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Programme for the implementation of a Regional Fisheries Strategy for the Eastern and Southern Africa and Indian Ocean Region

Programme pour la mise en oeuvre d'une stratégie de pêche pour la région Afrique orientale-australe et Océan Indien

INLAND SMALL-PELAGIC FISHERIES UTILIZATION OPTIONS, MARKETING AND OPPORTUNITIES FOR SUPPORT

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For The Eastern-Southern Africa and India Ocean Region

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PREFACE

This document is based on a series of activities undertaken during a 3 months period from March to June 2012. It was conducted in three (3) member countries of the East African Community (EAC) and funded by European Union (EU) through Indian Ocean Commission (IOC) as part of the Regional Fisheries Strategy (IRFS) for ESA-IO. The implementing agency was SMARTFISH under IOC.

Earlier on, it had been realized that cross-border trade in inland small-sized pelagics within the region was minimal and in most cases it was conducted clandestinely. One of the reasons advanced for its invisibility was lack of information on the available opportunities within the region. The purpose of the study was therefore to generate information to enhance cross-border trade in inland small pelagics by using a relatively unknown fishery as a test case. To this end, products from Brycinus nurse (Ragoge or Ragogi) and Neobola bredoi (Muziri) were uses as they are relatively unknown entities compared to sun-dried Mukene/Dagaa/ Omena (Rastrineobola argentea). To affirm the obscurity of the fishery, Muziri from L. Albert was being traded as Mukene from L. Victoria despite its small size and Ragoge on the hand, ended up in animal feed production mills as unknown entity.

Apart from the scanty eco-biological information, virtually nothing on processing, chemical composition and trade was known or documented on Ragoge and Muziri. For competitive participation in the regional or international fish trade compliance to basic quality standards is mandatory. For example, some standards on product labelling require technical nutritional information prior to their formulation. Generation of relevant information on both species would therefore enhance their position in the regional cross-border trade. Accordingly, nutritional information was generated and availed to potential suppliers of products made from the two species. To initiate the entry of Ragoge and Muziri-based products into the regional trade, samples were taken to a few commercial centres known for Mukene trade and tested for acceptability. It was also envisaged that once the trade gathered pace, demand would inevitably outstrip supply hence the need to strengthen potential processors in Uganda who were hampered by production bottle-necks. Under SMARTFISH funding identified the bottle-necks were identified, rectified and then up-graded to a level that would enable them to supply the required quantities to regional markets.

This report provides preliminary information on the processing options for Muziri and Ragoge, their nutritional information and the market potential of selected products within the EAC region. It also highlights the vitality of the identified and up-graded potential processors already involved in processing of inland small-sized pelagic but hindered from participating in the regional trade by a few technological, financial and knowledge related setbacks. It was noted that once the setbacks were lifted through well thought-out programmes, processors easily realized their potential and moved on to greater heights in their respective businesses. The report highlights two such processors who were picked at different levels of development, technological advancement and financial status but with intervention from SMARTFISH; they made strides to achieve their goals within a limited period of time. This is a lesson to other development partners to emulate because on several occasions finances have been released fisher communities without prior identification of potential and promising individuals or groups and the results have been disastrous. In most cases, expensive technologies have been abandoned at landing sites or misused because the target group did not “own” the project and so have ended up with white elephants. Finally, the report also underscores the opportunities available in the East, Central and Southern African region for the various value-added products from Uganda.

ACKNOWLEGMENTS

I wish to acknowledge the input of several colleagues in the fisheries departments of Kenya, Rwanda and Uganda and especially SMARTFISH focal points (Cluade, Simon and Daisy) for the invaluable information they provided on their respective fisheries. The Dagaa traders across the region are appreciated for responding to the incessant questions and to the potential processors (KASAVEX and ABEKENE) who participated in the up-grading scheme without forgetting the efforts of Agaba Umar who acted as a model processor to some sceptical processors. Dr J. Kwetegyeka is also thanked for conducting all chemical analyses for the samples. The Agrotec team is also thanked for facilitating my movements within the region and other colleagues like Carol Kirema-Mukasa, Damien Legros and Ansen Ward whose moral support was priceless. Finally, special thanks to the Project Co-ordinator, Mr Chris Short for bearing with me during difficult times and gratitude to IOC through SMARTFISH for funding this study.

LIST OF ACRONYMS

AOAC	Association of American Chemists
BMU	Beach Management Unit
CCRF	Code of Conduct for Responsible Fisheries
COMESA	Common Market for East and Southern Africa
DFR	Department of Fisheries Resources
DRC	Democratic Republic of Congo
EAC	East African Community
ECSA	East, Central and Southern Africa
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FBRC	Food Bioscience Research Centre
FTA	Free Trade Area
FMP	Fisheries Management Plan
FIQA	Fish Inspection and Quality Assurance
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis Critical Control Point
IDP	Internally Displaced Persons
IGAD	Intergovernmental Authority for Development
IOC	Indian Ocean Commission
ISO	International Standards Organization
LVFO	Lake Victoria Fisheries Organization
MAFF	Ministry of Agriculture, Fisheries and Food (UK)
MUFA	Mono Saturated Fatty Acid
NaFIRRI	National Fisheries Resources Research Institute
NFA	National Forest Authority
NFP	National Focal Person
PUFA	Poly-Unsaturated Fatty Acid
QM	Quality mark
SADC	Southern African Development Community
SFA	Saturated Fatty Acid
TCP	Technical Corporation Programme
TIN	Tax Identification Number
UNBS	Uganda National Bureau of Standards
UNHCR	United Nations Human Rights Council
URA	Uganda Revenue Authority
UIRI	Uganda Industrial Research Institute
WFP	World Food Programme

LAYMEN's SUMMARY

The SMARTFISH Programme, with funding from the European Union (EU) initiated this study to look at various utilization options that would enhance cross-border trade in small pelagics. As a test case, products from Brycinus nurse (Ragoge) and Neobola bredoi (Musiri) commonly found in Lake Albert of Uganda were developed together with potential Ugandan processors. The economically viable products from Ragoge and Muziri together with products from another small-sized pelagic Rastrineobola argentea (Mukene) that were already on the market in Uganda, were marketed in neighbouring Kenya and Rwanda to gauge their marketability.

The preliminary findings showed that there was an insatiable demand for all products marketed in the region albeit with variable quality standards. Whereas, traders in Rwanda preferred salted and sun-died products, Kenyan counterparts wanted salt-free products. However, the potential regional traders wanted to know the mechanisms that will be put in place to ensure consistent supply of high quality products, regularity of supplies, packaging and safe passage across the borders. The issues raised with potential traders have been discussed in other fora within the region and some efforts have been made to address them. It was also noted that while Rwandan traders re-packaged products for export to DR-Congo, Burundi and Congo Brazzaville, Kenyan traders were only catering for the local market.

Using secondary data and Consultant's expertise, opportunities for regional marketing of ten identified value-added products from Uganda were assessed. Population increases, regional geo-economic and political blocks, carbohydrate diet, nutritional properties of fish and civil strife were identified as the principal potential drivers that would enhance trade in the identified value-added. However, it was noted that these factors were overlapping and could influence each other and need for regional harmonization of policies to facilitate cross-border trade with minimal non-tariff barriers was emphasized.

In conclusion, trade in products made from small-sized pelagic fishes can be enhanced within the region with concerted effort from all key actors along the value-chain, improved upstream handling, broadening of utilization base, consumption campaigns and enforcement of harmonized quality and safety standards within the region. However, implementation of some intervention measures cited would require harmonized policies across national borders, substantial investment in the sector and sensitization of key actors with regard market requirements and goodwill among policy enforcers at border crossings. Additionally, formation of a platform where all key actors along value-chain would meet to resolve the inadequacies in the sector would also enhance regional trade in small pelagic.

LAYMEN's SUMMARY IN FRENCH

EXECUTIVE SUMMARY

The fisheries sector contributes greatly to the economies of the eastern, central and southern regions of Africa (ECSA) in terms of income, employment and export revenue. Until recently, only large-sized fish were exploited for human consumption but small-sized pelagic fish were used for animal feed production. However, in the last decade, concerted efforts have been made in various African countries to reverse the trend. For example in 2005, an FAO led study assessed post-harvest losses in one of the abundant small-sized pelagic fisheries (Rastrineobola argentea), in the East Africa states of Kenya, Uganda and Tanzania. In 2011, Uganda through the Department of Fisheries Resources (DFR), requested FAO under the Technical Corporation Programme (TCP) to address the question of high post-harvest losses in the fishery and improvement of upstream handling against a backdrop of declining per capita consumption trends. Under this programme, several products were developed to increase Rastrineobola argentea, locally called Mukene, for human consumption.

The SMARTFISH Programme, with funding from the European Union (EU) built on previous efforts by initiation of the present study that has been designed to look at increased utilization options to enhance cross-border trade in small pelagics. As a test case, products from Brycinus nurse (Ragoge) and Neobola bredoi (Musiri) commonly found in Lake Albert of Uganda were developed together with potential Ugandan processors and the economically viable products were marketed in neighbouring Kenya and Rwanda to gauge their marketability. Using a structured questionnaire with some input from the Trade Event Specialist, some potential regional traders tasked to evaluate their prospects. Prior to product development, information was gathered on all aspects of the Musiri and Ragoge fishery, including the sanitary status of fishing vessels, time of capture, daily catches, drying surfaces, storage facilities, packaging, wholesale operations as well as markets and transportation. The sand-free sundried products, powdered and fried products were promoted for regional markets. As a complementary study, the nutrient content of products from both fish species was determined for purposes of backstopping the three up-graded processors who were at different levels of development. The regional market opportunities surveyed indicated that there was an insatiable demand for all products made from small-sized pelagics ranging from sun-dried to powdered. The large quantities demanded by the regional markets could not be met by processors using traditional processing methods and operating at a small-scale. It was also evident that product quality was a determinant factor in product pricing. The cost of sand-free products was one and a half times more than adulterated products which underscore the influence of consumers in the market place. There were other external drivers that are likely to enhance regional trade of the identified value-added products from Uganda. They included population increases, regional geo-economic and political blocks, carbohydrate-based diets, nutritional properties of fish and civil strife or wars.

During the implementation of the present study, there were two major challenges namely; seasonality of the two species under scrutiny and the competence of local processors to be up-graded to standards required by the regional as well as international markets. Both factors slowed down the implementation process because unplanned exposure visits and training had to be conducted to improve the competence of potential processors under the up-grading SMARTFISH scheme.

In conclusion, there was an insatiable demand in the region for all products made from small-sized pelagic fishes from Uganda and trade in such products can be enhanced in the region with concerted effort from all key actors along the value-chain, improved upstream handling, broadened utilization base, consumption campaigns and enforcement of quality and safety standards. However, implementation of some intervention measures cited would require harmonized policies across national borders, substantial investment in the sector, sensitization of key actors with regard to market requirements and goodwill among policy enforcers at border crossings.

EXECUTIVE SUMMARY IN FRENCH

1.0 INTRODUCTION

The fisheries sector contributes greatly to the economies of East, Central and Southern African region (ECSA) in terms of income, employment and export revenue. The demand for fish has increased dramatically over the last two decades due to rapid regional population growth and the emergence of an export market for Nile perch and Nile tilapia (Oreochromis niloticus) in the Lake Victoria Basin. Globally, fish consumption has doubled since the early 1970's, and developing countries are responsible for over 90% of this growth (Delgado et al., 2003). Until recently, only large-sized fish was exploited for human consumption while small-sized pelagics were channeled to animal feed production systems. However, the trend is bound to change with unregulated population growth rates in the region. Indeed Von Braun et al. (2004) predicted that the annual consumption growth rates in East Africa (Burundi, Kenya, Rwanda, Tanzania, Uganda) will increase to 1.9% by 2015 for high-value (more expensive types of) fish and 2.2% for low-value fish.

Ragoge, (Brycinus nurse) and Muziri (Neobola bredoi) are small-sized pelagic fishes found mainly in African freshwater lakes. Whereas the former grows to a maximum size of almost 20cm (fork length (FL)), the latter rarely exceeds 4.4cm in length (Greenwood 1966). Ragoge is endemic to Lake Albert and Muziri is widely distributed in the Nilotic ichthyological region, extending from Lakes Turkana in the east to the Senegal River in the west, and occurs in Lake Chad and the Chari river system, as well as the Nile and Niger systems. Both species co-exist in Lake Albert, which is shared between the Democratic Republic of Congo (DR Congo) and Uganda. The lake is a typical rift valley water body measuring about 150 km long, with an average width of about 35 km, and a maximum depth of 56 m within 7 km of the mid-western shore. It boasts of multi-species fishery varying from small pelagics like Neobola dredoi and Brycinus nurse to large fish like Alestes baremose, Lates niloticus, Hydrocynus forskalli, Clarias lazera, Mormyrus kanume, Polypterus sp., Tilapia spp., Citharinus cithanus, Barbus spp. and Distichodus niloticus. Although Ragoge has a lake wide distribution with the highest concentrations occurring in the inshore waters and juveniles occur in very shallow water. Males dominate the population with a sex ratio of 3:1, they mature at 57 - 60mm FL and breeds throughout the year with peaks in March and April, recruiting into the fishery in January and February (Namboozo, 2004). It feeds on an insect diet and supplements it with Caridina and mollusks.

Muziri on the other hand, occurs mainly in the deep open waters of the lake and matures at a size of about 30 mm Standard Length (SL) and has a 1:1 sex ratio. It also breeds throughout the year but with a peak in December to January. As recently as 2004, about 95% of the fish caught were mature but with the increased fishing effort within the breeding area, the proportion of immature fish has understandably increased substantially which does not augur well with recruitment of juveniles into the next cohort to ensure sustainability of the resource.

The estimated total fish catch on the Ugandan side of the Lake Albert was estimated at 182,000 Mt in 2007 and 108,000 Mt in 2008 showing a decline of about 40% and an average of 145,000 Mt. About 80% of the total catch consisted of Ragoge and Muziri with an average of 86,900 Mt and 29,400 Mt respectively. Similar to other fresh water small pelagics, they are seasonal following the lunar cycle and caught by mosquito nets using lantern light to attract fish.

There has been a slight change in Ragoge size over a period of five years. In 2002 when the light fishery began, the SL was 66mm with 98% being mature but declined to 61mm SL with only 64% being mature in 2007. There has been no change in the size structure of Muziri and its mean length has remained constant at 37mm SL between 2002 and 2007. The variation in Ragoge size structure is a reflection of increased fishing effort targeting the species which implies enhanced market demand.

Both species are normally caught in large quantities and due to their small size they predominantly processed by the traditional open sun-drying method, which is weather dependent and therefore unreliable. It also requires a large drying area, which in most cases is shared between different uses. The incomplete drying coupled with poor handling practices contributes substantially to the current high post-harvest losses in the fishery sector. The traditional practice of drying on bare ground or gravel in unhygienic conditions, exposes Ragoge or Muziri to physical and microbiological contamination as a direct consequence of contact with domestic animals, and as well as birds and insects. The resultant product is mixed with sand/gravel, which constitutes poor quality and increases the risk to Salmonella contamination among other potential pathogens.

The choice of drying surface is dictated by market demand. As a result the quality is usually poor and unacceptable for both animal feed (Masette, 2008) and human consumption nationally and regionally. During the rainy season, the post-harvest losses are unacceptably high and yet the per capita fish consumption within the region has declined substantially from 15Kg in 1980s to less than 10Kg in 2011. Inevitably, most of the catch is processed for animal feed production rather than for human consumption. For example, within the Lake Victoria basin 80% of the total Dagaa catch is transformed into animal feeds and only 20% enters the direct human consumption chain. The scenario has been replicated for almost all the small-sized fish species within the region. The eastern, central and southern Africa (ECSA) region is faced with climatic fluctuations (drought, floods), food insecurity, human population displacements and other unforeseen circumstances that affect fish trade. Although the region is rich in fisheries resources, the utilization options for the catches is generally poor despite the declining per capita fish consumption. The limited utilization options also contribute to the high post-harvest losses observed in the small-sized pelagic fishery. In Uganda Bawaye and Mulamba (2006) estimated the post-harvest losses in the Mukene fishery to be 35% during the dry season and 90% during the rainy season. The losses were attributed to several factors including spoilage, wild birds and processing method (Okoche, 2008). All schools of thought attest to the fact that spoilage of harvested fish is partly caused by the inappropriate preservation methods and inadequate storage facilities. These factors unquestionably affect quality and shorten the shelf life of the processed products. Consequently, the marketing time for the product is not only reduced but the quality and safety are also highly compromised. This scenario does not augur well with some actors along the value-chain for instance traders and consumers.

Due to the inadequate nature of the drying method, limited utilization options, dynamic markets, changing eating habits and general disposition of value-chain actors in the small-sized pelagic fisheries in ECSA region, demand for interventions that are innovative, affordable and user-friendly technologies that are responsive to gender and the environment cannot be overemphasized. The present study as stipulated in the terms of reference (Annex 1) (was designed to address some the highlighted drawbacks. This was to be done through information collation on Ragoge and Muziri, designing processing methods, determination of nutritional content of fresh fish and products, development of commercially viable products, identification of constraints for emerging / promising fish processors and thereafter designing interventions for purposes of up-grading them to a level that would allow them participate in the regional fish trade. Finally an invitation would be extended to potential traders and processors to the SMARTFISH Trade Event in Lusaka (April 2012) designed to create a platform for processors and traders as a way of enhancing cross-border trade.

It was envisaged that the results of the study would be re-packaged and disseminated to other similar fishery within the region. In the long-run, regional fish trade would be promoted to invalidate the imbalances attributed to fish distribution, access, availability, security and nutrition to the consumers across various trade blocks.

2.0 IMPLEMENTATION OF TORS

Topical issues of the study included collation of existing information on the two species “muziri “(Neobola bredoi) and “Ragoge” (Brycinus nurse) and opportunities for handling, processing methods and marketing opportunities for these species were suggested. In collaboration with other specialists preparation for the SMARTFISH Regional Trade Event that took place in Lusaka- Zambia from 26 – 27th May 2012 were made. In this regard, regional field visits were made to Kenya and Rwanda to collect data on existing products, specifications, quantities demanded, constraints to current supply, demand and sale of fish and fishery products and finally changes occurring in the fish trade. As a test case, selected value-added products from Uganda were taken to regional markets for the purposes of identifying potential market outlets e.g. supermarkets. The results of the regional survey, market opportunities for value-added small-pelagic fish products from Uganda have been described to enhance market information for traders.

In addition, the study included the identification of existing progressive /emerging producers in Uganda with improved quality and value-added small-pelagic products. The identification of producers for up-grading was based on their business plans, available information and conclusions from discussions with the prospective candidates. As part of the up-grading process, a description of the opportunities for support to individual businesses was made. Opportunities included capacity building, provision of equipment, materials, marketing or other support to upgrade standards that were prioritised according to SMARTFISH requirements and objectives. Based on the resultant information, plans were made to undertake at least one prioritised intervention with one of the identified processing businesses and the uptake and impact of the intervention were assessed. Then afterwards the potential for a small-pelagic processor business were assessed and recommendations made for representation at the SMARTFISH Lusaka Trade Event in 2012. In Uganda, work was conducted with existing improved processor groups or individual companies with the sole aim of enhancing regional trade in small pelagics. All-weather improved and alternative processing techniques for small-pelagics were explored as a way of minimizing post-harvest losses in the sector. In this respect, an established processor in Uganda was identified and an improved “Senegalese” dryer had been planned to be constructed at his premises and field tested with local processors that had participated in the 2011 ACP Fish II trainers from landing sites of Kiyindi and Kasekulo. In collaboration with processors, modification and adaptation of the drier was to be undertaken based on sources of appropriate energy, fuel efficiency, fish drying capacity, cost of construction and other product needs and specifications. Unfortunately it was not possible to implement this TOR due to unforeseen circumstances. Instead, a concept note (ANNEX 8) on another potential drier was developed and submitted to SMARTFISH for potential funding.

