Knowledge, Technology and Growth: The Case Study of Lake Victoria Fishing Cluster in Uganda

Nyaki Adeya

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1. Introduction

From 1997, the European Union (EU) imposed and enforced a set of Sanitary and PhytoSanitary (SPS) standards on Uganda’s fish exports and was only lifted in 2000. This led to a conditional ban of one of Uganda’s important exports and a subsequent crisis within the fish processing and export industry when the country’s fish processing and export clusters were unable to meet the new exporting requirements. Consequently, the industry was plunged into a hard-hitting export crisis and for a prolonged period the fish processing clusters were locked out of their biggest and most lucrative export market. For a country recovering from a troubled past and still dependent on only a few traditional agricultural exports whose global trading prices were sharply declining, a swift and decisive response was imperative. Of the non-traditional agricultural exports, fish was the most important and hence the flurry of rescue efforts by both the public and private sectors across the industry; motivated in part by falling fish export revenues at a time when revenues from traditional commodity exports (coffee in particular) were also falling, but also because the ban was conditional and hence revocable upon certification of Uganda’s fish exports as EU compliant. Market re-entry to the high-value EU market was the principal driver of the spontaneous improvements introduced and access to the EU market was successfully restored after a relatively short period of process-related technological learning. Uganda has, however, not yet succeeded in translating its successful albeit reactive response to the EU fish ban(s) into a more cohesive and pro-active medium and long-term process of technological capability development and innovation that would provide a basis for sustained competitiveness of Uganda’s fish exports.

In this article, we provide an overview of the story of the fish processing and exporting cluster(s) in Uganda. The case provides an interesting example of why and how a cluster of technologically weak firms in Africa successfully managed to overcome its 1st challenge to upgrade in process through networking, linkages, learning and upgrading though it has so far failed to install a continuous process of learning and innovation that would help it to deal with the 2nd challenge to upgrade in products.

2. Profile and Organization of the clusters

1 This paper prepared by Rose Kiggundu, draws on a chapter by Rose Kiggundu in Banji Oyelaran-Oyeyinka and Dorothy McCormick (forthcoming 2006), Clusters and Innovation Systems in Africa, UNU Press, Tokyo.

2 This section draws from a forthcoming chapter by the author in Oyelaran-Oyeyinka and McCormick (in press)
The first point to make is that the agglomeration, or ‘clustering’, of Uganda’s industrial fish processing and exporting firms is better captured by Schimtz’s (1992) definition of clusters than Porter’s (1990). According to McCormick (2004:1-2):

The main academic definitions of the term ‘cluster’ have been advanced by Schmitz (1992) and Porter (1990). They have the same two elements – a geographic or spatial dimension and a sectoral dimension – but differ in the importance they place on close geographic proximity. For Porter (1990), a cluster is a group of firms engaged in similar or related activities in a national economy. ….Schmitz (1992), on the other hand, defines a cluster as a geographic and sectoral agglomeration of enterprises. By this, he and those who have followed his lead mean an area ranging in size from less than a square kilometer to a medium-sized city or a small sub-region of a country. It is argued that the difficulties of transport and communication in Africa as well as the prevalence of fairly small clusters make Schmitz’s approach better suited to the discussion of African clusters.

Going by the definition of a cluster offered by Schmitz (1992), fish-processing and exporting firms in Uganda are not all clustered in a particular geographical ‘city’ or sub-region. Table 1 shows that in Uganda, these firms have agglomerated in several cities surrounding Lake Victoria. However, Table 1 also shows that 10 out of 17 plants are located around two major cities: Kampala and Jinja (Jinja is about 80 kilometers east from Kampala). Thus, one could talk of clustering of 5 plants in Jinja and another 5 around Kampala City. But there are important locational differences between the Jinja cluster and Kampala cluster.

