Grain amaranth (*Amaranthus hypochondriacus* and *A. cruentus*) is a relatively new food crop in Uganda. It is rich in protein, calcium, iron, folic acid, carotenoids and vitamin E. Product development at Makerere University is promoting utilisation of this crop e.g. instant flour and breakfast cereals were developed using extrusion cooking. Product analysis showed that they contained higher protein, dietary fibre and iron than similar products made from de-germed maize, the ingredient widely used for manufacture of both breakfast cereals and complementary foods. Porridge made from the instant grain amaranth flour also exhibited higher energy density and superior sensory scores compared to commercially available maize-based complementary foods. The best organoleptic properties for the breakfast cereal were obtained by blending with maize in a ratio of 75:25 (grain amaranth to maize). Based on these findings, private-sector-led commercial grain amaranth processing has commenced in Uganda, availing the population of nutritious food products and providing a market to farmers.

Through the FTBIC, students of Food Science and Technology at Makerere University are exposed to practical training, enhancing their technical and entrepreneurial skills. Staff at the Makerere College of Business and Management Science and from the Entrepreneurship Centre at the Makerere Business School have helped to strengthen business skills. Lessons learned through the incubation programme will be incorporated into the Food Science and Technology curricula. The FTBIC has also helped to strengthen the linkage between the university food science and technology research, training and business.

Conclusion

Given the importance of agriculture to the economies of African and other developing countries, investment in agro-processing is critical to stimulating agricultural development. Universities can play a catalytic role in the promotion of agro-processing by adopting a triple helix model of research, teaching, entrepreneurship but there is also need for investment by governments and development partners and engagement with the private sector to support this. This Makerere case, presents valuable lessons for other universities in Africa, the Caribbean and the Pacific. However, additional public and private investments are needed to make the FTBIC programme sustainable. The Ugandan government has committed funding for 5 years (2010-2015) for the Makerere FTBIC and an extension is being sought to ensure its continued viability given its relevance to the long-term development of Uganda's small and medium agro-processing enterprises and the corresponding pull for increasing agricultural productivity and earnings of smallholder farmers.

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