Finally, using an in-country laboratory at Makerere University, nutritional analyses on underutilised small pelagic resources of Lake Albert namely “muziri “(Neobola bredoi) and “Ragoge” (Brycinus nurse) were determined and the results presented at the SMARTFISH Trade Event in Lusaka. For purposes of this report effort has been made to follow the logical sequence of events as opposed to the list reflected in the terms of reference (TOR). In addition, each TOR has been appropriately designated a title that summarizes its contents.

2.1 DEVELOPMENT AND ADMINISTRATION OF QUESTIONNAIRE

- In collaboration with STE responsible for organizing the SMARTFISH Regional Trade Event, prepare a checklist / questionnaire to collect data on existing products, specifications quantity demanded and constraints to current supply, demand and sale of fish and fishery products and occurring changes during market survey field visits to Kenya, Rwanda and DR-Congo

The Consultant drafted the questionnaire and forwarded it to Trade Event Expert (Mr D. Legros) and Fisheries Management Expert (Mr Ansen Ward) for their input but due to their workload at the time of questionnaire development, not much was contributed to enrich it. The questionnaire was also forwarded to SMARTFISH focal persons in Kenya as well as Rwanda for customization but in both incidences, the desired input was not realized for unknown reasons. After failure to get external input, some Ugandan colleagues were consulted and final version (Annex 2) was developed. Since it was not pre-tested in the region, there were several redundant questions which ought to have been omitted prior to its administration. Nevertheless, crucial information was gathered from a total of 25 individuals who were purposefully selected because of their involvement in the fish trade. With the help of National Focal persons (NFP), each identified respondent was interviewed from their places of work. By so doing the respondent continued with their work as the Consultant asked relevant questions and recorded responses. The approach used ensured that there was minimal interruption of respondent's work schedule and it reduced the likelihood of the Consultant being asked for a service fee. In cases, where the Consultant was not conversant with the local language, the NFP or another person helped with the translation. In Rwanda the SMARTFISH NFP only had time over the week-end and that explains the absence of government officials from the Department of Fisheries on the list of people met during the study (Annex 9) and their opinion on cross-border trade in small-sized pelagics was not captured. Owing to the small sample size of traders interviewed, it was futile to conduct a detailed analysis of responses. Instead information generated (Annex 3) has been used as reference to the discussion in Section 2.13 of this report.

2.2 BASIC INFORMATION ON UNDERUTILISED SMALL PELAGIC RESOURCES OF LAKE ALBERT

- Collate information on the underutilised small pelagic resources of Lake Albert namely; "Muziri "(Neobola bredoi) and "Ragoge" (Brycinus nurse) and suggest opportunities for handling, processing methods and marketing opportunities for these species.

Immediately after signing the contract several activities were undertaken simultaneously. This included collation of information about the Ragoge and Muziri fishery and a brief socio-economic survey to bridge some obvious information gaps. Although, Muziri is often mistaken for Mukene (one the three commercially important fish species in Uganda), it is smaller in size and only found in Lake Albert.

2.2.1 Brief socio-economic survey

Unlike Mukene, Muziri and Ragoge are not common in local markets distant from the Lake Albert basin. From the brief consultation with the Fisheries Officers in the Basin, the average catches of both species vary with landing sites as shown in Table 1.
It appeared that some landing sites such as

Table 1: Monthly quantities of Ragoge and Muziri landed at respective landing sites along Lake Albert

Landing site	Quantity fresh landed (MT)		Quantity of dried product (MT)	
	Muziri	Ragoge	Muziri	Ragoge
Wasenko	-	800	-	200
Bugoigo	1000	850	300	240
Butiaba	3000	2000	1000	450
Waaki	700	700	200	200
Walukuba	1000	900	250	300

Wasenko, did not handle Muziri at all and yet others like Butiaba captured almost 65% of the total catches. The reasons for the disparity may be twofold; either Muziri was deemed unimportant or its fishing ground was far from Wanseko but nearer Butiaba which compelled the fishers to land their catch at the nearest site. Some landing sites appeared to be collection centres for dry products. For example, Butiaba with its relatively developed infrastructure was a known collection centre for different fish species other than small pelagics. Walukuba, with a population close to three thousand (3,000) individuals was still lagging behind with regard to infrastructure development ostensibly due to wrong attitude towards external interventions, historical disposition and internal strife between locals and refugees from Rwanda and DR-Congo. However, during the present study, apart from the strife which was apparent, the other drawbacks were not evident.

Available information and field observations indicated that both species were invariably sun-dried on bare ground which influenced the quality of the final product. Products sun-dried in a similar manner are known to be highly adulterated with extraneous materials and highly contaminated with all kinds of pathogens. The type and level of contamination from various sources can be deduced from the surroundings depicted in Fig. 1. They may range from physical faecal matter from domestic animals to spoilage as well as pathogenic microbiological variants. Other processing methods like smoking, blanching prior to sun-drying, deep-frying, transformation into powder and fermentation had not been applied to the two species until the present study. However, Mr Agaba, Director of UMAGA (U) Ltd at Bugoigo landing site was already involved in deep-frying Muziri for Kampala markets.

Most sun-dried products were marketed mostly to DR Congo, Rwanda and South Sudan. The amounts marketed at various destinations varied with seasonality and landing sites but generally Rwanda had a lion's share.

Fig. 1: Clockwise direction: Ragoge drying on grass, plastic sheets, fishing net and bare ground

2.2.2 Value-supply chain

With regard to value-supply chain for Ragoge and Muziri, information gathered about the various inputs and actors indicated that inter-relationships of respective players were dynamic and extensive. For now, it is understood that Fig 2 is a fair representation of the linkage between key actors. They included boat owners, fishers, processors,

traders both local and regional, retailers, Beach management unit (BMU), local authorities and consumers. Each of the key actors has been described in details here below:

Boat owners

The boat owners cum fishers in the Ragoge and Muziri fishery were usually medium-to-high income earners who had accumulated their initial capital from other businesses or fish trade across the border. Although this category of value-chain actors was predominantly composed of males, there were several women who owned engine powered boats but hired the male folk to do the actual fishing. The hired fishers who were 2-3 in number per boat were paid in kind on agreed quantity of catch or a daily wage which did not exceed UGX 10,000 (US$ 4). According to the 50% of the respondents interviewed, fishing for Ragoge and Muziri was regarded as a risky business because of their seasonality, inability for the fishing community to access credit, fishing gears were exposed to rampart theft and weather conditions on L. Albert were quite unstable. Unlike Mukene boat-owners on L. Victoria who normally resided away from landing site in urban centres and checked on their business interests infrequently, the L. Albert boat owners resided at landing site and monitored their businesses closely. Regardless of the water body, boat owners related directly with fishers, processors, traders, BMUs and local government officials insofar as resources and policy is concerned. Apart from the boat landing fee, boat owners also incurred the initial cost of boat and operational costs which consisted of fishing gear and boat maintenance. The estimated cost of boat was UGX 700,000 -1,000,000 (US$ 280-400) depending on boat size and the fishing gear included a net made from 5-7rolls of mesh (each roll was 100m) was at cost of UGX 300,000 (US$ 120). Operational costs varied with number of crew members, type of lantern, distance to and from fishing ground and cost of paraffin however, it varied from UGX 100,000-120,000). Being in the western rift valley, the waters of L. Albert are quite choppy and destructive to fishing nets of small pelagics and v-shaped boats. As such, most of the fishing boats on L. Albert were flat-bottomed for stability purposes.

Fishers

Fishers on L. Albert were casual labourers if they did not own or hired boats. A common fishing crew was composed of 3-4 crew members because the

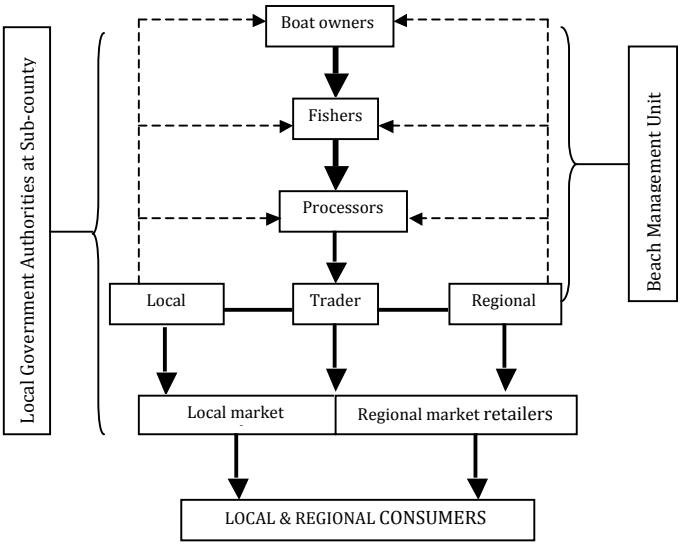


Fig. 2: Interactions between different players in Ragoge and Muziri fishery along Lake Albert

weight and size of Ragoge or Muziri fishing net requires at least two people to haul it while the remaining one or two ensured that the boat does not capsize during the hauling operation. During glut seasons, the catches are usually estimated at 200-500Kg per fishing trip per boat. Owing to the open access policy in Uganda, fishermen do not pay access fee However, landing sites charged a minimal landing fee ranging from UGX 5,000 to 10,000 per month depending on district by-laws. If it was a hired crew, the boat owner paid them a basin of Ragoge or Muziri or UGX 10,000-20,000 depending on amount of catch landed. If they had hired a fishing boat, then they paid the boat owner the agreed amount based on terms of the transaction. In incidences, the fisher was also a boat owner. In which case, payment was done at his own discretion.

Processors

The processors who were usually women or youth were either employed by traders or boat owners. Their first task was to ferry the catch from the fishing boat to the drying area, spread-out the catch to facilitate the drying process and then ensure that wild birds and domestic animals did not eat the fish. They were normally paid according to the quantity of Ragoge or Muziri processed. For example when 1 basin of fresh Ragoge or Muziri was sun-dried, the processor was paid UGX 500-1000/= depending on landing site. In some cases, the women who carried Ragoge or Muziri from the boat continued with the sun-drying operation and charged 1 basin of raw Mukene. Part of the drying operation involved turning over Ragoge or Muziri

every so often to facilitate the drying process. Some processors were paid in kind such that for every 30 basins of Ragoge or Muziri collected from the fishing boat to the drying ground, they got a basinful of Ragoge or Muziri which they dried separately from the trader's or boat owner's lot. After drying, the processor handed over the boat owners or traders product and retained her own which she accumulated until it reached saleable quantities (a basin or a bag). Storage of products varied with owners, quantities stored and capital input. Small scale processors like labourers operating less than UGX 100,000 capital base kept their dried Ragoge or Muziri in their houses while large scale traders cum processors with a capital base of more than UGX 5,000,000 kept their products in commercial stores. Small-scale processors sold their products to local or regional traders who in turn hired 7 MT capacity vehicles to transport their consignments to markets. Whereas most of the Muziri was marketed in DR_Congo and S. Sudan for human consumption, most of the Ragoge was marketed in Kampala to animal feed manufacturers. Often processors sold their products to retailers at UGX 15,000-18,000/= per basin or to wholesale traders at UGX 13,000-15,000/=. Each basin of adequately sun-dried weighed 4-5Kg and 7kg for Muziri and Ragoge respectively.

Traders

Local as well as regional traders habitually purchased sun-dried Muziri and Ragoge from major landing sites of Walukuba and Bugoigo but to make up for the required quantities other landing sites along shores of L. Albert like Wanseko, Butiaba and Waaki were visited. From these lucrative landing sites, Muziri and Ragoge might sell to other traders or the same traders might continue with their consignment to local markets like Arua, Gulu, Masindi and Kampala or regional markets in DR-Congo, Rwanda and S. Sudan. Interestingly enough most traders from DR-Congo were women while traders from Rwanda were men and in most cases got involved in the actual fishing. None of the traders met at landing sites visited around L. Albert was Sudanese. All the sun-dried Muziri from Uganda traded regionally was invariably used for human consumption regardless of the quality. The quantities of Muziri exported across the porous borders of Uganda were not known but information from the respective districts around L. Albert, indicated that the daily quantities varied from 30-50MT per week when in season. At the time, Rwandan traders took over 40% of all the Muziri processed from L. Albert landing sites, followed by DR Congo (20%) and then S. Sudan (30). It was reliably learnt that Rwanda re-exported large quantities to Burundi and Congo Brazzaville while S. Sudan also re-exported to Central African Republic.

Usually traders bought sun-dried Muziri and Ragoge from either boat owners or processors but on several occasions, some traders especially from Rwanda bought Muziri from boat owners before it was even fished out of the water. In such incidences, they employed both the fishers and processors to fish and dry the catch. The practice of advance payment to fishers or boat owners was also rampart on L. Victoria by the same Rwandese traders and estimated at UGX 2 billion per month. The practice did not keep the fisher in a contractual trap but it also had a bearing on subsequent handling and processing of small pelagics practices in Uganda. In that such contractors were subjected to such immense pressure to meet the conditions of the transaction that ensuring quality ideals was disregarded which resulted into quality-compromised products. Using the socio-economic lens, the processors were kept in a poverty trap that fermented eternal indebtedness since it was the kind of credit/loan they could not afford to default. The practice tends to weaken the bargaining position of fishers cum boat-owners to such an extent that returns on their investment is dictated by the financiers as opposed to their own business acumen. Given the stiff competition prevailing at most landing sites, most traders kept their merchandize in the available stores at landing sites until they accumulated enough tonnage for the available vehicle capacity. The storage charges varied with landing site. Whereas it was UGX 300/= per bag per day at Bugoigo, it was UGX 200/= at Walukuba. The quantities purchased by local traders varied from 1MT to 7 MT of sun-dried Muziri depending on vehicle capacity, capital and final destination. Traders involved in cross-border trade with S. Sudan or DR- Congo purchased large quantities to ensure business profitability since the transport cost was said to be exorbitant and besides, they had to contend with NTBs at border posts. Sun-dried Muziri or Ragoge was packed in gunny or hessian bags weighing approximately 125Kg because it was compressed. At the final destination, each bag of Muziri and Ragoge was sold at UGX 300,000/= and UGX 200,000/= in Kampala respectively. Traders that specialised in

Ragoge products distributed it mainly to feed meal manufacturers in Kampala. The same bag was charged equivalent of UGX 600,000-900,000/= at regional markets; with S. Sudan offering the highest price. Apparently, Rwanda purchased Muziri from Uganda, re-packaged it and exported it S. Sudan at 20-30% profit. The profit margins of actors along the supply chain of the small pelagics from L. Albert varied from 10% for the processor to 50% for the regional trader.

Retailers
Retailers basically purchased sun-dried Muziri and Ragoge from traders who were invariably wholesalers either at the landing site or local markets at the average price of UGX 100,000 per 50kg bag equivalent to about 7 basins (1 basin = 7kg). Generally, the retailer paid market dues or taxes on a monthly basis which varied with localities. Whereas the monthly market dues did not exceed UGX 1,000/= at landing site, most fish markets in Masindi, the nearest town to L. Albert charged UGX 10,000 and Kampala charged UGX 15,000/=. According to the majority of retailers, the storage charge was unacceptably too high and they wanted it revised downwards since customers were not many. In most cases, the retailers preferred to keep their small quantities in individual market lockers which were charged at UGX 5000/= per month by Market tax revenue authorities. There were two principal factors uppermost in the retailer's mind whilst engaged in selling of small pelagics; the profit margin and the intended use. The quality status of products rarely featured as a point of concern during transactions especially when the product had been branded as animal feed. On the contrary, if the product for human consumption did not meet consumer quality expectations, the retailer sold it at reduced prices which inevitably impacted on profit margins.

Beach management unit (BMU)
Initially, BMU was a legal entity in the three East African riparian States that share L. Victoria. It was put in place in 2003 to co-manage the fisheries resources of the lake. Following a few success stories at some landing sites around Victoria like Ssenyi, the approach was also introduced to L. Albert in 2007. BMUs play various roles which include sustainable utilization of the resource base, collection of boat landing fees and market dues from traders on behalf of local authorities, interpretation and implementation of regulations, conflict resolution, record keeping of basic fisheries statistics, organizing meetings for fisher communities, helping service providers to arrange training sessions and demonstrations for the empowerment of fisher community. In addition, they make by-laws in collaboration with fisheries as well as local authorities. Essentially, they are the operational link between governmental organs and fisher communities for resource management purposes.

Local authorities
Local authorities play an important role as actors in the value-chain. They are an extension of Central Government at a landing site and they are responsible for the overall management of fisheries activities at respective site. They liaise with fisher communities to develop and implement by-laws that affect the fishery in terms of production, infrastructure, revenue collection, sanitation and other relevant forms of development. Revenue is collected from all other value-chain actors and taken to respective districts. By law 20% of the revenue should be ploughed back at the landing site for developmental programmes including fish handling facilities, drying racks, storage facilities and social amenities like toilets and recreation halls. However, many of the landing sites around L. Albert rely on donor funded projects to develop their respective areas despite the monthly collection of revenue by local authorities. For example Walukuba collects about UGX 5,000,000/= per month in terms of revenue but none of the infrastructure has been put in place. Available information indicated that the revenue collected was insufficient and it was used for other programmes like education and health in other parts of the district. In other words, although the landing sites generated substantial income for the district, they were grossly marginalized with regard to developmental issues.

Consumers
Most consumes of sun-dried small pelagics are low income earners. However, the majority of consumers ate small pelagic through the secondary consumers like poultry, pigs and farmed fish. Considering that most people within the Great Lakes Region are non-vegetarians, there are about 200 million potential consumers of small pelagics within the East and Central African region. Unlike the retailer, the two principal factors of concern uppermost in the mind of a consumer when purchasing sun-dried small pelagics from the local market, is cost per unit volume and the

quality properties of the product like appearance, smell, levels of cleanliness, drying, sorting, fragmentation and lustre. The scrutiny for quality was comparatively more rigorous with Muziri than Ragoge because the former was intended for human consumption while the latter was undoubtedly meant for animal feed production. In most retail markets in Uganda, Mukene and Muziri for human consumption was sold in plastic cups whose contents weighed 100g and cost UGX 700-1500/= depending on distance from landing site. The Ragoge was always sold per weight unit and the price varied accordingly.

2.2.3 Preservation methods

Sun drying is the predominant method for preservation of both species around Lake Albert. The drying surfaces vary from bare ground or grass to plastic sheets spread on the ground (Fig. 1). Other preservation methods include salting and deep-frying albeit on a small scale depending on market demand. Transformation of small pelagics into powder is a recent development around Lake Albert although it is gaining market among the previously sceptical affluent consumers in cities like Kampala.

The concept of drying on raised racks was still not common among the majority of processors met at Bugoigo landing site. Government of Uganda had constructed several racks at Wanseko landing site in late 1990s but at the time of the visit, they were in a state of disrepair as shown in Fig 3. Based on previous observations spanning a period of 30 years, the Consultant has noted with dismay that generally fisher communities do not have a culture of maintenance or repairing facilities offered by government if they were not involved in decision-making. It seems fisher communities in Uganda exhibit the same attitude to government-initiated facilities as it was also observed at Kisuku landing site in Section 2.9.3.