Table 1: Geographical location of fish-processing plants by nearest 'city' in Uganda (as of March 2004)

<table>
<thead>
<tr>
<th>Number of plants in same city</th>
<th>Plants located in same suburb within city</th>
<th>Suburb where plants are located</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (Kampala)</td>
<td>- Plant 1</td>
<td>Nakawa Industrial area</td>
<td>Kampala</td>
</tr>
<tr>
<td></td>
<td>- Plant 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plant 3</td>
<td>Old Kampala</td>
<td>Kampala</td>
</tr>
<tr>
<td></td>
<td>- Plant 4</td>
<td>Kanyanya</td>
<td>Kampala</td>
</tr>
<tr>
<td></td>
<td>- Plant 5</td>
<td>Luzira</td>
<td>Kampala</td>
</tr>
<tr>
<td>5 (Jinja)</td>
<td>- Plant 6</td>
<td>Jinja</td>
<td>Jinja</td>
</tr>
<tr>
<td></td>
<td>- Plant 7</td>
<td>Jinja</td>
<td>Jinja</td>
</tr>
<tr>
<td></td>
<td>- Plant 8</td>
<td>Jinja</td>
<td>Jinja</td>
</tr>
<tr>
<td></td>
<td>- Plant 9</td>
<td>Jinja</td>
<td>Jinja</td>
</tr>
<tr>
<td></td>
<td>- Plant 10</td>
<td>Jinja</td>
<td>Jinja</td>
</tr>
<tr>
<td>3 (Entebbe)</td>
<td>- Plant 11</td>
<td>Entebbe Municipality</td>
<td>Wakiso</td>
</tr>
<tr>
<td></td>
<td>- Plant 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plant 13</td>
<td>Kisubi</td>
<td>Wakiso</td>
</tr>
</tbody>
</table>
While distances between plants within the Jinja cluster are much closer, 3 out of the 5 firms in the Kampala cluster are located in different suburbs or parts of the City covering a total cluster area exceeding one square kilometer. It may be possible to talk about agglomeration in the Kampala-Entebbe sub-region (3) and, Masaka-Kyotera sub-regions (4). Both of these sub-regions fall under a broader geographical zone known as the central region. However, the idea of a central region cluster is inappropriate given the long distances and notable differences in the state of infrastructure, utilities and general state of development in the two sub-regions. Masaka City, for instance, lies about 120 kilometers from Kampala City, making it difficult for firms to benefit from economies of agglomeration.

In the literature (Schmitz 1997; McCormick 1999), clustering is often associated with four key advantages for member firms, namely market access, labour market pooling, intermediate input effects and technological spillovers. Currently, the fish processing industry depends on Lake Victoria, a fresh water lake shared by Tanzania, Kenya, and Uganda, as its natural resource base. This resource is used to produce fresh export products but because fish is a highly perishable product, the ability of the firms to handle, prepare and export their product under a functional ‘cold’ chain is critical to their operations. For a majority of firms, access to supplies and infrastructure must thus have provided greater locational advantages than market access alone.

All fish processing firms in the various clusters have had to provide intensive training for their workers to create a new pool of local skills in factory-based fish preparation. This skill base has benefited both new and old firms in the clusters – through labour mobility and the diffusion of ideas often associated with the routine interaction of workers. However, the clusters are marked by an acute absence of high-skilled workers in the more sophisticated aspects of fish processing. Yet, formal technical or vocational education institutes in Uganda have failed to provide adequate numbers of graduates qualified for industrial food processing. For their personnel needs therefore, firms tended to rely more on in-house training of persons with only a few years of formal schooling but, occasionally, also of graduates of the few local institutes available. For more complex tasks such as product development, some firms obtained technical expertise from buyers and other experts outside Uganda as such skills were unavailable locally (Kiggundu, forthcoming). An additional benefit of clusters is that they often induce the emergence of suppliers who benefit from having to deal with a group of customers co-located next to one other. Some of the suppliers often receive support from their customers. Both phenomena were observed within Uganda’s fish-processing clusters but we should emphasize that these benefits have been undermined by the failure to resolve
the problem of reliance on a natural resource that cannot be harvested limitlessly. Research-industry linkages were also difficult even where research institutes were in close geographical proximity to the clusters.