The attitude was principally embedded in the question of facility ownership. Fisher communities in Uganda and probably in the whole ECSA region seem to object to any intervention they have not participated in its initiation. They fail to take responsibility and leave the facility to fall in a state of disrepair. Probably, the government approach to development should change such that from the very inception of the project, government should only play a supportive role as opposed to financing and implementating. In this regard, awareness

Fig. 3: Raised drying racks made from weld mesh at Wanseko landing site (poorly maintained)

should be created about the necessity of certain facilities within the community and the concerned target group should buy into the idea by committing a substantial contribution to the proposed facility before commencement of the project. The contribution may be in terms of money or materials. Although the contribution may take time to materialize but it will worthwhile to wait because it may make or break the project.
From field observations, lack of premium on high quality products played a huge role in the choice of a drying surface. Since most products were marketed across the borders of Uganda where quality was not an issue, processors rarely bothered with the drying surface. Quite often, Ragoge or Muziri intended for domestic consumption was always dried on tarpaulin or old fishing nets or polythene sheeting but all commercial fish products were invariably dried on bare ground or grass at all landing sites visited around Lake Albert. The drying period varied with seasonality and cloud cover. During the wet season, the drying rate was understandably much slower than during the dry season and faster on a sunny than on cloudy day. When weather conditions become unfavourable for drying, all affected Muziri or Ragoge products were relegated to animal feed production. Considering that the per capita fish consumption is declining against a background of incessant human population increases, innovative alternative drying methods should be developed to increase supplies of small sized pelagics for human consumption as opposed to animal feed production.

2.3 NUTRIENT COMPOSITION

- Determine nutritional analyses of the Muziri and Ragoge using an in-country laboratory.

There are several reasons that necessitate determination of chemical nutrients in a given fish species. The choice of a preservation method requires prior knowledge of the chemical constituents of the respective fish species to avoid unnecessary quality related mishaps. For example open sun-drying is not recommended a fatty fish because the unsaturated fatty acids tend to react with atmospheric oxygen to produce chemical compounds associated with rancid off-flavours (Huss, 1995). Secondly, the fat layer beneath the fish skin tends to impede water movement from the core of the fish to the exterior to allow evaporation. Moisture impediment slows down the rate of drying due to retention of water within the inner parts of the fish. Instead of drying for a day, the fatty fish may take 3-5 days during which time products of rancidity associated with off-flavours may have exceeded the threshold accepted by the majority of consumers. Once consumers reject a fish product on account of rancid flavours, then the product cannot be marketed at a premium price. With regard to pelagics, it may be relegated to animal feed production. In other words, knowledge of chemical constituent of fish would prevent diversion of the product intended for human consumption to animals. Another reason that necessitates determination of fish nutrient composition is compliance to product labelling. In most developed economies, it is a consumer's right to have access to nutritional information prior to purchase of a product. Food labelling is intended to provide consumers with simple, comprehensible, and consistent information about the food they buy, enabling them to make wise choices (Katona-Apte et al, 1977). In the absence of such information, the packaging and labelling of the product will not only be non-compliant to local as well as international standards but the sales of such product will not pick-up especially if the product is new on the market. Of late, eco-labelling has assumed prominence in the market space and a prospective processor may have a competitive advantage over other processors if the product is eco-certified by a recognized firm. One of the many criteria underscored during eco-labelling certification is the involvement of fisher communities in responsible fishing and whether the accrued benefits trickle back to the community. Assuredly, if a processor from L. Albert Basin reaches that level of market access, the benefits will trickle back to the community directly or indirectly depending on the processors involvement at the landing site. Another advantageous marketing strategy a prospective processor can adopt is the implementation of a traceability system in the production of a product. The system allows the consumer to have information about the product from "farm to fork" and in the present circumstances; it will be from "capture to fork". The information which may include place and date of capture, processing conditions and shelf-life among other relevant information is captured in the barcode appended on product package. There is a premium price in developed economies for eco-labelled and barcoded product. Although the present principal objective of the SMARTFISH is to enhance regional trade in small pelagics, Europe, Americas, Australia and the Far East are the most lucrative fish markets. However, if one of the small-sized pelagic Ugandan processor that has been up-graded under the SMARTFISH scheme attains that status and secures such a lucrative market outlet, it will be a credit to them. Indeed, it would be an avenue for fast-tracking economic development in ECSA region. Probably, it would be a good idea for the up-graded companies to venture into eco-labelling and traceability as a vehicle to tap into upper range of the international fish trade.

In view of the aforementioned knowledge base, it was imperative that the prospective processors in Uganda were supported in their endeavour to access regional as well as international trade in small pelagics. To initiate the process, there was a need to generate nutritional information for appending on respective product packages. Currently, there is a knowledge gap on their chemical composition and the present study has been designed to determine basic nutrient constituents like fat, protein, gross energy and selected minerals namely calcium, phosphorous, zinc, manganese and iron. In addition, environmental chemical contaminants like lead and cadmium have been analysed for safety reasons. According to Huss (1995), chemical constituents vary with sex, seasonality, fishing ground, type of food and physiological status of the fish. However, owing to the limited scope of the present study, the analysis did not delve in effect of various variation factors. As a test case, basic nutrient composition of fairly unknown products from Ragoge and Muziri products was determined using standard AOAC methods. The Ragoge and Musiri samples were collected from from Bugoigo landing site during the month of March 2012, transported to a local laboratory (Makerere University, Department of Chemistry) and analysed in triplicates. The broad categories of fish nutrients analysed included proteins, lipids (fats) and ash in terms of

minerals. Essentially, the chemical composition of most fresh water tropical fish species varies with species but on average freshly caught fish contains 18% proteins, 12% fat, 1.35% ash and 73% water. Indeed the chemical compositions of Nile perch (Lates niloticus), Nile Tilapia (Oreochromis niloticus), Mukene (Rastrineobola argentea), catfishes like Bagrus docmac and Clarias gariepinus fall within the same range. However, methods that tend to reduce moisture in fish muscles during preservation culminates into seemingly elevated compositional values as shown in Table 2 for small pelagics of L. Albert. Otherwise if Ragoge and Muziri were to be analysed while fresh, their compositional values would be similar to other fresh water species. The Ragoge and Muziri results in Table 2 are indicative of the chemical composition for the month of March. It is possible that if the same tests were repeated in the month of December, they would be slightly different. To attain conclusive results for the two species, there would be a need to repeat the analyses over a period of time and taking into account all the variables like seasonality, condition of the fish and fishing ground among other factors.

Each of the nutrient constituent analysed plays a vital role in the dietary requirements of a consumer (Huss, 1995). Generally, fish have high protein content and provide an excellent source high quality protein with sufficient amounts of all the essential amino acids. In comparison with crop protein, fish has a higher biological value (Potter and Hotchkiss, 1995) and that is the reason most fisher communities in Uganda use Mukene or Haplochromines soup as medicine for cure of Kwashiorkor (a form of malnutrition that occurs when protein is a limiting factor) among children. Technically, the two species do not have medicinal properties but have high levels of protein. For example Mukene protein content has been estimated at an average of 60% dry weight (Kabahenda et al, 2011). For this reason, signs of kwashiorkor disappear as a victim is fed on a concentrated proteinous fish soup. The Ragoge and Muziri have almost the same amount of content like Mukene or Haplochromines and therefore should exhibit the same medicinal properties when fed to children suffering from Kwashiokor. The fat content of both species is comparable to 100 Kg Nile perch Lates niloticus (Ssali, 1988) which contributes to its slow drying rate and rancid flavours during the drying process that takes almost 10 days regardless of the drying surface. The gutting and blanching operations could be remedial measures to rancidity development and prolonged drying period. According to Wandera (small pelagics biologist based at National Fisheries Resources Research Institute (NaFIRRI)) Ragoge breeding peaks in December and January and therefore the fat content characteristically lower than during other months of the year including March. Fats therefore tend to vary with water content, condition of the fish and seasonality. Fats in fish are principally unsaturated compared to plant fats which are highly saturated. The level of unsaturation is evidenced by the presence Omega 3 fatty acids known for prevention of cardiovascular diseases. Although the fatty acid composition and profiles were not conducted for Muziri and Ragoge during the present study but Table 1(a) shows results for Mukene from L. Victoria. Since Ragoge and Muziri are also small-sized pelagics, it is probable that they may have the same fatty acid composition and profile. In which case, they can be marketed as a rich source of Omega 3 to individuals prone to cardiovascular diseases. Fish fats are therefore play a vital dietary function in the reduction of cholesterol and solvent for vitamins like D and B12. Both Ragoge and Muziri have comparable amounts of minerals as other small pelagics (Kabahenda et al, 2011, Potter and Hotchkiss, 1995, Huss, 1995); in that the mineral average for both species is about 2%. Minerals are an important ingredient in the functioning of body systems. The most important ones include phosphorous, calcium, iron, zinc, sodium, potassium, manganese and copper. Phosphorous and calcium are required by humans in greatest amounts because of their roles in bone and teeth formation, control of body fluids and particular calcium is necessary for clotting of blood. Deficiencies of important minerals in the human body lead to malfunctioning of various body systems (Potter and Hotchkiss, 1995). According to MAAFF (1995), the daily intake by an adult human varies with essential minerals (Table 8). Based on the daily intake, calcium, phosphorous and iron contained in any 100g of either Muziri or Ragoge far exceeds the recommended amounts in Table 3. As such, products from both species can be recommended for children under 5 years of age, pregnant and lactating mothers, invalids, elderly and people living with HIV/AIDS. Table 3: Daily intake of minerals for an adult

Table 2: Nutrient composition of mukene expressed in unit/100g of sample on dry basis

	Average nutrient chemical composition (n=3)										
Product description	**Protein (%)**	**Fat (%)**	**Gross energy (Kcal/100g)**	**Ash (%)**	**P (%)**	**Ca (ppm)**	**Fe (ppm)**	**Mn (ppm)**	**Cd (ppm)**	**Pb (ppm)**	**Zinc (ppm)**
Ragoge freshly dried	62.88	20.58	5177	11.36	1.80	1225.0	100.0	15.0	0.0	16.3	100.0
Ragoge sun-dried	66.99	14.55	4834	11.82	1.70	550.0	215.0	13.8	0.0	17.5	122.5
Ragoge smoked	65.78	15.24	4523	11.78	1.75	650.0	218.0	14.5	0.0	17.7	121.9
Ragoge blanched & sun-dried (1 min)	63.35	16.75	4428	10.89	1.69	653.0	220.0	15.15	0.0	15.5	120.6
Ragoge blanched& sun-dried (4 min)	67.92	17.78	4344	11.36	1.72	670.5	219.0	15.4	0.0	16.0	123.6
Muziri freshly dried	65.49	16.33	5112	13.53	2.20	1125.0	102.3	11.3	0.5	20.2	236.8
Muziri blanched & sun-dried (4 min)	69.53	9.51	4560	14.35	1.83	625.0	162.5	13.8	0.5	10.0	418.8
Muziri blanched & sun-dried (1 min)	63.25	12.67	4598	14.56	2.02	625.0	165.6	11.5	0.5	11.5	402.7
Muziri salted and smoked	51.40	13.10	6339	10.01	1.43	512.5	145.0	12.5	0.3	15.0	295.0
Muziri salted & sun-dried	70.44	9.51	4446	13.04	2.04	537.5	111.3	13.8	0.6	10.0	393.8
Muziri salted drip-dried & smoked	47.13	14.21	6180	9.93	1.34	350.0	122.5	10.0	0.3	18.7	243.8
Muziri unsalted and sundried	69.60	10.30	4769	13.99	2.14	550.0	147.5	10.0	0.6	23.8	436.3

Table 3: Daily intake of minerals for an adult

Mineral	Calcium	Phosphorous	Potassium	Sodium	Iron	Zinc	Cobalt
Daily intake	0.9g	1.5g	3.2g	3.4g	14.0mg	11.4mg	0.3mg

Source: Manual of nutrition (MAFF, 1995)

In present study, the chemical composition of Ragoge and Muziri (Table 2) was comparable to other small inland pelagics like Mukene (Masette, 2011). The average protein content in both species was above 50% which underscores their importance as a source of protein for malnourished children especially the powdered product which can be further transformed into a weaning food for children under 12 months of age. The powdered product can also be extruded together with carbohydrates into ready-to-eat products for invalids or people living with HIV/AIDS (FBRC, 2010).
Considering the level of protein, fat and minerals content all products made from both fish species may be marketed as highly nutritive and recommended for vulnerable members of society especially, children under five years of age, invalids, elderly and pregnant mothers..

2.4 PRODUCT DEVELOPMENT

- Working with existing improved processor groups explore all-weather improved and alternative processing techniques for small-pelagics.

Processing of small-pelagic fishes into high quality products for marketing within the ECSA region is a tricky business. Due to inadequate technological advancement, the sector is faced with several challenges that range from preservation to market. Usually, small pelagics are caught in large quantities and owing to their small size, the commonest processing method is sun-drying. The method may affordable by majority of processors but it is weather dependent which implies that during the rainy season, the post-harvest losses may be as high as 90% of the total catch. The high post-harvest losses in the sector severely undermine food security in the region and considering that the per capita fish consumption is lower than the world average, alternative processing techniques should be developed and promoted within the ECSA region. The most logical remedial approach would be to design processing technologies that are less dependent on weather elements and with the capacity to handle large quantities of pelagics landed at various sites along water bodies. Currently, there are several processing prototypes on shelves of some research institutions but some are either too expensive or their processing capacity too low. The development of a mechanical drier would be the best option but it is expensive and the prototypes so far developed tend to compromise product lustre and yet most consumers within the region associate lustre with quality. It is important to note that a product that lacks lustre costs less than products with the desired lustre by almost a third. The other remedial approach would be to increase the utilization options or product diversification as a means to reduce post-harvest losses in the small pelagic fishery. Indeed, the recently concluded FAO funded project (TCP/UGA/3204 (D)) that was intended to increase supply of Mukene (Rastrineobola argentea) for human consumption, broadened the utilization base for Mukene. Several products were developed using low-cost technologies with least reliance on weather conditions (Masette, 2011) and a few products were developed from recipes from S. E. Asia. Previous efforts (Masette, 2005; Masette and Atyang, 2007 and Masette, 2011) with respect to product diversification from Mukene were done in collaboration with fisher communities at landing sites; Kisuku in Masaka District, Bumeru A in Namayingo District, Kiyindi in Buikwe District and Kasekulo in Kalangala District. Since Ragoge and Muziri are equally small and bony like Mukene, the present study applied similar processing methods with minimal modifications. For instance, Ragoge was blanched prior to sun-drying due to its high lipid content. Several products were developed during the present study. They included blanched and sun-dried, smoked, deep-fried, powdered and silage. The latter product was recommended for production during the rainy season as the only viable option in prevailing circumstances. Silage was purposely developed for animal feed while the rest of the products were intended for human consumption. Most of the work was done at Bugoigo landing site where UMAGA (U) Ltd is located but as a dissemination ploy production of Muziri powder was demonstrated at Walukuba landing site located 20 Km away from Bugoigo. For purposes of this report, development and processing of each product will be considered singularly.

2.4.1 Blanched and sun-dried product

Fish blanching is common in S. East Asia where small marine pelagics are dipped in boiling water for one minute prior to mechanical or open sun- drying. Blanching was unknown in Uganda until the present study. The blanching operation kills potential microbiological spoilers that may be present on the surface of the fish. With the elimination of spoilers, the product shelf-life is extended for longer time than if the fish was not blanched. With regard to Ragoge, blanching offers an additional advantage; the off-odours are reduced appreciably which increases its acceptability index among consumers. The resultant product is pale in colour (Fig. 4) and it may be marketed as the traditional sun-dried product despite its loss of lustre.

Fig. 4: Blanched Ragoge spread out to dry on a drying surface

The average yield for blanched Muziri and Ragoge is about 32% and 40% respectively. Reduced yield was attributed to moisture loss and pulverization of fish tissues. Because the product was new on the market, it was not possible to gauge the exact price traders were willing to offer locally or regionally. However, most local consumers were offering less than for direct sun-dried products by 20% i.e. UGX 1,200 per 100g (US$ 0.50). Since it looked like the traditionally sun-dried product, the tool of measurement normally used at Bugoigo landing site is a tin or jerrican shown in Fig 5. The contents if sun-dried without blanching weigh about 8kg and charged UGX 15,000 (US$ 6.00)

Fig. 5: Plastic jerrycan used as measurement tool for sun-dried pelagics

Procedure for fish blanching

About 1 kg of fresh Muziri/Ragoge was weighed, washed with clean water and then put in a wire strainer before lowering in brined boiling water for one minute. The blanched fish was removed from boiling water and spread on a raised rack for drying. The drying process took 1-2 days depending on weather conditions and species. Normally, Ragoge takes longer to dry than Muziri because of the adipose fat beneath the skin. The blanched sun-dried product may be subsequently treated like sun-dried products with regard to packaging and marketing.

2.4.2 Smoked products

Smoked Ragoge or Muziri was a new concept around L. Albert but it is common practice with Dagaa in Mwanza-Tanzania. The smoking process cooks the fish, imparts the smoky flavour, exerts anti-oxidant properties and dehydrates the product to a moisture level of 45%. The low moisture content also influences water activity (Aw) which is the partial pressure of a product divided by partial pressure of pure water. In other words, Aw is the amount of water available for the growth of micro-organisms in a given food. As such, reduction of Aw inhibits the growth of spoilage micro-organisms and extends the shelf-life of a smoked product.

Fig. 6: Packaged smoked Muziri

The resultant smoked product is golden brown in colour (Fig. 6). It may be consumed directly as a snack since it is virtually cooked or it may be further cooked as a sauce. Alternatively, the smoked product can be milled into flour and used as a condiment on greens or other vegetables. The production yield of the smoking process ranges between 30-40% for Muziri and 42-50% for Ragoge with profit margins of 20% to 30% respectively. Typically, the smoked product was packaged in 500g sachets and sold at UGX, 1500 on the local market but could probably fetch as much as US$1 when exported to lucrative markets in Europe. The minority groups from ECSA spread all over Europe and Americas represent a viable market for most products made from small pelagics

Procedure for fish smoking

Freshly caught Muziri/Ragoge was washed using clean water then dry salted with 2% salt before drip-drying for 1-2 hrs depending on weather conditions. It was then sparsely spread on drip-drying tray(s) until dry to touch. The semi-dry Muziri/Ragoge was loaded on a smoker tray which had been previously smeared with vegetable oil to reduce incidences of sticking on tray. Then load semi-dried products on kiln (smoker) and start the smoking process. Being small in size, exposure time to smoke was limited to only to 15 minutes at low temperatures (40ºC) for flavouring purposes depending on type tree species generating smoke. The smoke source was removed before increasing temperatures to 80-120ºC for 1-4 hours as a way of ensuring that dehydration occurred and that the fish cooked adequately. The two operations are preservation measures. Temperatures were reduced to 40-60ºC for 6-12 hours by either removing excess ambers of charcoal/firewood or shovelling in loads of sand. After completion of the smoking process, the Muziri/Ragoge was allowed to cool for at least 2hours before offloading from kiln. The smoked product was packed in woven baskets and stored in a well-ventilated store away from vermin and domestic animals.

2.4.3 Deep-fried

Apart from UMAGA (U) Limited, deep-frying of Ragoge or Muziri was also a new concept around L. Albert. Deep-fried product is crispy golden brown snacks (Fig.7) that may be spiced using different local flavours like carry powder, garlic, pepper, lemon, onion and ginger. The yield ranges between 30-40% for Muziri and 42-50% for Ragoge with profit margins of 20% to 30% respectively. Previous studies (Masette, 2005) indicated that to break-even in fried pelagics, the product ought to be packaged in 50g sachets and sold at UGX 500. At the time of writing, 100g sachets of deep-fried Mukene snack in Ugandan supermarkets are sold at UGX 2,500 but could probably sell at US$3 when exported to lucrative markets for minority groups in Europe.

Fig. 7: Packaged fried snack Muziri

Procedure for fish frying

About 1 kg of fresh Muziri/Ragoge was weigh, washed with clean water, ½ tea spoon of salt added and drip dried on a net for 1hour. The Ragoge were gutted, washed before subjecting to subsequent treatments. Then heat up 1 L of the vegetable oil in a frying pan before lowering measured quantities of drip-dried Muziri/Ragoge in hot oil. When the colour of the fish changed to slightly golden brown, it was removed and excess oil drained using a net. Finally, the product was cooled and prior to packaging.

2.4.4 Powdered

Muziri/Ragoge powder is dark in colour (Fig. 8) because of offals or guts. Removal of guts prior to product development was deemed not cost effective and too laborious for a typical processor. The resultant product that may be used as a condiment was spiced using different local flavours like garlic, pepper, onion and ginger. The yield ranged between 25-30% and the profit margins (10%) covered up for the water loss. Typically, the powder was packaged in 50g sachets and sold at

UGX 1,500 on the local markets but could probably sell at US$1 when exported. Since the rate of oxidation is exacerbated by particle size, small sachets weighing 10g would be recommended for a producer.

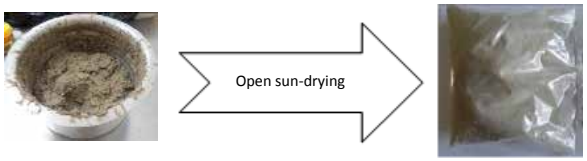


Fig. 8: Muziri/Ragoge powdering process

Procedure powdered product
About 1 kg of freshly caught Muziri/Ragoge was washed with 1% brine, weighed and put in a clean saucepan to boil. About 30 g of salt and 5g of desired flavour (local flavours include ginger, lemon, onion, garlic, hot pepper) were added. The mixture was boiled while being stirred until a thick paste developed which was cooled before being spread on a metallic tray to dry for 2 days. The resultant product was milled in a domestic mincer to produce a powder that was packaged in recommended quantities.

2.4.5 Silage

From past experience, silage production using formic acid was better than enzymic hydrolysis. Generally transformation of pelagics into silage offered a better solution for the feed industry than the adulterated sun-dried pelagics. However, in its liquid form, marketing of silage would pose a transportation challenge as it would require huge unaffordable drums. Addition of cassava flour or rice bran or maize bran to form a firm mixture prior to sun-drying would improve the texture, stability and portability of the resultant product. Previous studies (Legros and Masette, 2010) found out that such products were more appealing to potential users than the liquid option (Fig 9). The sun-drying process of the mixture of silage and cassava flour took two days to reduce moisture level from 80% to 10% in Muziri and a whole week for Ragoge.

Fig. 9: Liquid silage transformed into portable granules by adding solid prior to open-sun-drying

Procedure for silage production
Same quantities of clean fish as used in 2.5.4, was weighed and minced before adding 3.5ml of formic acid. The mixture was kept in anaerobic condition for 2-3 days to produce liquid silage. About 500g of cassava flour was added to solidify before sun-drying for stabilization purposes. The dried mixture was packed in Hessian bags and kept in a ventilated dry cool place.

Each of the processing options demonstrated above had a number of constraints/challenges which have been tabulated in Table 4 for ease of reference and comparison.

It is evident from Table 4 that production capacity of each of the processing options was a killer constraint which needed to be addressed by increasing processing capacity through innovations. The only innovative option with expected long term profit margins is mechanization of the process line. However, none of the existing groups involved in processing small pelagics in Uganda can afford it without external financial support from a developmental partner or government. Most of them have meagre incomes and sceptical about massive investment in a technology that has not been time-tested.

2.4.6 Canning

In 1960s the fisheries biodiversity of L. Victoria was predominantly characterized by Haplochromines and Mukene fishery. At that time, fish consumers had a wide range of selection from large-sized pelagics like Labeo, Schlibe, Bagrus and many others. Hence the Haplochromines and Mukene fishery were severely underutilized. In mid- 1960s, GoU made some efforts to maximize their utilization through canning of Haplochromines. The small pelagics were canned in either tomato sauce or brine and the sensory evaluation conducted at that time indicated that though the product had a muddy flavour, it was acceptable to both the expatriate and local consumers. On both occasions, the major constraint was the importation of tins for canning and a ready market. Before the inception of the experiment, the GoU had planned to market the canned product to the military but at the end, the military declined because it was cheaper to import a superior product at a lesser charge. Indeed when the cost benefit was conducted, it was found out that it was not economically viable to can Haplochromines in Uganda. So the idea of canning Haplochromines was shelved and the second option for utilizing small pelagics in L. Victoria

Table 4: Constraints associated with production of products with minimal dependence on weather

Blanched and sun-dried	Smoked	Deep-fried	Powdered	Silage
• Processing capacity too low and relies on availability solar energy to complete the drying process • Labour intensive • Dipping time and temperature control in rural setting is difficult • The product is yet to be market tested for acceptability • Use of charcoal or firewood as source of energy for blanching is not environmentally friendly • Besides, the identified source of energy are expensive	• Low processing capacity • Acquisition of fuel wood for smoke and heat generation leads to environmental degradation. • Prone to kiln fires which may affect product quality • Deposition of phenolic compounds on fish is a health hazard • Not cost effective because the cost of product may be more than sales price • Product has a narrow consumer base and therefore it will require rigorous marketing to popularize it	• Low processing capacity. • To break-even, It must be sold in small sachets • Vegetable oil used for frying is quite expensive. • Restraining unscrupulous processors from using unauthorized oil or multiple usage of vegetable oil. • Expensive ideal packaging material	• Low processing capacity • Production is labour intensive and yield low • Limited shelf-life as a result of oxidative rancidity • Appropriate packaging to slow down oxidative rancidity and development of off-flavours • Most of the available hammer mills are made from mild steel which is not recommended in food industry • Requires colour enhancement	• Low processing capacity • Availability of appropriate processing equipment • Conversion into product for human consumption • Transportation to market whilst in liquid form • High cost of maize or rice bran used to change to firm texture. Besides, the resultant mixture will require solar energy to dry into a portable product. • Cost of production during dry season is prohibitively higher than sales price.

commenced in earnest by introduction of Nile perch from L. Albert a quarter a century ago. The sole purpose of the introduction was to convert the small bony pelagics into table-sized fish. Currently, the fish export sector based on Nile perch fishery earns Uganda substantial amount of foreign money. At the peak of Nile perch exploitation, the sector earned about US$ 114 million in 2005. Although, the volumes of exports have declined over the last six years, at its peak, it was the second non-traditional source foreign earning after sesame.

During the present study, canning option was revived because Ragoge's fat content rendered it unsuitable for the traditional and affordable sun-drying method. Besides, it resembled marine sardines in terms of size and fat content which are normally canned. The proprietor of Greenfields (U) Ltd was requested to make enquiries in Spain and France to find out prospects for trial runs. First, it was one of the processing plants that were contacted but they declined. Then a French research institution was contacted and they pegged €10,000 on the initial tests. The amount requested was beyond budget allocation for the trial so the Consultant contacted a local institution that was likely to have canning facilities. Sure enough, the Uganda Industrial Research Institute (UIRI) was contacted to undertake the task. UIRI is mandated by Act of parliament to undertake applied research and to develop and/or acquire appropriate technology in order to create a strong, effective and competitive industrial sector in Uganda. During the discussion with the Technical Manager cited availability of cans as the major limiting factor since Uganda did not have a manufacturing plant for

cans. However, he expressed interest in conducting joint research with the relevant local research institution provided there was a Memorandum of Understanding (MoU) between UIRI and that particular institution. He also listed a number of other requirements which included bench fee to pay for processing facilities and other utilities like power and water, project co-ordination allowance and probably some incentives for the plant technician. Although the UIRI terms of operation were affordable, the offer was not taken up because of time constraint. In comparison to European option, UIRI's offer was cheap, practical and easy to supervise. Besides, the Project would have to incur the high expense of sending raw materials abroad. Once again canning option for small pelagic fish in Uganda was abandoned because of high expense in Europe and time limitation in Uganda. However, it was recommended that work on Ragoge canning should be initiated as a separate project at latter date and conducted locally with UIRI. Probably, a local research institution should be identified and together with UIRI develop a MoU and then a Concept Note for submission to SMARTFISH for consideration. The relevant segments in the MoU and the project budget can be assessed by the funding agency and consensus may be reached sooner than later.

2.5 SPECIFICATION FOR SENEGALESE IMPROVED DRIER

- Obtain a list of materials / specification for the construction of the "Senegal"improved dryer discussed at the FAO meeting on fish handling and quality, Seychelles, 2011.

During the bi-annual Consultative Workshop on Expert meeting on Fish Technology, Utilization and Quality Assurance in Africa that was held in Mahe Seychelles from 22-25 November 2011, Professor Oumoukary Ndiaye based at Senegalese National Training Centre of Fisheries Technologies Aquaculture (CNFTPA) presented a paper on an improved drier for drying small marine pelagics but she had intimated that it could be used for other fish species like Mukene. The Senegalese improved drier uses charcoal as source of heat which implies that reliance on weather was minimal. The paper was presented in the French language, so SMARTFISH secured the services of a translator (Ms Newumbe) to translate from French into English (Annex 6). From the translated material, the following list of materials (Table 5) was obtained but since the paper did not give the specification, local masons and blacksmiths were contacted to deduce from the pictures in Annex 4. .

Table 5: Materials and specifications required for improved Senegalese drier

Item	Quantity	Specification	Unit cost (UGX)	Total Cost (UGX)
Cement	20 bags	Ordinary cement	35,000	700,000
Bricks	2000	Clay baked (size 3"x6"x9")	320	640,000
Sand	2 trips	Lake sand + plaster	330,000	660,000
Iron bars	5 pieces	y-12 x 18	30000	150000
Aggregate stone	1 trip	¼- inch	230000	230000
Weld mesh	9 pieces	Cast iron (1x2m)	24,000	216,000
Metallic sheet	2 sheets	Mild steel (gauge 5mm)	450000	900,000
Drying trays	2	Stainless steel (gauge 5mm) + steel bar (2mmx 25mmx 1m)	600,000	1,200,000
		Total material cost		4696000
Labour charge		35% of materials		1,650.000
Grand total				**6,346,000**

2.6 FIELD TRIALS OF SENEGALESE IMPROVED DRIER

- In conjunction with an identified established processor in Uganda, construct an improved dryer and field test it with local processors including BMU ACP Fish II trainers from Mukene landing sites.

Most small-sized pelagics in ECSA region are caught in large quantities and owing to their size and bonny structure; almost all catches are preserved by open sun-drying which is weather dependent. So, during the rainy season, it is practically impossible to process a high quality sun-dried product with the desired consumer lustre. Quite often the processor incurs 90% loss as most of the semi-dried product is relegated to animal feed production. As a remedy, most fishers do not go fishing at all during the rainy season which implies that most processors are also rendered redundant. Consequently, the livelihood of fisher communities engaged in small-sized pelagics fishery is gravely affected due to the fear of losses and inability to go fishing. It was against this background that at the inception of the present study, plans had been made to find an alternative method that could be used to dry small-pelagics with minimal reliance on weather. Indeed several meetings were held in Entebbe town between the Consultant, two designated Fisheries Inspectors from DFR, SMARTFISH Fish Management Expert and Managing Director of Greenfields (U) Ltd. The main purpose of the meetings was to suggest and discuss alternative processing options for small-sized pelagics that were less dependent on weather. The various options considered included, smoking, blanching prior to drying using a mechanical drier, salting, fermentation and a combination of the cited methods. The Senegalese modified drier using charcoal as source of heat as opposed to solar energy was also discussed and it was agreed that some form of adaptation would be carried out with somebody conversant with drying of high quality Mukene. It was therefore suggested that AAA firm in collaboration with the Consultant and the Senegalese originator should be tasked to adapt the new drying technology but other trials were to be conducted at Greenfields under the supervision of the Consultant. From the translated document it was not possible for the mason decipher the actual measurements and other specifications from pictures and diagrams. Efforts to consult the originator of the technology, Prof Ndiaye Oumoukary based at Senegalese National Training Centre of Fisheries Technologies Aquaculture (CNFTPA) failed. Instead, the Project Co-ordinator (Mr Chris Short) contacted FAO about the technology since they had funded and participated in its implementation and testing. The prompt response was that the drier could not be disseminated without thorough testing and refining of its operational protocols. Consequently, the present TOR was abandoned but the Consultant developed a Concept Note (Annex 8) in which an alternative prototype drier would be developed by a local research institution mandated by Act of Parliament in Uganda to fabricate processing equipment. It was proposed that instead of using charcoal which is environmentally destructive, methane gas generated from landing site garbage would be a feasible and better alternative. The principle behind the proposed drier is that the biodegradable garbage which is abundant at most landing sites in Uganda would be collected in a digester over designated period of time to produce methane gas. The generated gas would be used to heat up water which will be then piped through a vertical or horizontal tunnel structure that has trays on which small pelagics have been spread. Using a fan to facilitate water evaporation from the fish and the principle of heat exchange, the drying process would be accomplished with minimal reliance on weather. However, there are three major foreseen challenges associated with the proposed technology. They include the relatively long time lag between fabrication of the prototype and final launch of proven technology (drier), the limited capacity of the proposed drier in comparison with the average daily catch at any given landing site in Uganda and the corresponding expense associated with fabrication and operational of the proposed drying system. Nevertheless, none of the challenges are insurmountable. With time and financial resources the proposed system can be developed and operationalized within the region.

2.7 ADOPTION OF SENEGALESE DRIER

- In collaboration with processors, modify and adapt the drier based on sources of appropriate energy, fuel efficiency, fish drying capacity, cost of construction and other product needs and specifications.

Since this TOR was not actually implemented, the Consultant reviewed Prof Ndiaye's drying technology and from the specifications given, the processing capacity would be a limiting factor. Each tray was designed to handle only 10kg of small pelagics. Considering that small-pelagics

are normally landed in large quantities, the drier would have to be replicated in several units which would mean additional expense for the prospective processor. Besides, the high spoilage rate associated with most small pelagics due to their area-surface to volume ratio, the incidental overlay of catch waiting to be loaded for drying would not augur well with the processor. Technically, when already spoilt fish is processed in one form or the other, the resultant products are qualitatively poor and tend to fragment easily causing undue physical losses. As a mitigation measure, fish is always kept on ice but since most pelagics are small and fragile, traditional icing with flakes or cubes is not an option. Instead, potable chilled water in large holding tanks is used to slow down spoilage in small pelagics. Based on available information, such facilities are non-existent and impractical at most processing sites in the ECSA region. Another drawback of the proposed improved Senegalese technology was the use of charcoal. The forest cover of most countries within the ECSA region with the exception of DR-Congo is declining at an alarming rate. For example, in Uganda the forest cover declined by 27% between 1990 and 2005 (NFA, 2010). It is possible that the rate of environmental degradation in Uganda is comparable to any other country within the ECSA region and since fisher communities have nomadic tendencies and least interested in tree planting, promotion of a technology that uses fuel wood would be disastrous to the environment. Being in the tropics, the other immediate alternative would be harnessed solar energy but the initial investment is prohibitively too high for the prospective processor. The only viable option to operationize and promote the improved Senegalese drier may lie in the use of renewable energy as source of heat. Landing sites are usually littered with domestic refuse which could be converted into biogas and used as renewable source of energy for drying fish.

2.8 OPPORTUNITIES FOR SUPPORT TO INDIVIDUAL BUSINESSES

- Describe the opportunities for support to individual businesses including opportunities for capacity building, provision of equipment, materials, marketing or other support to upgrade standards and prioritise these according to SMARTFISH requirements and objectives.

Since the fisheries sector in most countries within the ECSA region is similar, the opportunities for support to individual fisheries businesses in Uganda will be used as an example for the rest of the region. Based on Consultant knowledge of Uganda's fisheries sector for over 30 years, several opportunities for support have been identified from capture to market. The different actors along the supply chain as indicated in Fig. 2, experience different challenges which can be translated into opportunities for support which may vary in context and magnitude according to different actors. For purposes of this report, each actor will be considered as an entity though there is always an overlap between various actors. Fishers, processors and traders have been considered as examples of actors along small pelagic value-chain. Most fishers are functionally literate and yet the market requires them to be knowledgeable about recommended practices for handling fish immediately after capture. For fishers to comply with market quality requirements, they should attend training sessions in a language they comprehend on topics like sanitation of fishing vessel, personal hygiene, handling facilities and other related topics. If need be, pictorial illustrations should be used to ensure that 90% of the trainees understand the topics since the majority of them (47% in Uganda) cannot read or write. Quite often fishers cite boat size and fishing gears as the most limiting factors during fishing operation. As such, financial support should focus on loan schemes to procure boats and fishing gear but the institution advancing such credit should be mindful of defaulters. Fishers have been known to default quite regularly. The most escape route used by defaulters is migration from one landing site to the other to evade paying back such loans. Processors on the other hand, who are predominantly females, would require support for procurement of technologies that add value to small pelagics, training in product diversification and market access. As it may be appreciated, most of the value-addition processing equipment is costly for the ordinary individual processors at landing sites. Instead, it is normally recommended that 4-10 individuals corporately purchase the required equipment with personal funds or a credit facility from a commercial institution. In such cases, they access funds using each other as guarantor which reduces the risk of defaulting. Several studies conducted in Uganda indicated that women folk were better debtors than their male counterparts. Indeed they have established a reputation among financial institutions for prompt payment. This reputation has paved a way for development and promotion of SACCOS at several

landing sites that exclusively target the womenfolk. As a result, intervention strategies among fisher communities that sideline the womenfolk usually have low success rates. It is no wonder therefore that the main focus of the present SMARTFISH intervention has centred on women groups. In most cases, the women processors are culturally obliged to concurrently take care of their respective families which quite often hamper marketing of their products away from residential landing site. In incidences where they have successfully marketed their products beyond the vicinity of landing sites, different approaches have been employed. These have included group marketing and networking with male groups.

Fish traders are a heterogeneous group of value-chain actors consisting of both genders and fairly educated. Most traders met during this study, came across as risk-takers and their capital input varied with type of product and market outlet. Although most traders were expected to know market demands and specifications for the respective products, they had scanty information on product specifications. Yes, the traders were conversant with markets for their fishery products and corresponding demands but they knew very little on factors affecting fish quality. From the various discussions with them, it was observed that the driving force in the fish trade was the profit margin as opposed to the quality and safety of product. In this regard, traders hardly considered the concerns of end users with respect to product quality and safety. The case in point was the adulteration of sun-dried pelagics intended for animal feed production. The profit margin accrued as a result adulteration was over 35% and yet the poultry and livestock farmer have had to contend with reduced incomes attributed of low production as a result of poor feed. By way of support, this group of actors would require sensitization sessions on the consequences of product adulteration first and then on ethics before their coveted support for logistics, market access, non-tariff barriers and finances to capitalise their businesses.