Overall, agglomeration of fish-processing firms in several locations provided only limited advantages.
3. Knowledge and technology aspects of the clusters

Some analysts might not expect resource-based sectors such as Uganda's fish processing sector to be based upon diverse knowledge inputs. Such a view would grossly be at odds with what we found in Uganda. The industrial fish processing sector, a natural resource sector, was based on a diverse set of knowledge critical for its ability to compete in markets. In this industry, firms needed engineering knowledge inputs for the design and restructuring of the plant layout.

They needed food science, food technology, chemistry and bio-chemistry knowledge inputs to deal with microbiology and other tests, to introduce new products and in some instances to be able to apply the concept of Hazard Critical Control Point (HACCP). Environmental knowledge on proper waste management and effluent treatment was also vital. Though not readily available, knowledge generated through fisheries stock assessment and research on the reproductive biology of commercial species would have been an essential component particularly in respect to decisions related to the search for value-added technologies.

Prior to the imposition and enforcement of the EU ban(s), the distribution of knowledge, information and technical support was ineffective. Although the post-ban period is associated with tremendous improvement with regards to process-related knowledge accessibility, our recent interviews in Uganda (2005) indicate that the clusters still suffer from a shortage of critical knowledge inputs including technical skills in the fields of product value-adding technologies and diversification of raw materials (fish farming).

With the help of buyers, the clusters have made some progress in product development but have not yet shifted from a mere preparation and export of whole and semi-processed fish products (portions, fillets) to the export of further processed products such as crumbed fish products, perfectly portioned fillets and loins or ready-to-eat packaged fresh and frozen products differentiated by weight. The incentives and skills to develop SPS compliant and affordable fishing and collection vessels are still lacking.

The fish cluster has gained knowledge from different sources although policies tend to affect firms differentially. Small firms are constrained in their attempt to upgrade because they lack the financial, technical and human resources to initiate and sustain technical change. However, larger fish-processing and -exporting firms have gained access to a wider menu of financial sources and thus greater opportunities to invest in technological change. They are able to employ well-educated and trainable managers, making it easy to absorb new techniques and to train other workers in the correct implementation of HACCP procedures. In addition, dealing with specialized firms, all engaged in the same activity, must have made it easier for local and international agencies such as UNIDO to provide support services and keep service-delivery costs low while maintaining outreach. These efforts all facilitated the diffusion of knowledge, skills, and resources to foster technological change.
4. Policy and incentives

The fisheries department was involved in fisheries policy development and implementation since its creation in 1948 and discussions in favour of a development strategy for the fisheries sector were already in progress by 1990 (Frielink, 1990). However, matters regarding policy tended to be scattered in various departmental documents. Crucially, the long list of responsibilities the fisheries department had assigned itself (Frielink, 1990) is an indication that the government in Uganda, like many other governments in sub-Saharan Africa, perceived itself as the main driver of economic activity not only in the fisheries but in other sectors too.

In fact, in the 80s and early 90s, the government ran a number of state enterprises and projects including those engaged in the production of fish nets (Uganda Fishnet Manufacturers), fish trawling (the Sino-Ugandan Fisheries Joint Venture with the Chinese), fish processing, 3 fish distribution centers, and a fleet of fish trucks (Uganda Fisheries Industries Limited) and the supply of fishing inputs (EEC funded Artisanal Fisheries Rehabilitation Project). Many of these state outfits ran into management and financial trouble prior to their closure or privatization. The key point is that despite this long history of public investments in the fisheries, no attention was paid to the need to build and support local systems for learning and innovation.

Owing to the prudent implementation of the economic stabilization and reform program since 1987, there was a surge in the flow of bilateral and multi-lateral aid and debt into Uganda and by 1990, it was generally felt that the development of the fishing industry was a private sector matter. Inspired by the new climate of free markets and private sector led development, donors started building a case for the creation and strengthening of the policy and support environment within the fisheries and other sectors. In the fisheries, this would be an environment that would encourage profitable and efficient private sector involvement while taking care of conservation and local nutrition objectives. Consequently, a new donor-led strategy for the development of the fisheries sector began to emerge in the early 90s. The main idea was to scale down government involvement to only those activities that warranted public sector intervention. These would include sector-level planning and monitoring, resource evaluation and statistics, management measures and enforcement, adaptive research and extension, export promotion and quality control, education and training and rural credit (Frielink, 1990). In particular, the Artisanal Fisheries Rehabilitation Project (AFRP) funded by the EEC suggested a re-organization of the fisheries department into four independent divisions namely a statistics and planning division, a management and law enforcement division, a research and development division and, an extension and training division.