As already stated, the supply chain analysis in small inland pelagics is a reflection of the whole regional. Implying that whatever intervention recommended for the respective supply chain actors in Uganda would be applicable in each of the ECSA countries. Nevertheless, the implementation strategy may vary from one country to the other depending on the role played by the fisheries sector in the respective national economy.

2.9 ASSESSMENT OF PROCESSORS FOR UP-GRADING

- Identify existing progressive /emerging producers of improved quality and value-added small-pelagic products based on their business plans, available information and discussions for purposes of up-grading.

Over the last two decades, there have been several studies conducted that suggested mitigation measures to reduce post-harvest losses and diversify utilization options in the Mukene fishery. Most of them were funded by either EU or FAO in collaboration with Uganda Government or Lake Victoria Fisheries Organization (LVFO) and targeted fisher communities living at landing sites around L. Victoria and none focussed on L. Albert. The choice of fisher community was made regardless of their business acumen or intention to take Mukene processing as a business. In addition, none of the studies tried to link processors with potential markets. As a result, the improved technologies were hardly adopted after the expiry of the project which often led to repetition of similar projects by subsequent intervention teams without tangible impacts. This was not only waste of resources but also effort and time. The present study was designed in such a way that only promising fisher processors already trying to put products made from small pelagics on the market would be up-graded to a level of regional competitiveness. It was from that standpoint that their business plans and other relevant information was used as criteria for selection. Previous strategies had not paid attention to small pelagics on L. Albert but on this occasion, they were the main focus of the study. Using previous interactions with various fisher groups or individuals around lakes Albert, Victoria and Kyoga where small pelagics were in abundance, two individuals and one group were visited by the Consultant and their potential for up-grading assessed. The three (3) progressive/emerging producers cum processors identified for the purposes of up-grading them to a level of competitiveness in the regional trade. The emerging processors were at different levels development and exposure with regard to competitive regional fish trade. In order of development and exposure, the companies that were identified to participate in the SMARTFISH up-grading scheme included: -

1. KASAVEX Enterprise (U) Ltd
2. UMAGA (U) Ltd
3. ABEKENE GROUP-KISUKU

2.9.1 KASAVEX Enterprise (U) Ltd

KASAVEX Enterprise (U) Limited is a private family business established in 2011 and located in Kalangala District at Lutooboka Beach Management Unit on Kalangala main island of Lake Victoria. Kalangala is endowed with an expanse of resourceful lake and a steadily growing population which inevitably correlates with demand for fish especially silver fish. However, due to poor handling, lack of processing and packaging facilities, the company was not accessing lucrative markets. As a partial remedial measure, the company designed a hybrid solar drier that was effective, affordable and environmentally friendly but its capacity was low and besides, it relied on weather elements.

The idea of adding value to Mukene for international markets was conceived when the parents participated in the 12th Agricultural apprenticeship programme for African countries in Indonesia in 1997 under the Ministry of Agricultural Community Foundation. In addition, the mother attended a Training of Trainers Course for Functional Adult Literacy instructors on the Functional Adult Literacy Programme in 2002 which entailed horticulture management techniques on food preparation and packaging. Members have been trained in entrepreneurship, nutrition and related topics offered by several organizations like the Indonesia Agricultural Society Foundation, Management Training and Advisory Centre and Land 'O'Lakes Incorporation. Currently, they are engaged in the capture, processing and marketing of several Mukene-based products, which include sun-dried, powdered and deep-fried fish packaged in 100g unit weights but using different packaging types according to consumer specifications as shown in Fig. 8. The facility handles 1,500 Kg per month although the demand is 10,000 Kg per month. They attribute the supply deficit to the inefficiencies of traditional processing methods and seasonality. They reckon that Mukene dehydration cannot be profitable when relying on sun energy alone. To dry fish hygienically, profitably and effectively, one needs a drier with a required capacity to meet one's available resources and market demand all year round.

They had a vision that compelled them to improve the quality of Mukene for the regional market. They had specific objectives to drive their family business. They included:

- Attraction and demand creation among people of all ages to consume their products owing to the nutritional and medical properties.
- Improvement of their living standards and that of the surrounding community in Kalangala.
- Creation of employment for the community for enhanced livelihoods
- Awareness creation about nutritional content of Mukene-based products
- Laying a foundation for the Mukene industry in Kalangala and Uganda at large.

During the discussion with the Consultant, the following constraints in terms of priority were identified as; insufficient drying racks during glut seasons, which incidentally occur during the wet season; an economically viable fishing boat to ply in the offshore waters, stiff competition and limited fishing periods i.e. only 19 days in a month. On further cross-examining of the product label, Consultant noted with concern the lack of quantified nutritional information, sell-by date and other information on the label as shown in Fig 10. The identified drawbacks may hamper access to some regional as well as international markets. Besides, the labels were not product specific which compromised the saleability of the product. For example, in Fig. 11, the powdered and deep-fried products were not labelled as such and yet their contents were quite different.

Fig.10: The current information appearing on all KASAVEX product labels regardless of type

Fig. 11: Similar label used on powdered and ready-to-eat fried Mukene products

As a remedial intervention, SMARTFISH undertook nutritional analyses for both products and revised the information on the product label using the nutritional information determined in Table 6a-c).

Table 6a: Micro-nutrients of KASAVEX Mukene products

Product	Zn (ppm)	Mn (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	P (%)
Deep fried	145	7.6	51250	42.9	6250	1.96
Sundried	183.8	11.4	50000	49	8625	2.17
Powdered	193.8	13.3	97500	51.1	6125	2.38

Table 6c: Macro-nutrients of KASAVEX Mukene products

Product	Deep fried	Sundried	Powdered
Dry Matter	93.66	90.24	92.36
Ash	12.95	15.01	15.02
Protein	52.04	62.02	65.73
Fat	28.03	13.11	10.21
Fibre	0.56	0.25	0.545
Gross energy	5279.26	4456.09	4038.17

Table 6b: Fatty acid composition of Mukene of KASAVEX products

	Different Mukene products			
Fatty acid	WHOLE	POWDER	FRIED	Name of 3 Omega fatty acid
14:0	4.51	4.64	1.44	
iso 15:0	0.61	0.69	0.00	
15:0	0.67	0.70	0.00	
16:0	30.68	27.53	34.97	
17:0	1.48	1.75	0.00	
18:0	10.20	10.69	5.30	
SFA	48.15	46.01	41.71	
16:1n7	12.82	13.06	2.07	
17:1n9	0.32	0.31	0.00	
18:1n9	7.53	7.97	35.10	
18:1n7	3.57	3.71	1.60	
MUFA	24.25	25.04	38.76	
18:2n6	1.75	1.93	8.06	
20:4n6	2.17	2.49	0.43	
22:4n6	0.79	0.74	0.57	
22:5n6	1.27	0.97	2.99	
Σn-6	5.98	6.15	12.05	
18:3n3	1.30	1.54	0.00	Linolenic acid (ALA)
20:5n3	6.05	6.53	1.08	Eicosapentaenoic acid (EPA)
22:5n3	1.27	1.49	3.24	
22:6n3	13.00	13.25	3.16	Docosahexaenoic acid (DHA)
PUFA	21.63	22.80	7.47	
Σn-3/ Σn-6	3.62	3.71	0.62	

From the information generated in Table 6(a-c), KASAVEX can develop another label for each product and indicate the nutritional information in 100g of product, shelf-life and storage conditions. Depending on the target market, a specific nutritional item can be hyped. For example, if the target consumer are children under 5 years of age calcium and phosphorous can be hyped and if the target group are adults prone to heart disease or other ailments, then presence of zinc and omega 3 (PUFA) may be emphasized. An example of a deep-fried product with corresponding label detail has been shown in Fig. 12

Nutritional information in 100g	
Protein	52.04
Fat	28.03
Gross-energy	5279.3 Kcal
Micro-nutrients	
Calcium	51250 mg
Phosphorous.....1.96 mg	
Zinc	145 mg
OMEGA 3	0.62
Net weight	100g
Production date	Aug 2012
Expiry date	Jan 2013
Best before	Oct 2012

Ingredients: Mukene, salt, spices..... Sand-free hygienically processed and packed by KASAVEX Enterprises (U)

Store in a cool dry place

Fig. 12: An example of label detail that should appear on a deep-fried Mukene product

The company was also advised to approach the Uganda National Bureau of Standards (UNBS) for purposes of securing a quality mark (Fig. 13). A quality mark (QM) has a catalogue of benefits that range from consumer-oriented to market-oriented. QM enables the consumer to identify quality products on the market and creates confidence in him/her which results into increased market share of the product. When a company has a QM on the product, it conforms to national standards and enhances product image in both national and international markets. It also increases product acceptance and promotes new products in the market. In the event of unfair competition from inferior products on the market, it safeguards the product from them. Through mutual recognition schemes, countries recognize each other's products that are certified, thus easing entry into regional and foreign markets. Finally, Government of Uganda (GoU), Non-governmental Organization (NGO) and International bodies rely on UNBS to ensure quality products.

Fig. 13: UNBS quality mark (QM) issued to a certified product

To acquire UNBS quality mark, the prospective company undergoes a rigorous certification process which involves a series of steps. The company must acquire a tax identification number (TIN) from Uganda Revenue Authority (URA), the products intended to be put on market must be tested for safety and nutrient content in UNBS laboratory for verification purposes. All their measurement sensitive balances and scales must be calibrated using UNBS standardization procedures and technicians. All products intended to be certified must comply with respective UNBS quality and safety standards including the label requirements which should indicate country of origin, expiry date, storage conditions and nutritional information among other things. In the case of KASAVEX, it must comply with Mukene draft standard of 2012 that was formulated recently with input from the Consultant. The company must be registered with Registrar of Company in the Ministry of Trade and Industry and then finally pay a fee to UNBS for each product to be certified. After each of the steps has been accomplished, an audit team from UNBS visits the Company's processing site to verify and audit the product processing line. The company should have an operational Good Manufacturing Practice (GMP) and Hazard Analysis Critical Control Point (HACCP) or any other quality management system in place. In preparation for the proposed audit visit, the company has already procured two sets of standards: **U7 Second edition 2002-12-14 General Standard for labelling of pre-packaged Foods and US 20 EAS 39 second edition 2002-12-14 Code of practice for hygiene in the food and drink manufacturing industry**. It is envisaged that by mid-November 2012; new product-specific label with relevant

nutritional information will be developed at a cost of UGX 75/ per label. As part of SMARTFISH intervention scheme, the Consultant will support them in acquisition of a quality mark, development of GMP and HACCP. With the proposed intervention (certification process) wholly funded by SMARTFISH, the company will be in position to market its products regionally as well as internationally.

As a way forward, KASAVEX without funding from SMARTFISH, plans to undertake a series of tasks which include construction of 5 Mt fishing boat propelled with a 30 horse power engine, construct water purification unit, construct a modern all-weather drying facility, purchase a hammer mill, acquire ISO Certification and with increased capitalization invest in product diversification.

2.9.2 UMAGA (U) Ltd

UMAGA (U) limited is a private enterprise established in 2008 and located in Buliisa District at Bugoigo landing site on the Ugandan side of Lake Albert. In spite of the many species in the lake, UMAGA has specialised in processing various products from the two small pelagics for the local market. In one fish forum organized by FAO in collaboration with Department of Fisheries Resources (DFR) on Mukene fish trade, the Consultant met Director of UMAGA (U) Ltd. The company operations were so fascinating that he was introduced to SMARTFISH project and invited to the Lusaka Trade Event to exhibit his products to a wider market. In the process, he got into talks with the SMARTFISH Project Co-ordinator and subsequently secured separate funding to up-grade his enterprise. However, he still kept in touch with Consultant for technical backstopping and he acted as role model for the ABAKENE group. After 4 months of SMARTFISH intervention he has transformed his business substantially. The details of his performance has been reflected in the awarded contract number 035CF-PE-1 REPORT.

2.9.3 ABAKENE GROUP-KISUKU

The ABAKENE group is located at Kisuku landing site, 40Km away from Masaka regional commercial town along Bukakata road. Masaka is situated on western side of L. Victoria and it is 140Km from the Kampala capital city of Uganda. Kisuku is one of the four major landing sites within Masaka District involved in catching and processing of small pelagics and particularly Mukene. According to the Masaka District Fisheries Officer, Kisuku was commonly known for Mukene intended for animal feed production until a few years ago. In 2005, under technical corporation programme (TCP) of the FAO, a two-week hands-on training session was conducted at the same landing site by the Consultant. Different processing options for Mukene were demonstrated to fisher communities at Kisuku landing site which included smoking, deep-frying, drying off ground and fermentation (Masette, 2005). Apart from imparting processing techniques, the community were urged to form a group and develop a saving culture. They immediately formed the ABAKENE GROUP and opened a bank account at the nearest town (Masaka) in anticipation for external funding which did not materialized at the time. While waiting for external intervention, the Fisheries Department through Masaka District arrangement under the Plan for Modernization of Agriculture (PMA) scheme constructed several racks (Fig 14) in 2006 as part of modernizing the fisheries sector.

Fig. 14: Mukene drying racks constructed by Masaka District under PMA

The landing did not only drop the label of being known as centre for low quality Mukene products but it attracted traders from distant markets interested in high quality products. However, due to some reason which the Consultant deciphered as lack of ownership, the racks fell in a state of disrepair and at the time when the Consultant visited the site in May 2012, the racks were sagging and could only handle less than 40% of the original capacity. Nevertheless, the group was selected for up-grading because they demonstrated resilience and willingness to learn and adopt new technologies. The fact that they had started processing Mukene for human consumption as opposed to animal feed production was a step in the right direction. By selecting this group for

up-grading, SMARTFISH was complementing previous efforts by other development partners and ensuring that after the intervention there would be tangible outcomes given the resilience of the group. This would be possible because under the SMARTFISH scheme there was a requirement to that necessitated the group to own the project before implementation of the intervention measure. So to begin the process, the group was involved in the identification of the killer constraint and the possible mitigation measures. In the absence of a comprehensive business plan for their Mukene enterprise, a SWOT analysis was done to identify their strengths, weaknesses, opportunities and threats using question and answer sessions. Since they were not many as evidenced by their attendance list (Annex 4) and the fact that the Consultant was alone, the discussion was held in one group. Before the meaning of SWOT was explained to the group, they were asked about the main objective of their association and in response, they listed many objectives that could be summarized into 3 broad categories. They included credit, market and livelihoods. With regard to credit, they assumed that if they had access to local financial credit through loan schemes, they would be empowered to buy fish or take their children to school. Apparently, they recognized that marketing of their dried product at relatively same price would be an added advantage to the group. Protection of their resources was also identified as one of the objectives for their association but based on Consultant's knowledge of the management of fisheries resources in Uganda; fisher communities regard them as a perpetual resource. In summary, it appears their principal objective was to improve their livelihoods through sustainable use of their resources.

Based on their summarized objective, the meaning of SWOT analysis was explained in their local language (Luganda). Strengths were defined as those characteristics within their association that give them advantages over other similar groups within their locality or vicinity. Weaknesses or limitations were the opposite of strengths and defined as those characteristics within the group that placed them at a disadvantage in relation to others within the locality or vicinity. Opportunities were defined as those chances in the environment that were available to the group and if appropriated gainfully, they would improve their livelihoods. Threats on the other hand were elements within the environment that could cause problems for their business. The common denominator for strength and weaknesses was that they were both internal factors which the group had the ability to change the situation if they desired. On the contrary, opportunities and threats were external factors which affected the group in one way or the other but the group did not have control or ability to change the status quo. In other words, the people with the ability to effect change were outside their group or locality.

During the subsequent discussion with the group, several major strengths were identified (Annex 5). As mentioned above, the training offered by FAO in 2005 on basic product diversification and knowledge acquisition was strength and it laid a foundation upon which the present work can be built. The fact that they were located at the very source of raw materials was strength and it reduced the transportation cost drastically apart from the minimal costs incurred for ferrying Mukene from fishing boat to drying area. The resultant savings from transport costs could be ploughed back into the business for sustainability and the remaining balance could be used to improve livelihoods.
Despite the strengths cited, the ABAKENE group displayed glaring weaknesses. First, they lacked focussed leadership, exhibited a laid-back attitude to sanitation and hygiene that discouraged prospective buyers from buying their ostensibly high quality products. There was also lack of exposure to the outside world which exacerbated the laid-back attitude to cleanliness of their processing site.

With respect to opportunities, the 2005-FAO training session gave them a competitive advantage over fisher groups within the area. They had an idea on product diversification, record keeping and group dynamics. The current growing demand for high quality Mukene products also presented an opportunity for the group which if maximally exploited; it would bring dividends to them. The drying racks (Fig. 5) can also be an entry point to production of sand-free products to meet the growing demand within the region. Since the policy on Mukene quality was still in draft form, the ABAKENE group had taken advantage of its absence to market their adulterated sun-dried products. The unsuspecting traders from the nearby Masaka town and distant places like Kigali-Rwanda, purchased the adulterated Mukene ostensibly for animal feed production but they

were marketed as food for human consumption in DR-Congo and S. Sudan. Understandably, the cost of adulterated Mukene was three times cheaper than Mukene dried on raised racks intended for human consumption but the traders were selling it in the neighbouring countries at three times the landing site cost. It was this heft price differences that propagated the trade in adulterated Mukene handled at Kisuku landing site and the unwillingness to dry Mukene on raised racks. In principle, the trade was a win-win situation for the Kisuku processors and traders although the end-users were short-changed on the account of quality. The threats included vulnerability to group if a serious outsider willing to invest in the same business came on board. Another threat was the lack of cohesion in the group as evidenced by frequent desertions. Commitment to group's ideals was also a big threat which an outsider can exploit to the maximum if he/she came on the landing site.

Generally, the opportunities available to the ABAKENE group tipped the weaknesses and threats that seemingly disadvantaged it. So when SMARTFISH sought for a group of women processors to up-grade and enter regional fish trade, ABAKENE group was more promising than others within the vicinity. Currently, this group consists of 14 women and 6 men (Fig 15) and process Mukene for the local market.

Fig. 15: Some of the women members of ABEKENE group –Kisuku, Masaka District

However, they were faced with a number of challenges which included lucrative market, adequate drying racks, and ignorance of the regional market expectations. According to the Consultant, the latter challenge was due to lack of exposure to the world beyond Kisuku landing site. To partly solve it, the Consultant sought permission from the Project Co-ordinator to arrange for an exposure visit to an establishment involved in processing small pelagics for regional market and therefore conversant with its demands. Although the activity was not in the TOR because it had not been anticipated at the inception of the study, it was deemed necessary and a pre-requisite if the group was to participate in the regional trade. Consequently, three representatives of the group that comprised of the Chairperson, Secretary and one member were taken for a 2 day exposure visit to Arrow Aquaculture Africa (AAA), a Mukene firm engaged in regional trade and based at Kiyindi in Buikwe District.

Visit to AAA

The representatives of the ABEKENE group were sponsored by SMARTFISH in terms of return-trip transport from Kisuku landing site in Masaka District to Kiyindi, Buikwe District, up-keep during their stay at Kiyindi and "tuition fee" per person per day. The purpose of the visit was to expose the leadership of the group to recommended methods of handling and processing Mukene for regional market.

After formal introductions and payment of tuition fee, the group was shown around the facility (Fig, 16) starting from the racks where Mukene was being dried on raised racks whose mesh was made of plastic as opposed to weld mesh. As it was season for bumper harvest of Mukene, the proprietor of AAA firm had mobilized family labour together with contracted workers to ferry Mukene from one of the RIGS to the waiting pick up vehicles and then to the drying racks. At the drying racks, the men workers were off-loading while the women were spreading Mukene on the racks.

Fig. 16: Leadership of ABAKENE group at Kiyindi AAA firm being shown around the facility

Thereafter, the group was taken to observe the operations on the rig and one of the workers conversant with rig operations explained to the group using the local language. The Consultant requested AAA worker translating in the local language to be emphatic on cleanliness of facilities and the surroundings and stress the consequences of not maintaining cleanliness on market expectations. They were further shown the main components of the RIG including generator for power supply, on-board engine, circular fishing net fitted on a rim, bulbs, pulleys, steering wheel and fish finder which fascinated the group. They were told that a RIG should have a separate carrier RIG for transporting the catch to the shore for drying while the other RIG stayed at fishing ground to ensure continuous operation.

The next day was spent on measurements of drying racks, net materials and designs, storage facility, packaging room, different sizes and types packaging materials used to meet different market requirements. Lastly, the group had an opportunity to discuss the visit with the AAA proprietor. He talked about his firm's operations in totality and explained further detailed the various steps along the distribution chain from capture to supermarket or final consumer at the end of the chain. The group enquired about the demand trends and marketability of high quality Mukene fish. In response, he confirmed the insatiable demand of high quality Mukene which he was not in position to meet on his own. Due to the high demand, he revealed that he had sub-contracted numerous out-fishers to harvest Mukene using their own canoes and then sell to him fresh Mukene which he dries using his raised racks. The quantities of Mukene supplied by out-fishers supplemented the catches from his rigs. In so doing, he met at least 50% of the market requirements.

This was worthwhile visit because the group appreciated the essence of quality and promised to improve their facilities upon their return to Kisuku site. Indeed upon their return, their outlook had changed and they constructed 5 new drying racks (Fig. 17) in record time of only one week. Each drying rack is 21m in length and 2m width with the capacity of 450kg of fresh Mukene per day. Bearing in mind that Kisuku landing site receives an average of 2MT of fresh Mukene per day, SMARTFISH intervention ensures that at least 22.5% of total catches landed is appropriately sun-dried and sold at premium price. The group leader reported that before SMARTFISH intervention, drying time was 2-3 days but with the new black, safe and hygienic shade nets, the drying time had reduced to ONE day only. It should be noted that fast drying time results into development of lustre desired by consumers who are willing to offer high prices. The reverse holds true in that, prolonged drying contributes to loss of lustre and compromises consumer acceptability and willingness to offer premium price.

Fig. 17: Constructed drying rack at Kisuku landing site after visit to AAA

Since they started using the shade nets for drying Mukene, the price of the resultant product has tripled. They used to sell a jerrycan similar to Fig 5, at UGX 10,000 (US$ 4) but with improved quality and the desired lustre, the same quantity is being sold at UGX 30,000 (US$ 12). The tangible impact as a result of SMARTFISH intervention has had a ripple effect in the Sub-county in that several groups around the landing site have visited the site with the intension to adapt the practice. The DFR has also promised to give them additional shade nets to increase the drying capacity to at least 50%. It was such an achievement of the month that the Masaka District authorities included it in their quarterly report and planned to show case it to the Minister of Agriculture Animal Industry and Fisheries (MAAIF). This was a strategic plan to attract additional GoU funding for similar ventures at other landing sites within the district. At the time of writing, consumers in Masaka town are able to distinguish between Mukene dried on raised racks from Mukene dried on bare ground and they are willing to pay a premium price for Mukene dried on shade nets as it depicts quality. Although none of the ABAKENE group members attended the Lusaka Trade Event, the Consultant linked them with the Director of UMAGA (U) Ltd who had attended the event and had established

a network with potential regional traders. It was hoped that the link between UMAGA and ABAKENE group would be strengthened by their joint participation in the regional cross-border trade in small pelagics. The regional market outlets as well as local supermarket demand well-sealed and labelled products and yet during the group discussion, the absence of electricity or other source power was cited as a hindrance to sealing product packages. However, it was hoped that with increased incomes, the group will be able to afford a generator and a sealer without external intervention.

Based on the two study cases, the SMARTFISH intervention is likely to have unparalleled success because promising or emerging processors were identified, brought on-board through group discussion to prioritize killer constraints and Consultant worked with group to fulfil their aspirations.

2.10 PRIORITISED INTERVENTION OF ONE PROCESSING BUSINESS

- Plan and undertake at least one prioritised intervention with one of the identified processing businesses and assess the uptake and impact of the intervention.

Although UMAGA (U) Ltd secured a separate line of credit from SMARTFISH after introduction to the scheme by the Consultant, he still relied on the Consultant for technical backstopping. Over the period of the study, he has made strides in his business worthy of reporting in his separate report. Of the two (2) processors that were identified for up-grading during the implementation of this study, ABAKENE group has made tremendous improvement. As stated in Section 2.9.3, this group was the more laid-back than the other two enterprises that were up-graded. As a strategy to get them on-board Mr Agaba, Director UMAGA was requested to act as role model to the group for two reasons. He had clearly understood the objectives of SMARTFISH as explained by the Consultant and he was in a similar business and therefore well placed to communicate to the group in the same business language. It was easy for them to relate to him closely and pick practical knowledge like measuring and cutting of shade nets (Fig 18) and mounting them on the wooden rack structures without wasting time in translation from English to the local language. If he had not been co-opted, it would have taken the Consultant relatively long period of time to get the group on-board. Most of the challenges facing the group were similar to UMAGA (U) Ltd but less in magnitude because of their lack of exposure. Their priority area of intervention was drying of high quality Mukene for a hyper market outlet like local supermarkets and yet UMAGA targets were beyond the borders of Uganda.

Fig. 18: Mr Agaba helps ABAKENE group to measure and cut the shade net at Kisuku landing site

The rate at which SMARTFISH interventions were accepted or adopted varied with groups, their level of understanding and type of intervention. Generally, adoption of the shade net as opposed to weld mesh was quicker than anticipated because of the advantages were tangible. For example, the drying time reduced by a factor of three. The ABAKENE group accepted it because their role model demonstrated with examples from his enterprise. They were further convinced when the first sun-drying trial was conducted by the Consultant at Kisuku. They observed that the resultant products exhibited superior qualities and dried faster than using their weld mesh or drying on plastic sheet. As indicated above, the drying rate was three times faster and the price for the product tripled on account of quality. In other words, the two factors created enough momentum within the group to perpetuate the intervention even after the closure of the project. It is hoped that even without the intervention of the Consultant, they will out-scale and up-scale with time. There is also a possibility of cross-selling their products to a stable market when the Director of UMAGA will link them to his network he established during the Lusaka Trade Event. Gradually, the group will be strengthened and with the technical backstopping from the Consultant, they will become trainer of trainers (ToTs) within Masaka District, country or even beyond the borders of Uganda.

2.11 ASSESSMENT OF PROCESSOR FOR REPRESENTATION AT LUSAKA TRADE EVENT

- Assess the potential for a small-pelagic processor business and make recommendations for representation at the SMARTFISH Trade Event in 2012.

In an effort to promote Ugandan products made from small pelagics like Mukene, Ragoge and Muziri, two potential processors who had been up-graded under the SMARTFISH programme, were invited to show case their semi-improved products to a wide range of potential buyers within the ECSA region. The methods of preparation for all the products exhibited by the two processors have been fully elaborated in Section 2.4 of this report. Mr. Agaba, the Director of UMAGA (U) Limited took blanched and sun-dried, deep-fried and traditionally open-sun-dried Muziri-based products. Ragoge products were similarly treated. By the time of the event, the ABAKENE group had not mounted their shade net so the Consultant requested Mr. Agaba to label their open sun-dried Mukene products using UMAGA label. Both sets of products were taken for presentation at the Lusaka SMARTFISH Trade Event. Mrs Harriet Kasavu, one of the proprietors of KASAVEX Enterprises (U) Ltd took deep-fried and powdered Mukene products to the same Event. Prior to the Lusaka event, the Consultant travelled to Bugoigo landing site to ensure that UMAGA complied with the processing and packaging protocols. Since KASAVEX Enterprises (U) Ltd had fairly processed and packaged her products professionally (Fig. 12), technical backstopping was not as intense as it was with UMAGA. Most of the transactions were made online. The Consultant consulted DFR for a health certificate to verify that the products were intended for exhibition in Lusaka Trade Event and not for commercial purposes. The certificate also guaranteed that the products had been hygienically processed and met standards for human consumption. Before departure, the Consultant liaised with the Specialist of SMARTFISH Trade Event, Mr. Legros, to ensure that the Zambian immigration officers were in possession of relevant permits for entry of products carried by the two Ugandan processors. Upon their return to Uganda from Zambia, the Consultant had one-to-one meeting with each of the small pelagics processors. The main agenda of the individual meetings was to get their feed-back from the Trade Event. In response, Mr Agaba reported that it had been an opportunity for him to establish extensive network with potential buyers from DR-Congo, Kenya, Rwanda, Zambia and Zimbabwe. He had also noted the various forms of product packaging from other exhibitors and he was going to modify his product packaging accordingly. He also hatched the idea of a rig construction similar to AAA (Fig 19) so that he could have control over the supplies of raw materials for his enterprise. He made had enquiries from Mr. Neville, the proprietor of AAA who had also attended the Lusaka Trade Event to find out the cost of construction. He was told that the cost of production was close to US$ 45,000 but when he contacted the local artisan, the charge was UGX 52,000,000 (US$20,000).

Fig. 19: AAA Fishing rig

Naturally, he made plans with the local artisan and probably by the end of December 2012; UMAGA (U) Ltd will have their own rig plying the waters of L. Albert fishing for Ragoge and Muziri.
Ms Kasavu on the other hand, had similarly established contacts with potential buyers and she was planning to expand her market to Southern Africa. Most buyers were interested in her powdered product. However, owing to its powdery form packaged in a jam bottle (Fig. 11) and the quantity contained therein, it was deemed not consumer friendly. This is because once a fish-based powdery product is frequently exposed to air during the course of opening and closing after use of limited amounts, the lipid constituent of the product reacts with atmospheric oxygen to form by-products characterized by rancid off-flavours. Most consumers detest such rancid products and subsequently sales may decline. The processor was therefore advised by the Consultant to re-package powdered products in small 10g sachets; such that when opened, the sachet contents can be used all at once to avoid customer rejection of her products on account of rancidity. The small 10g sachets can then be packed in a box with a capacity of a kilogram to accommodate 100 of such sachets. The 1-Kilogram boxes can then be packaged in a larger box for transportation to markets. After the Lusaka Trade Event, Ms Kasavu also realized that to guarantee product quality, there was a need to control the entire supply chain from capture to market. The most challenging chain segment was the fishing stage where KASAVEX was relying on other fishers to supply Mukene. They had observed that quite often the catch was contaminated with paraffin and that it had been multi-handled by the fishing crew which ultimately compromised the final product quality. As a remedy and a control measure, the company wished to own a fishing rig similar to AAA (Fig. 10). Two of the company Directors also contacted Mr. Neville, the proprietor of AAA to find out the cost of rig construction. The indicative cost was so prohibitive that they approached the Consultant for alternative fabricator. Some people from Zimbabwe conversant with rig construction on L. Kariba were consulted. The person contacted expressed willingness to travel to Uganda and construct at least 2 rigs for the two processors.

As a way forward, UMAGA and KASAVEX were advised to meet the national quality standards of their respective products first before embarking on the rig construction. It was envisaged that once the two companies complied with the standards, the sales of their products will increase appreciably regardless of the present form of packaging both locally or regionally. From the sales they should be able to raise enough funds for construction of a fishing rig without external funding. The two companies were therefore urged by the Consultant to endeavour to have all their marketable products duly certified by UNBS. This will facilitate their full participation in fish trade beyond the ECSA region without undue barriers.

2.12 PRESENTATION FOR SMARTFISH TRADE EVENT

- Based on the activities and the results prepare a presentation for the SMARTFISH Trade Event.

Using the collated information on small pelagics in Uganda, a 20 minute presentation was made at the SMARTFISH Trade Event that was held in Lusaka, Zambia from 25 -27 May 2012. Briefly, the presentation gave a background to small inland pelagics characterized by their bony and small size. Traditionally caught in large quantities and therefore open sun-drying is the easiest preservation options although it is weather dependent. As such, the post- harvest losses are exceptionally high against a backdrop of declining per capita consumption trends in the region. Apart from the inadequate preservation, there were other contributory factors to high post-harvest in the sector. Most countries within the region had embarked on various initiatives but the paper proposed low cost alternatives that could be applied at both artisanal and industrial level. The essence of value-addition in the fishery was explained as a strategic action undertaken to add value on the existing raw material or product. Then the paper divulged into the different levels of product development at both artisanal and industrial level which is usually capital-dependent. The paper also highlighted the available opportunities for cross-border trade in small pelagics within the East, Central and Southern African (ECSA) region which included rapid population growth, nutritive value of small-pelagics with emphasis on Omega 3 and high protein content amidst scores of malnourished children below 5 years of age. Finally, the challenges hampering regional trade were underscored and way forward suggested. A complete power point presentation has been attached (Annex 7)

2.13 OPPORTUNITIES FOR REGIONAL TRADE IN SMALL-SIZED PELAGICS

With declining stocks of large-sized commercial fishes such as Nile Perch and Tilapia, trade in small pelagics has increased by ten-fold in the last decade. Traditionally, small pelagics are used as a protein source in animal feed manufacture in Uganda but in DR Congo and the Republic of South Sudan, most sundried products are used for human consumption. It had been planned at the inception of the present study that the Consultant would visit all the regional markets to assess trade in small pelagics but it was not possible to visit DR Congo because of political insecurity. South Sudan on the other hand was not considered as a beneficiary country at that time so it was omitted at the last minute from the study. However, it was re-instated at the end of June 2012 when the study had been completed. As a result, under the present study only Rwanda and Kenya were visited. Using the check-list (Annex 2) several people were interviewed and responses recorded (Annex 3). However, due to small number of traders interviewed, responses have been used as indicative data.

2.13.1 Rwanda

During the visit to Rwanda, it was evident that it was more reliant on imports of small pelagics from Tanzania and Uganda than from her own fisheries resources. It was reported that almost 60% of its fishery requirements was met by regional imports while the remaining 40% was supplied from the national water bodies like Lake Kivu. Until recently, the per capita fish consumption in Rwanda was less than 0.2kg and consumers of fish were only found near water bodies and near the border with DR-Congo. Similar to the strategy that was designed to improve the fishery of L. Victoria by introduction of Nile perch from L. Albert in late 1950s, Limnothrissa miodon locally known as Isambaza was introduced in L. Kivu from L. Tanganyika. At the time of the visit, the Limnothrissa fishery had met the expectations of the strategy as evidenced by the many heaps of Isambaza observed in all the markets visited. It was processed in various forms, deep-fried, sun-dried or frozen. The introduction of similar products from Uganda was therefore not entirely new apart from the packaging Using a questionnaire (Annex 2) only eight individuals interviewed; comprising of 50% females and equal number of males and the responses have been recorded in Annex3. Most interviewees were in the three markets within Kigali City that were visited. In Kimironko market the three (3) traders interviewed were all women and they were involved in retailing of several species of small pelagics from lakes Victoria and Kivu (Fig. 20). The quantities traded varied from 1-3 bags that weighed 60Kg each.

Fig. 20: Deep-fried "Isambaza" Limnothrissa miodon (A) from L. Kivu and sun-dried Rastrineobola argentea (B) from L. Victoria

Nyabugogo, the largest main market and major distribution centre with huge storage facilities for Mukene in Kigali was visited. There were over ten stores each with a capacity of 200 MT (Fig. 13). There were about 50 traders using the facilities a depot for local as well as regional retail markets. Rwanda imports almost all fish species but with respect to small pelagics, they prefer salted as opposed to smoked. Four (4) traders were interviewed and the responses were quite similar. Apparently, most traders handled 10MT of small-sized pelagics per week. Generally, the quantities of small pelagics varied from 3.6 Mt to 30 Mt per week per trader. The traders have organized themselves into cooperatives and trade as a block with government incentives. The cooperatives own huge storage facilities with a capacity of 10,000 MT each (Fig 21). Rwandan traders involved in small pelagics trade can travel to landing sites in either Uganda or Tanzania and purchase products in bulk unimpeded but the Ugandan or Tanzanians processors have failed to penetrate the Rwandan organized cooperatives due to lengthy bureaucracies and NTBs. Consequently, they sell to middlemen at border markets or in Kigali central fish market for half the cost. When the proposed merger of COMESA, EAC and SADC will become a reality, then some of these hiccups in the regional trade will be solved. From the central market, products are divided into two portions depending on market demand. Fish for

local consumption is sold to local retailers who distribute to the provinces and urban centres. The remaining fish is then repackaged and exported to DR Congo, South Sudan and Congo Brazzaville.

Fig. 21: One of the storage facilities in Kigali with inset showing sacks of sun-dried Mukene

There was a general observation that Mukene from Uganda was smaller in size than that from Tanzanian. The observation is correct because small-sized Muziri from Lake Albert is marketed as Mukene. Apart from size, the quality of pelagics from these two east African countries differs markedly and they served different market niches. Whereas Mukene from Uganda was sold in Kigali, Tanzanian Dagaa was marketed in the provinces and the regional markets like DR Congo. The price of the product is determined by its quality status. Sand free and salted fetched Mukene from AAA firm located at Kiyindi landing site in Uganda was charged the equivalent of € 4 per Kg compared to € 1.5 per Kg for similar quantities of Dagaa from Kirumba market in Tanzania. Owing to Rwanda's strict policy on polythene packaging, all AAA packaging (Fig. 22) is sent back to Uganda at the expense of the exporter. Considering that the type of packaging did not influence price, then one wonders whether other forms of relatively cheap materials cannot be used instead of the present AAA version.

Fig. 22: Unwanted polythene packaging in Rwanda normally returned to point of origin

In the wet season, almost 50% of the small pelagic imported by Rwanda is converted into animal feed and inevitably sold at a lower price because of the mashed texture and off-flavours. Usually the mashed fish products are re-dried (Fig.23) to reduce risk of further deterioration.

Fig. 23: Texturally damaged small-sized pelagic destined for animal feed production

It was also noted during the visit to Rwanda that there were no taxes levied on Agriculture products provided the Company was registered with government. A new fish trader pays only 5% of the profits while waiting to get its business registered. A trader can trade without a license but it is better to get one which can be accessed online. Within 2 to 3 days a company can be registered with the Rwanda Development Board (RDB). The mode of distribution is negotiable with another distributor. Setting up a sister company in Rwanda, one needs to go through Rwanda Development Board. Generally, Rwanda offered incentives to traders involved in small-sized pelagic trade in terms of tax exemptions. Probably, if other countries within the region implemented the same strategy, trade across the borders would be enhanced.