With hindsight, it would appear that this effort to sketch out scaled-down tasks for the fisheries department and reorganization was an attempt to build a stronger support system within the sector. However, these early efforts to strengthen and improve policy coordination were still not attentive to technological improvements required in the fisheries. The inferior fish handling and processing technology that was prevalent did not seem to concern relevant government agencies and the donors who, at the time, supported much of the development effort in Uganda.

The prolonged economic and political problems in Uganda proved fertile ground for illegal fishing practices and detrimental fishing gear such as small mesh gill nets and seine nets (Ogutu-Ohwayo, 1999). But even after the country had returned to the rule of law in 1987, the right fishing gear did
not immediately become available. Law enforcement officers, mainly DFR extension workers within the districts, did not have surveillance capacity to effectively deal with the situation. A number of management measures and regulations were in place but they were often inconsistent or inadequately enforced. Mesh size requirements, for instance, varied with each different lake. On lakes Edward and George, the requirement was 5 inches while the countrywide requirement was a lower size mesh limit of 3” (Frielink, 1990: 3). Moreover, the Fish and Crocodile Act of 1964 had not been upgraded to meet changed conditions and requirements of the fish sector (Dhatemwa, 1999). While the failure to enforce laws was often attributed to the paucity of information on available fish stocks, reliable catch statistics, unavailability of craft and, financial difficulties, Frielink observed that the inherent conflict in the roles of field officers to collect statistics, enforce laws and provide extension services at the same time also played a role. Overall, the problem of weak surveillance had to do with a number of factors including inadequate capacity, low levels of interaction to exchange information, legal weaknesses and a lack of political will.

At the fisheries department (DFR), inspectors could not adequately perform their duties. They lacked guidelines and standard operating practices with regard to the inspection of fish batches landed, hygiene conditions at landing sites as well as procedures for sampling and traceability recording. The situation further worsened following the introduction of government’s policy on decentralization. District fisheries officers were no longer accountable to the DFR and were subsequently found not to be adhering to the correct instructions relating to the hygienic handling of fish (Interviews at UNIDO UIP, 2001).

Improvements in the process of producing fish exports were driven by external developments in the international trading environment, particularly the new European Union legislation known as Council Directive 91/493/EEC (Kiggundu, forthcoming). Briefly, the legislation required the government to appoint a local competent authority to oversee and manage the inspection process across the fisheries sector. Secondly, testing laboratories were to be designated and approved by the EU to ensure produce quality and safety. Third, infrastructure at landing sites was to be upgraded to improve sanitary conditions. Fourth, government had to ensure better hygiene and handling of fish throughout the supply chain – by fishermen, fish collectors and other transporters in addition to a whole host of improvements at industrial fish-processing plants. More specifically, fish-processing plants would only be certified compliant if they fulfilled requirements in the broad areas of plant layout, operations, application of HACCP (Hazard Analysis and Critical Control Point) and inspection. The list of compulsory requirements was long, complex and required major restructuring.

However, almost six years after the passing of Directive 91/493/EEC the relevant agency from the EU had not visited Uganda to monitor compliance. Uganda, in the meantime, had made little effort to comply with the Directive. In February 1997 Spain discovered salmonellae bacteria in fish exports from Uganda (6). Consequently, Spain and Italy imposed a bilateral ban on fish exports from Uganda. In April 1997, the EU made a decision requiring fresh or frozen Nile Perch exports from all three countries sharing Lake Victoria to be systematically checked for salmonellae bacteria as it entered the EU market. As Uganda started to learn new ways of dealing with changed exporting conditions, a cholera outbreak hit the country in December 1997. On December 23, 1997 the EU placed a ban on fresh fish imports from Uganda, Kenya, Tanzania and Mozambique due to insufficient measures to control the outbreak of cholera (Nathan Associates, 2000). Shortly after the
November 1998 EU Inspection Mission, anecdotal evidence pointed to a possible use of agricultural chemicals particularly pesticides to poison fish as a method of fish capture. A self-imposed export ban (March 1999) was announced by Ugandan authorities until the safety of fishery products could be guaranteed. One month later, the EU suspended imports of fish products from Uganda, Kenya and Tanzania. This series of bans created a hard-hitting and prolonged fish export crisis not to mention the sharp drop in export earnings between 1996 and 2000.