2.13.2 Kenya

In Kenya, there were two categories of respondents; the industrialists and the traders that were mostly found in Gikomba market. The industrialists were principally involved in processing of large-sized fish like Nile perch and Tilapia or crustaceans. Most of them were operating between 25-40% of the installed capacity due to the declining stocks of the large-sized fish

species. They were processing fish into primary products for the lucrative markets in European, American, S. E. Asian and Australian. Asked whether they would consider participating in the regional fish trade, most of them had little regard for it. The regional market was ostensibly shunned because of a myriad of factors which included, exorbitant freight charges since poor road network rendered land transportation an impossible option, poor returns on small pelagics compared to large sized pelagics, prolonged waiting period for payment and unreliable market among others. In some few incidences, when asked whether they would consider processing small-pelagics for their already established markets, the response was always a hesitant affirmative. Some reckoned that the high cost that would be involved in changing the processing machinery to handle small pelagics would be prohibitive and unwarranted. Others like Telly's thought that it was a worthwhile proposition since they already had canning facilities for fruit and vegetables. If they had regular supplies of freshly caught Ragoge from L. Albert and were assured of market for the final product, they would consider the venture. However, Uganda would not allow passage of unprocessed fish across its border with Kenya because of NTBs. Again when there will be a merger of the regional geo-political blocks, such passage would be permissible.

On the contrary, the second category of traders that traded in small pelagics and principally Mukene comprised of market dealers in Gikomba and Nakumatt chain of stores. The Marketing Manager of Nakumatt expressed interest in all products that had been taken as a test case (deep-fried, sun-dried and powdered). He appreciated the contents but decried the type of packaging which according to him required massive improvement. Then he wondered whether the prospective Ugandan processor could supply all his Supermarkets from the Busia on the Ugandan border to Mombasa. He wanted 20MT of sun-dried per month and small quantities of deep-fried and powdered on trial basis since the latter two products were not known in the Kenyan market. Other issues aside, he was emphatic on the packaging improvement if he was to seal the deal. Upon my return to Uganda, the message was passed on the prospective processors to improve the packaging and then pursue the market. Gikomba market is located in south east of Nairobi. There about 200 traders involved in the Omena (Rastrineobola argentea) trade as retailers and wholesalers with a turnover of 15,000kgs per month. The retailers in the market place were mostly women who purchased their supplies from the wholesalers who were mostly men. The gender roles were dictated by the capital input and the transportation hardship from either Kisumu or Uganda-Busia border post. On average retailers were handling 15Kg of dried Omena per consignment which cost them around Ksh 20,000. To break-even, it was sold in small amounts as demanded by the customer using the measurements indicated in Fig. 24. The price of each tin varied from … for "A" to….for "D".

Fig. 24: Retail measurement tools for Omena in Gikomba market (A-KSH 400.00; B=KSH 250; C=KSH200; D=KSH 100)

Unlike Rwanda with limited fisheries resource, Kenya is endowed with both marine and fresh waters fish stocks comprising hundreds of species but the most predominant small fresh water pelagic in Kenya was Rastrineobola argentea commonly referred to as Omena., In most cases, it was supplied from Tanzania and Uganda porous borders. Over ten traders were interviewed in various markets in Nairobi city but Gikomba located in the South East of city, appeared to be the biggest fish market in Kenya. Most of the traders were handling multiple fish species which included Nile perch (Lates niloticus), Tilapia (Oreochromis niloticus), Lung fish (Protopterus spp). As such, the quantities that were being handled by individual traders were small. There was not a single trader involved in small pelagic trade that handled more than 1 MT per month. Factually, the average amount of Omena handled by a single trader was only 15 Kg per day or 360 Kg per month compared to 2 – 4 Mt that was handled by a single Rwandan trader. Apparently Kenyan pelagic traders were not organized into

cooperatives like Rwandans which made regional trade difficult for them. None of the respondents exported Omena or any other fish species to the region; probably due to the meagre quantities they were handling. Most of the traders were catering to the domestic market and individual customers were purchasing small quantities in cups (Fig 25). Despite the small quantities, there was a market storage facility which charged Kshs 200/= per day for whatever quantity of Omena.

Fig. 25: Small quantities of Omena sold to local customers

The Kenyan traders was also raised the issue quality like their counterparts in Rwanda. They noted that the quality of products from Kirumba market in Tanzania was poor and they recommended products from AAA firm in Uganda. Low quality products were sold at 30 – 50% the cost of high quality Omena. In most cases, low quality Omena was sold for animal feed production. It was reported that there were several companies in Nairobi that were involved in processing of omena into pet food destined for European markets and the reason for low pay on low quality products was attributed to extra cost incurred in sieving of raw materials and washing prior to processing. However, despite the extra cost incurred the pet food companies have continued to import adulterated Dagaa from Tanzania which implies that the business is profitable. Although Nakumatt was emphatic about the type of packaging for all the Ugandan products, the small-scale Kenyan traders retailing small quantities like in Fig 26 were not perturbed because transactions involved small quantities for domestic consumption and fancy would be unnecessary expense. Generally, individual Kenyan traders did not import large quantities of small pelagics like their Rwandan counterparts but in totality the quantities may be large to cater for human consumption, animal feed and pet food production. The current Kenya's human population estimated at 41 million provides an opportunity for other east African countries like Uganda and Tanzania to establish lucrative markets for their various products.

2.14 POTENTIAL MARKET OUTLETS FOR VALUE-ADDED PRODUCTS FROM UGANDA

- Obtain samples of value-added products to take to regional markets for purposes of identifying potential market outlets e.g. mining companies and Supermarkets

As it was previous mentioned in the introduction, the per capita fish consumption in the ECSA region has declined with increase in human population against declining fish stocks. Ironically, there are some pockets of fish abundance within the region whose major constraint is access to lucrative market. In some incidences, the major problem is exposure to markets beyond the vicinity of the fish processor and in others the newness of some products on the market is a limiting factor. The purpose of this TOR was therefore to demystify the latter by exposing new products on the market and assessing their marketability. So fairly new products made from small pelagics were obtained from Uganda and taken to regional markets. Using previous information gathered from several landing sites in Uganda and Tanzania, the major commercial centres for fish business in EAC were Nairobi in Kenya and Kigali in Rwanda. Three (3) products that were fairly new on the market were taken to these major centres as a test case. They included blanched and sun-dried, powdered and deep-fried produced from Muziri, Ragoge and Mukene. Upon arrival at the major centres of fish trade in small pelagics, the first point of call, was the fish market where traders usually congregated and then supermarkets. While in Kenya, e drinking joints were cited as potential market outlets for deep-fried products but they were not visited. However, most people who tasted the deep-fried sample recommended drinking places as potential outlets. Furthermore, the deep-fried product was accepted across the consumer spectrum right from school children to middle-class office workers. The powdered product was popular with the females because of its versatility and the perceived usage options. .

The quantities of products required by prospective customers varied between individual traders and supermarket chains. Understandably so because of the capital investment involved.

Whereas Supermarkets had fairly large amounts of disposable incomes for the intended fish business, the individual traders relied on personal incomes or loan schemes. Take for example the Marketing Manager of Nakumatt supermarket chains in Kenya. He wanted 20MT supplies of sundried Mukene or Muziri per month valued at UGX 40,000,000 (US$ 16,326.5). On the other hand, an average individual trader within the region may have access to only a tenth of the Nakumatt investment. In which case, the quantities required per consignment may be quite small and may vary with national objectives. For instance, at national level, Rwandan individual traders were willing to trade in larger quantities of products than Kenyan counterparts. This was because Rwandan traders re-packaged and re-exported to other regional countries like DR-Congo and S. Sudan while Kenyans concentrated on the local market that required comparatively small quantities. The most frequently asked questions within the region were principally two the regularity of supplies and the cost per kilogramme or tonne. Admittedly, a single processor in Uganda may not be able to meet the required quantities of the product throughout the year because two major reasons. The first one is seasonality within the fishery. Most small-size pelagics in Uganda are harvested following the lunar cycle. In a given month, there are only 18-20 days for active fishing when it is dark. The second reason is lack of storage facility at most landing sites. The most probable guarantee for regular supplies would therefore be the availability of well-ventilated and vermin-proof stores at production sites with holding capacity exceeding market requirement; such that during glut seasons, products are processed and kept in store to ensure regular supply during lean seasons. However, from observations made by the Consultant during previous visits outside the scope of the present study, most landing sites in Uganda did not have a semblance of a fish store. Most processors kept their products in their residential houses with a storage capacity of only 200Kg. They relied on corporate marketing to make up for the required quantities by traders. On numerous occasions, traders have been observed collecting supplies from several landing sites or wait at a particular landing site until the required quantities are collected to constitute a break-even consignment for the intended market outlet. For example, for trader to break-even when supplying sun-dried Mukene to DR-Congo, he would need a minimum of 30MT. With regard to cost per unit volume or waiting of product depending on the intended use, most regional traders wanted products at fixed cost which was unrealistic because of inflation, seasonality and taxes at respective landing sites. Besides, production cost varies with species, lake and location of landing site i.e. whether it is located on the mainland or in the Islands of L. Victoria. Production cost of Ragoge is quite different from Muziri and Mukene. Generally, the regional traders were told a general cost price of UGX 4,000kg-1 (US$ 1.50) for products intended for human consumption. Products for animal feed manufacture were charged 25-45% less than products for human consumption. The women regional traders did not want to travel to Uganda. They wanted consignments to be either taken to the border post or delivered at their respective areas of operation in Rwanda or Kenya at almost the same cost.

Upon her return to Uganda, the consultant relayed the responses to processors and two of them made contacts with individual traders identified in Kenya and Rwanda but the non-tariff barriers like accompanying health certificates, unspecified documentation and cross-border encumbrances have slowed down the first cross-border trade under the smartfish intervention. With regard to questions frequently asked by the regional traders, namely regularity of supplies and cost, Uganda suppliers intimated that it was possible if the right price was offered. However, they would only take the products across the borders, if the respective traders picked the transport charges.

2.15 MARKET OPPORTUNITIES FOR UGANDAN VALUE-ADDED PRODUCTS

- Describe the regional market opportunities for value-added small-pelagic fish products from Uganda.

With the declining high-value and large-sized pelagics namely Nile perch (Lates niloticus) and Nile tilapia Oreochromis niloticus stocks, the small-sized pelagic fishery has been the main stay for domestic as well as regional markets. The decline in stocks of large-sized pelagics has been attributed to increased fishing effort exacerbated by exports to Europe, Americas, Middle East and the Far East. Of the several species among the small-sized pelagics, the Mukene (Rastrineobola argentea) fishery was the most well-known. It

is actually the third commercially important fish species after Nile perch and Tilapia in Uganda and it accounts for 60% of the total fisheries biomass in L. Victoria which increased from 59,000MT in 1998 to 1,200,000MT in 2011 (Taabu, pers. Commun.). Correspondingly, it contributed to almost 90% of the total pelagic catch landed on the shores of lakes Victoria, Kyoga and Albert where they are endemic. Owing to their small size, and method of fishing that uses mosquito net and a lantern light for attraction, catches landed are substantially larger than catches for big sized fish species. Usually the fishing canoes for small pelagics are small and manually powered with hardly enough space on-board to ensure hygiene and on board handling. As such, the overall catch has mixed batches at different levels of spoilage which influences the final product quality. Because of the large quantities landed at different levels of spoilage and the available facilities at most landing sites in Uganda, most small pelagics are traditionally preserved by open sun drying which entails direct use of solar energy. Different surfaces are used for the purpose. They include rocks, stone pebbles spread on bare ground, tumpline sheets and direct bare ground. Pelagics dried on bare ground results into low quality products and usually marketed as raw material for animal feed production. Until a few years ago, the Muziri and Ragoge fishery was off the national agenda. Not much had been done in terms of post-harvest technology and product development until the present SMARTFISH intervention. From the preliminary data collection conducted at the inception of the present study, Muziri was being marketed in Uganda as “Mukene” because of their similarity in size and appearance. Nonetheless, most traders complained about its extra-tiny size and quite often mistook it for immature Mukene. Trade in immature fish is a criminal offence under the 2004 Quality Assurance rules which have been revised into the same rules of 2012. By virtue of these rules, DFR’s Regulatory Unit is obliged to arrest and charge anyone found in possession of immature fish. As such, trade in Muziri was a risky business which further compounded its obscurity. Ragoge trade on the other hand, was impeded by its physio-chemical properties. Due to its high fat content, open-sun drying takes a minimum of three days on a bright and sunny day and a whole week during cloudy or rainy days. From quality view point, any small pelagic ought to dry and within a day if it is to maintain its lustre. So the prolonged drying period of Ragoge allows the development of rancid flavours which most traders associate with spoilt fish and as such offer minimal price for a given unit of measurement. According to Buliisa District Fisheries Officer all Ragoge consignments from Lake Albert destined to Kampala markets were not fit for human consumption and therefore they were principally used for animal feed manufacture as a protein source.

The prevailing climatic changes have further undermined the already unreliable open-sun drying method to such an extent that alternative preservation methods have to be developed. The resultant incomplete drying coupled with poor up-stream handling contributes to the current high post-harvest losses in the small-sized pelagic fishery. Indeed, the post harvest losses in the Mukene fishery have been estimated at 90% during the wet season and less than 10% during the dry spells. In addition, the dependence on the traditional sun-drying method and the type of drying surfaces has contributed to the deplorable quality of small pelagics available on the market. The traditional practice of drying on bare ground or gravel in unhygienic conditions exposes small pelagics to physical as well as microbiological contamination caused by direct contact with domestic animals, wild as well as domesticated birds and insects. The resultant product is highly adulterated with sand/gravel and other debris which amounts to poor quality. Exposure to environmental elements at landing sites also heightens the risk of Salmonella contamination which is a health hazard. Consequently, there is an age-long social stigma associated with consumption of sundried small pelagics in Uganda and it will take some technological transformation to reverse the trend. Nonetheless, the, GoU in partnership with various development partners have intervened at different levels along the value chain to lift the stigma. One of the suggested mitigation measure was the development of alternative products from Mukene so that the small bonny fish is presented in different form to consumers. This initiative was undertaken in 2005 by FAO when the women group at Kisuku landing site, Masaka District were trained in various options for Mukene utilization. The options included, deep-frying, smoking, milling and fermentation. Then in 2008, LVFO with funding from EU conducted a similar work at Bumeru A and Yebe landing sites in formerly Bugiri District and the present Namayingo District. In 2010, again FAO under TCP/UGA/3204 (D) project that was

designed to increase supply of Mukene for human consumption, crisps, powdered and sweetened products were added to the previous list but on this occasion, the women fisher communities at Kiyindi and Kasekulo landing sites in Buikwe and Kalangala Districts respectively were targeted. In October of the same year, EU through the Secretariat of the ACP group of States under the broad objective of Strengthening Fishery Products health Conditions in ACP/OCT countries, conducted a 2 week study (IND017UGA) to test different processing methods for Mukene intended for human consumption and fish meal in Uganda at an industrial level. This study was based at Greenfields (U) Limited; one of the 15 plants in Uganda processing large-sized fish for the export market.. About four (4) products were developed and they included battered deep-fried whole Mukene, silage, bulk frozen and individually quick frozen (IQF). The common denominator for all the initiatives implemented until the present study targeted fisher communities that were least interested in the new innovations. The present SMARTFISH intervention has gone a step further by singling out individuals already processing any of the pelagics into value-added products and then identifying and sorting out the bottle-necks. By so doing, the targeted potential processor utilizes the SMARTFISH intervention measure as a stepping stone to their aspirations. So far the approach has made headway as exemplified by the three (3) processors who participated in the SMARTFISH up-grading scheme and supplied products for market testing in the neighbouring countries of Kenya and Rwanda.

Over the last five (5) years, there have been ten (10) value-added products developed from small pelagics in Uganda. They include, deep-fried, smoked, milled, powdered, sweetened, crisps, bulk frozen, IQF frozen and sand-free-blanched sun-dried. However, not all the ten products have been popularized within the ECSA region because of non-tariff barriers and fear of the unknown. Currently, it is only the sun-dried products that are marketed across borders without undue clarifications but there is sufficient evidence that demonstrates opportunities for each of the products listed above. There is also an indication that if Ugandan processors employed some aggressive marketing techniques, their products can easily gain popularity within the region. However, there are other socio-economic and dietary factors prevailing in the region which can augment their efforts and thereby provide opportunities for Ugandan value-added products made from small-sized pelagics. In terms of significance, they include among many others not cited here; uninhibited population increases, regional economic blocks, dietary disposition, nutritive value of fish and civil strife or wars (insecurity) which tends to drive larger numbers of people into one place as refugees or internally displaced persons (IDPs). Although natural calamities like volcanic eruptions or extreme climatic changes that cause drought and floods may also drive large populations of people to designated reception centres, their occurrence and longevity is so unpredictable that plans to supply food on a regular basis cannot be maintained. As such, natural calamities have not been considered in the present study as an opportune factor for value-added products from Uganda. Admittedly, these factors overlap and interrelate with each other and quite often they are consequences of each other. Nonetheless, each one of them has been discussed singularly in detail and the appropriate value-added Ugandan product identified. .

2.15.1 Human population increases

The ECSA region has a population of nearly 600 million people (FAOSTAT, 2009) and it is increasing at an average rate of 3% annually which provides unlimited market for any of the value-added products produced from Uganda. In the fisheries sector, the most ideal tool to gauge the influence of human population increase on available fisheries resources is the per capita consumption. It indicates the amount of fish consumed by an individual over a whole year regardless of person's access or affordability. Ideally, as the population increases, there should be mechanisms to sequentially increase the available fish to meet the daily recommended intake of 150 g for an adult per day. Instead, the fisheries resources have remained static at best or declined steeply as the population has incessantly increased. The decline in fisheries resource within the ECSA region has been attributed to increase in fishing effort, climatic change and high post-harvest losses as a consequence of by-catch, spoilage and narrow product base.

About three decades ago, the per capita fish consumption in EAC was slightly above 15 kg but it has declined to a regional average of slightly less than 12kg. The decline in capita fish consumption

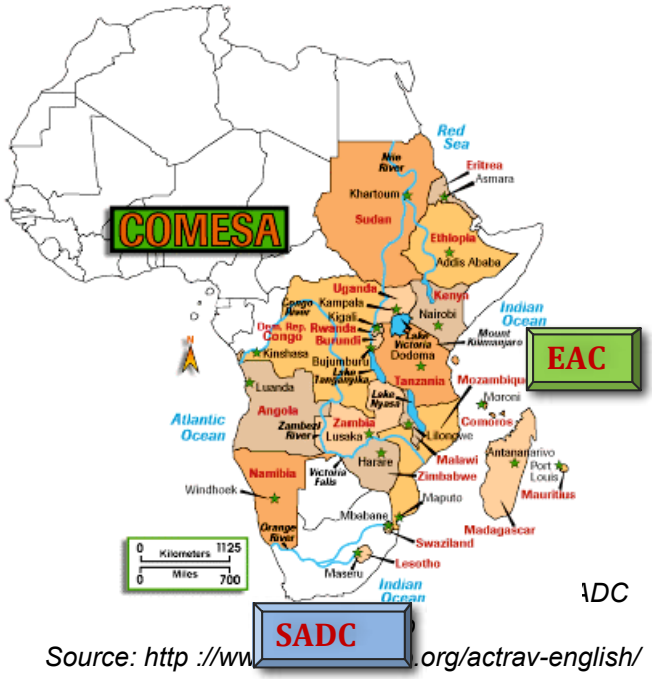
has been attributed to three major factors. The first school of thought attributes the decline to the 3% population growth rate which has allowed the population to almost double in the same period of time and yet the fisheries resources have remained static at best or declined at the worst scenario. The second school of thought is that the Nile perch boom of 1980s which attracted investments in industrial sector around Lake Victoria Basin, declined drastically in the last decade of the 20th Century due to increased fishing effort. It is important to note that almost 99% of the processed Nile perch and Nile tilapia is exported outside the EAC region which makes them unavailable to fish consumers within the region.. The third school of thought is that before the introduction of Nile perch into lakes Victoria and Kyoga in late 1950s, there were other fish species like Bagrus, Barbus, Labeo and Clarias which were more preferred by the consumers within the L. Victoria Basin than the carnivorous Nile perch. As the Nile perch populations peaked in mid-1980s, the biodiversity in both lakes declined and the consumption trends changed accordingly. Coincidentally, the biomass of small pelagics increased but since consumers regarded them as source of protein for animal feed manufacture, they were not available for human consumption. As such, they only featured on the menu of most consumers disguised as poultry or pork or beef. In essence, any strategy that retrieves fish resources from undue waste increases per capita consumption albeit through secondary consumers. There is empirical evidence to attest the decisive role played by the three factors in the decline of fish per capita consumption in EAC but industrialists involved in fish processing have tended to play down the second factor. Nonetheless, regardless of the causal factors, the decline in per capita consumption in the EAC region offers an opportunity for products made from small-sized pelagics to be marketed as food for human consumption. The deep-fried and crisp products may be consumed as snacks while the powdered and milled products may be used as condiments or incorporated into other composite flours. The frozen products may be transformed into other products at the desired time. Generally there is a market outlet for virtually all the value-added products at societal level. For example, the men folk may prefer deep-fried while the children will go in for crisps and the women will utilize the powdered and milled products.