Given the importance of the fish sector to Uganda’s economy, there was a sense of urgency within government and development agencies to support compliance with the EU imposed Sanitary and PhytoSanitary (SPS) measures from 1997 to 2000. Since these conditions were compulsory, exporting countries and firms could only be permitted to re-access the EU market on condition that they fulfilled all the requirements. The ban was therefore conditional and because the EU was a high-value market, a strong incentive existed to accede to its new requirements. Across the clusters, firms invested substantially in process upgrading well beyond what was compulsory. For example, some introduced computer-aided devices for critical procedures such as tracking yield and storage temperature. Some introduced automated methods and non-basic mechanized equipment which opened up a further process of technological learning. All firms upgraded their in-house laboratory capabilities too. Their working knowledge of HACCP procedures, plant layout and industrial fish preparation and exporting improved at the same time. In other words, there was a great deal of process-related learning across these clusters. Following a review mission in early October 2000 (October 2-6), Uganda was upgraded to List I and hence permitted to resume exports of fishery products to the EU on a definitive basis.

However, our findings also show that fish processing firms had not yet learnt sufficiently to export fully processed products at this point for three possible reasons. First, in as much as the pressure to upgrade in products was increasingly felt by more firms in the clusters, incentives to stimulate private investment in product-upgrading were still weak. Secondly, product upgrading was supported and desired by the state but the state’s response to this new challenge was less decisive than was the case at the time of upgrading in process. Notably, the state played a more direct role in providing leadership and coordination in developing local standards and through its fisheries inspection service, regular monitoring. It also sustained pressure on the clusters to keep up with improved process-related standards. Thirdly, only a few actors within Uganda came together to jointly search and respond to the product-upgrading challenge. For example, the processors business association (UFPEA) played a lesser role in the product-upgrading effort than it did with process-related upgrading. This was probably because clusters perceived the introduction of product-upgrading more as a competitive strategy requiring creation of firm-level investment solutions and vertical joint efforts and less as a challenge requiring joint solutions of the horizontal multilateral type. Processors rapidly searched and accessed critical external knowledge inputs for upgrading in process because they faced a common difficulty – a common lack of knowledge inputs to introduce improvements demanded by the EU. In response to the product-upgrading challenge, the clusters still faced this common difficulty. However, the knowledge inputs required were exactly those that were better provided through bilateral linkages of the vertical type where producers and proprietors of this knowledge would minimize free-riding and supplier disloyalty.
5. **Key success factors for the process-related improvements introduced**

What factors explain the ability of Uganda’s fish processing and exporting industry to learn and innovate?

Overall, the clustering of fish-processing firms in several locations provided only limited advantages which supports the conclusions of other analysts who caution that a mere geographical clustering of firms does not necessarily predict to their development into systems of learning and innovation (Mytelka, 2003).

We attribute the ability of the fish processing and exporting clusters to engage in process-related learning and innovation processes to the interplay between institutional and organizational changes in the subsystem mediating market institutions, in the subsystem dealing with knowledge distribution and coordination, associated sector-based policies, and to some limited extent institutional changes in the finance subsystem in addition to a number of firm-level factors. The latter include the size composition of firms, orientation to institutionally-augmented markets, access to technical assistance, the financial gearing position of firms, personnel education and firm-level institutions. The emergence of flows of knowledge, support structures and inter-relationships was crucial to the ability of fish processing and exporting firms to successfully introduce innovative change.

Crucially, the government, international development agencies, the fish processors association and private firms all worked very closely and swiftly to rescue the industry. Fish processing firms jointly explored solutions through the fish processors association. New arrangements between processing firms and their suppliers were introduced. Buyers of Nile Perch in Europe formed an association that served as an information broker between the fish processors in Uganda and the European Commission in Brussels. A few of these buyers supported their suppliers in Uganda to comply with the EU rules while others did not. Interestingly, the joint search for solutions extended well beyond producers (fish processing firms), their suppliers and buyers. University departments combined efforts to develop and jointly deliver a new training course in fisheries and aquaculture. International development agencies participated in this effort too. Government departments and other providers of technical assistance introduced joint ways of delivering services to fish processing firms. There was another joint effort between government, international development agencies, fish-processing firms and boat builders to upgrade fish collection boats and fishing canoes. Joint efforts\(^3\) were critical in enabling Uganda's fish-processing clusters to upgrade their processes.

Elsewhere (Kiggundu 2006, forthcoming), we noted that success in terms of the introduction of innovative activity depends on the degree to which the set-up and dynamics of various key subsystems in the support system and firm-level competences (including firm-level institutions)

\(^3\) Joint efforts between public and private actors supporting the clusters; joint efforts between buyer firms outside the clusters; joint efforts between firms in the clusters
bring to bear on one another to promote learning and innovation. It was also noted that though the Nile Perch exporting industry always enjoyed the benefits associated with firm size, a wider range of financing possibilities, export orientation and other favourable characteristics, it was the flows and inter-relationships that emerged within the Nile Perch fisheries system that created a better fit between an improved support system and the firm-level competences necessary for a positive learning and innovation outcome.

6. Lessons learned and policy implications

What can we learn from the inability, so far, of Uganda to translate its successful albeit reactive response to the EU fish ban(s) (1997-2000) into a more cohesive and pro-active medium and long-term process of technological capability development and innovation?

The pilot projects initiated by UNIDO’s Uganda Integrated programme attempted to extract lessons from the fisheries sector for the benefit of a few other food subsectors. However, the kind of ‘fit’ observed within the post-ban fisheries system was absent across the pilot projects. This implies that pro-active interventions seeking to upgrade the capabilities of a sector ought to take into account the need to create this fit. In other words, it is important to build a ‘sector-based system’ such that learning and change can occur in each of the subsystems and in a manner that enables the learning across all these system parts to reinforce each other.

The second lesson which is related to the first is that while technological improvements introduced in the fisheries sector were in no doubt significant, they were insufficient to sustain competitiveness. If we assume that the fish processing industry has three main areas of production; capture and delivery; fish transportation to processing plants; and the processing and transportation to the market place, any technological improvements would need to interact and provide linkage across these three main areas in order to be fully effective.

Thirdly, the experience of the fisheries sectors in Kenya and in Uganda suggest that public efforts have a vital and multi-faceted role to play in enhancing technological improvement for greater competitiveness. This role includes but is not limited to enforcing regulation and standards of performance, funding research, facilitating innovation, and arranging the provision of technical assistance. In addition, the Ugandan case underlines the vital role of public efforts in providing overall leadership and co-ordination of systemic learning, institutional change and continued interaction with the various players in order to ensure that combined efforts bring about the required knowledge flows. For greater competitiveness of the fisheries sector in all three countries, public efforts will still have to play this multi-faceted role (Kiggundu, 2004).

In sum, Uganda must invest in SPS capacity and the associated knowledge infrastructure. The country generally needs to focus on technical change as an important driver of economic growth and development, which requires effective delegation of powers to a high-profile competent authority, perhaps a renewed and upgraded Uganda National Council of Science and Technology (UNCST). Through unambiguous policy and with the involvement of all relevant actors, the national competent authority on technological upgrading should provide leadership in organizing background research across carefully selected sectors; evolving standards and performance targets
for technological change; and developing new reward systems, and support, and enforcement mechanisms—all with an appropriate budget. Technological upgrading solutions will have to take account of sector-specific requirements and conditions. In this context, the competent authority should encourage productive relationships across all relevant public and private agencies, such as the investment authority, banks, government ministries, universities, business associations, suppliers, buyers, and research and training institutes.
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