2.15.2 Regional geo-political blocks

Uganda is part of or surrounded by geo-political and economic blocks of countries with common political and economic aspirations. They include East African Community (EAC), Common Market for East and Southern Africa (COMESA), Southern African Development Community (SADC) and Intergovernmental Authority for Development (IGAD). The shared principle across the blocks is the desire to foster cross-border trade in goods and services through elimination of structural and institutional weaknesses. The envisaged economic integration will undoubtedly create a conducive environment for marketing of value-added products from Uganda. Currently, there are non-barrier tariffs (NBT) hindering free trade between COMESA-EAC-SADC trade block but with the envisaged merger, goods including products from small pelagics will find market in the remote parts of the region. Indeed, last year an effort was made to merge COMESA, EAC and SADC into a large single market (Fig. 17) that would combine member countries in a free trade area for promotion and attraction of cross-border in addition to international trade/investment. The merger would pave a way for Economic community by 2025 and possibly for a harmonized monetary system as well. A common currency across the region will ease financial transfers. In 2009, Customs Union was launched which was a step ahead of Free trade Area (FTA) to cut down on bureaucracy and cross-border taxes. These new developments imply that cross-border trade will be enhanced in the near future and the present NBT will be a thing of the past.

Currently only sun-dried small-sized pelagics from Uganda are exported to regional markets which include Rwanda, Burundi, Democratic Republic of Congo (DRC), South Sudan and Central African Republic (CAR) albeit clandestinely. The demand is so insatiable that traders from Rwanda decided to engage in advance payment as a strategy to out-compete others. When the merger comes into force as planned, the demand will exceed supply by a factor of 10. It is also envisaged that within the merger framework that connectivity will be improved with FTA which implies that frozen products from Uganda can be marketed in Freetown- South Africa within a week. Currently, the proprietor of AAA transports his sun-dried products by road and it takes him almost two weeks because of impassable roads at some places and needless bureaucracies at

border posts. With improved road network and harmonized policies within the region, the journey will take him less than one week.



Source: http ://ww .org/actrav-english/telearn/global/ilo/blokit/comesa.htm

During the Lusaka Event, it was reported that the Limnothrissa moidon and Stolothrissa tanganicae (Kapeta) fishery in L. Kariba were declining and since the consumers within the surrounding region are already used to consumption of small pelagics, introduction of Ugandan value-added products made from similar pelagics will not pose a dietary discomfort. Besides, most products are almost ready-to-eat and comparatively cheaper than the available products.

2.15.3 Dietary disposition

Most African countries located south of the Sahara (SSA) grow staple crops that are rich in carbohydrates and negligible amounts of protein. They include cereals (rice, maize, millet and sorghum) and root tubers like potatoes, cassava and yams. Although legumes like beans, soybeans groundnuts, and other nuts are also grown in large quantities (Table 7) their biological value is lower than in meats, fish and eggs (Potter and Hotchkiss, 1995) hence the need to supplement diets with animal based foods. In most SSA countries cattle, sheep, camels and goats are status symbol and therefore hardly slaughtered for merely observing dietary requirements. As such, most people within the ECSA region rely on carbohydrate-based diets laced with plant protein. For several decades, fish was described as the cheapest source of animal protein but since the world stocks of large-sized fish declined in 1990s, it is no longer cheap. For example, in 1980s a kilogram of Nile perch was charged UGX 200 (US$ 0.15) but in 2011, it was charged UGX 7,000 (US$3) which was beyond the reach of most fish consumers. The trend may have been repeated in other ECSA countries which rendered large-sized fish unavailable to the majority of consumers most of whom earned less than a dollar per day. Although the cost of small-sized pelagics also increased simultaneously during the same period of time, they were still affordable. In some countries small pelagics became the mainstay of most traders as well as consumers. The most traded product at that time was sun-dried Mukene/Omena/Dagaa or Kapeta and very little deep-fried versions. Introduction of value-added Ugandan products made from Mukene, Ragoge and Muziri on the regional market will definitely find a dietary slot in most homes within the region to supplement the carbohydrate-based diets. Since most products are user-friendly as condiments and snacks, adoption will be easy across the various cultures. For example, milled Mukene can be mingled with maize meal to enhance the protein content and flavour. Maize meal is consumed on a regular basis in most low-income homes from Sudan to South Africa.

Table 7: Selected Agricultural produce (MT'0000) for countries within ECSA region in 2010

Agricultural produce	Angola	Burundi	DR- congo	Eritrea	Ethiopia	Kenya	Lesotho	Madagascar	Malawi	Mauritius	Mozambique	Namibia	Rwanda	Seychelles	South Africa	Former Sudan	Swaziland	Uganda	Zambia	Zimbabwe
Cassava	1385.9	18.8	1505.0	0	0	0	0	300.9	342.0	0	570	0	237.7	0.02	0	0	0	528.2	115.2	20.3
Indigenous Cattle Meat	10.5	1.6	0.0	2.2	39.0	46.3	1.0	15.0	3.42	0	1.9	5.8	3.7	0	88.6	150.7	1.4	13.1	6.1	9.959
Maize	107.3	12.6	115.6	2.1	440	322.2	12.8	41.2	380	0	187.8	5.8	43.2	0	1282	0	6.8	137.3	279.5	119.2
Beans, dry	25.0	20.2	11.5	0	26.3	39.1	0.3	8.2	15.2	0	0	0	32.7	0	0	0	0	46	0	2.167
Potatoes	84.1	0.0	0.0	0	78.6	45	9.8	0.2	470.6	1.7	0	0	178.9	0	207.2	0	0.7	69.5	0	0
Bananas	43.3	13.7	31.6	0	0	79.2	0	23.2	41.8	1.1	11.5	0	0	0.1	39.3	0	0.6	60	0	9.2
Sweet potatoes	98.7	30.3	0.0	0	0	0	0	91.9	0	0	92	0	84.01	0	0	0	0	283.8	25.3	0
Cow milk, whole, fresh	18.4	2.6	0.0	13.1	177.4	515.7	3.4	70.3	0	0.4	0	11.5	18.4	0.02	323	555.5	4.2	119	8.9	49.3
Indigenous Pigmeat	3.3	1.2	2.6	0	0	0	0.4	5.50	4.5	0.1	9.7	0.44	0	0.03	33.8	0	0.2	11.3	1.7	3.1
Groundnuts, with shell	11.5	0.0	37.1	0	0	0	0	0	22.2	0	0	0	0	0	0	76.3	0.4	17.2	16.4	10.6
Indigenous Goat Meat	1.1	0.6	1.8	0.6	6.6	4.7	0.2	22.5	2.1	0	2.4	0.6	0.7	0	0	16.09	0.2	3.2	0.8	1.3
Indigenous Chicken Meat	0.8	0.7	0.0	0.2	0	0	0.2	3.6	2.1	4.6	2.3	0.6	0	0.07	147.3	0	0.4	4.3	4.3	6.2
Rice, paddy	0	8.3	31.7	0	0	0	0	473.8	14.4	0	18	0	6.7	0	0	0	0	0	5.2	0
Sorghum	0	8.3	0.0	6.7	299.7	0	2.4	0	0	0	39.5	0	16.1	0	0	263	0	50	0	7.4
Goat milk, whole, fresh	0	1.8	0.0	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peas, dry	0	3.2	0.0	0	0	0	0.11	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantains	0	0	125.0	0	0	79.2	0.5	0	32.5	0	0	0	274.9	0	0	0	0	955	0	0
Game meat	0	0	11.0	0	8.5	0	0	0	0	0.06	0	0.6	1.3	0	0	0	0	0	3.6	3.5
Indigenous Sheep Meat	0	0	0	0	8.6	4.2	0.3	0	0	0	0	1.5	0	0	13.3	36.6	0	0	0	0
Wheat	0	0	0	2.7	300	51.2	2.0	0	0	0	0	0	0	0	146.5	0	0	0	17.2	0
Oats	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0
Barley	0	0	0	6.7	140	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Adapted from FAOSTAT Country Data, 2012

2.15.4 Nutritive value

In comparison to other foods, fish is the most nutritive food source (Table 8). Regular consumption of fish has been known to reduce the risk of cardiovascular related diseases particularly antihypertensive and varicose veins (Huss, 1995). The Omega 3 component of the polyunsaturated fish fat is responsible for the acclaimed health effects. These are essential fatty acids necessary for body metabolism. The most important of Omega 3 fatty acids are eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and linolenic acid (ALA) known to play a favourable role in prevention of coronary heart disease. The small-pelagics as evidenced in Table 3(a) have substantive quantities and therefore they would be highly recommended for all consumers but particularly individuals in the risk age group of 50 years and above would be urged to include powdered product in their daily meals.

Table 8: Basic nutritive composition of staple carbohydrate foods in ECSA region compared to pelagics

Food item	Protein (g/100)	Fat (g/100)	Carbohydrate (g/100)	Energy (kJ)	Fibre (g/100)	Sugar (g/100)	Calcium (mg/100)	Phosphorous (mg/10	Iron (mg/100)	Magnesium (mg/100)	Mangenese (mg/100)	Zinc (mg/100)
Maize	3.2	1.18	19	360	2.7	3.22	2	89	0.52	37	0.16	0.45
Rice	7.1	0.66	80	1528	1.3	0.12	28	115	4.31	25	1.09	1.09
Potato	2	0.09	17	322	2.2	0.78	12	57	0.78	23	0.15	6
Cassava	1.4	0.28	38	670	1.8	1.7	16	270	0.27	21	0.38	0.34
Sweetpotato	1.6	0.05	20	360	3	4.18	30	47	0.61	25	0.26	0.3
Sorghum	11.3	3.3	75	1419	6.3		28	287	4.4			
Yam	1.5	0.17	28	494	4.1	0.5	17	55	0.54	21	0.4	0.24
Plantain	1.3	0.37	32	65	2.3	15	3	34	0.6	37		0.14
Small-pelagics	64.4	11.64	negligible	4915	none		24.25	2.29	181.25	49	11.9	279.3

Source: Adapted from FAOSTAT, 2010. Pelagic data from present study

The protein content with its high biological value is evidently higher in small-sized pelagics than in all other staple crops. Its quality is similar to that of milk and meat. The array of value-added products from Uganda are available in different processed forms such as smoked, deep-fried and powdered which are easy to incorporate into various meals. Products can also be added to porridge and administered to children suffering from kwashiorkor as medicine. Kwashiorkor is a disease related to protein deficiency and it is rampart in SSA. The other forms of pelagic products can be used as sauce while eating the carbohydrate-based staples. Fish is known to contain well-balanced supply of minerals especially iron which is the principal ingredient in red blood cells and required by pregnant mothers and children under five years of age. It is incredibly higher in fish than in all the staples combined (Table 4). Instead of taking expensive iron tablets, medical personnel in antenatal health facilities should consider prescribing small pelagics to pregnant mothers. Considering, that 70% of people in SSA live in rural areas where medical service delivery is unsatisfactory; provision of sachets of powdered or milled product would allow some countries in ECSA region to meet Goal 5 of the Millennium Development Goal (MDG) on maternal health by 2015. There are some patients in Uganda with broken bones who have been told to eat small pelagics on a regular basis as a curative medication. The same prescription can apply in other countries within ECSA region when Ugandan value-added products will be available on market.

2.15.5 Civil strife/war (insecurity)

Although, it may appear harsh and insensitive, civil strife and wars in SSA provide an opportunity for ready-to-eat products from Uganda. For the last half a century, there have been protracted wars and civil strife in different African countries; for instance, Sudan, DR-Congo, Rwanda, Burundi, Uganda and Somalia. Consequently, refuges have been resettled in camps like Dadaab in North Eastern Province of Kenya which currently hosts over 500,000 refugees fleeing conflicts in Somalia. There are also refugee camps in the western part of Uganda hosting over 100,000 Congolese fleeing wars in DR-Congo. Until recently, Northern Uganda was littered with camps hosting internally displaced persons (IDPs) as a result of Kony's Lord's resistance army insurgency. Most camps are densely populated and characterized by shortage of food. Arable land for agricultural purposes may not be sufficient for both habitation and crop production in such camps or IDPs. Quite often, conflicts erupt between the local people and refugees over natural resources and especially food. The United Nations Human Rights Council (UNHRC) is obliged to cater for their well-being but quite often it is the World Food Programme (WFP) that supplies food to refugees. Indeed, according to its mission statement WFP provides food aid to refugees, improves the nutrition and quality of life for the most vulnerable members of society that include women, children, elderly and the sick. It also fights against micronutrient

deficiencies, child mortality and combats diseases like HIV/AIDS. In 2011, WFP reached almost 100 million people from 75 countries most of them were from developing countries and particularly in Africa (WFP, 2012). The Programme provided 3.6 million MT of food including nutritionally improved products. In Uganda, WFP was purchasing maize, cassava and beans locally and distributing it in IDP or refugee camps. Although, it may appear cruel and insensitive, refugee and IDP camps provide an opportunity for value-added products from Uganda. There are three factors that can be advanced for the proposition; one the deep-fried, powdered and smoked are ready-to-eat products that will not require further cooking. This would be an added advantage because most refugee camps are environmentally degraded due to population pressure and firewood for cooking food may be a problem. Secondly, the protein content of all the value-added products is quite high and it would be recommended for the vulnerable members of society forced to stay in the camp by prevailing circumstances. There are persistent stories in the media highlighting the plight of malnourished children with kwashiorkor reaching refugee camps in Kenya or S. Sudan or Uganda in poor health. Apart from medical administration of body fluids, they would definitely require high energy and high protein density foods. Powdered products from small-pelagics meet the requirements and they can be administered to the victims with minimal preparations. From Owor et al., (2000) study, energy and protein malnourished children under five years of age recovered from their condition within a month when fed on a meal that included Mukene. Thirdly, refugee camps are also known to be hubs for spread of HIV/AIDS. This would deal a double blow to the victim and particularly so when the available food is least palatable. According to medical personnel, some patients tend to develop ulceration of the gullet which makes swallowing of food difficult. In such incidences consumption of food containing high energy, protein and zinc components is vital and small-pelagics meets the desired requirements. Besides, powdered or milled products are easy to prepare into a porridge-like stew which may be more acceptable to the patient than other foods.

Currently, the proprietor of AAA firm has a contract to supply about 20MT of sand-free salted and sun-dried Mukene products to WFP per week and it has not been easy to honour the contract. He has had to solicit for additional supplies from other processors which unfortunately may compromise his product quality standards. UMAGA (U) Limited has also been contacted by similar international bodies involved in relief work to supply ready-to-eat products from Muziri and Ragoge. In other words, trade in value-added products from Uganda has already commenced and the only limiting factor is supply of the required quantities. The probable major constraint in this regard would be efficient processing technologies to meet the required quantities and quality within the specified time.

3.0 CONCLUSION & RECOMMENDATIONS

In conclusion, although post-harvest losses are unacceptably high in small pelagic due to limited affordable mitigation technologies, there is potential for regional trade in the sector as attested by products made from fairly unknown fish species (Muziri and Ragoge) from L. Albert. The fact that traders from Kenya and Rwanda were willing to offer acceptable prices, it was indicative enough for the fishery. In view of the declining stocks of large fish species like Nile perch and Tilapia, exploitation of the small-sized pelagics for human consumption, can contribute to increase in per capita fish consumption within the region. Product diversification seems to be an alternative option for increasing supply of small pelagics for human consumption and small-scale processors may be the key to commercialization of new products provided they are technically backstopped along each step from production, certification and market place. High levels of protein, Omega 3 and vital minerals like calcium, phosphorous and iron in various products made small pelagics allow them to play a crucial in the health of vulnerable members of the society.

The approach used by SMARTFISH to up-grade emerging processors of small pelagics is likely to have a tangible transformation in their respective businesses. However, there will be a need to re-evaluate the impact of the programme on trade enhancement, financial status and the whole business outlook after a time lag of at least one year. There are other recommendations that include harmonization of safety and quality standards for small pelagics to facilitate cross-border trade in the ECSA region. The harmonized standards would not only contribute to the improvement of product quality but they will also minimize the impact of non-tariff barriers. Information on chemical nutrition, safety and spoilage rates for all small pelagics within the region should be collated where it is available or determined where there is an information gap. The availability of nutritional information will allow potential processors to comply with packaging standard that will in turn facilitate trade beyond the ECSA region. Other initiatives should be undertaken to increase supply of small pelagics for human consumption through diversification of utilization options during advance weather conditions. For example, there is a potential for canning Ragoge and a mechanical drier that uses renewable energy. Finally, a comprehensive survey involving a minimum of 100 traders in each country should be undertaken to ascertain the acceptance of Ugandan products made from small pelagics.

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ANNEXES

ANNEX 1: TERMS OF REFERENCE

	AGROTEC CONSORTIUM	
Study Name	Implementation of a Regional Fisheries Strategy (IRFS) for ESA-IO	
Mission Schedule Number	4M2.3.1-TOR	
Coordinator	Chris Short, KE3; Coordinator of RESULT 4: Regional Trade Strategy	
Technical Verifier	Chris Short, KE3; Coordinator of RESULT 4: Regional Trade Strategy	
Background to study	The SMARTFISH (IRFS programme) was launched in February 2011 with the aim of contributing to an increased level of social, economic and environmental development and deeper regional integration in the ESA-IO region through the sustainable exploitation of fisheries resources. The programme is financed by the European Union under the 10th European Development Fund (EDF) within a total financial contribution of Euro 21 million. The programme is implemented by the Indian Ocean Commission (IOC) in collaboration with the Common Market for East and Southern Africa (COMESA), the East Africa Community (EAC) and the Inter-Governmental Authority on Development (IGAD). Other regional institutions involved include the Southern African Development Community (SADC) and regional fisheries management organizations, such as the Indian Ocean Tuna Commission (IOTC), the Southwest Indian Ocean Fisheries Commission (SWIOFC), the Lake Victoria Fisheries Organization (LVFO), and the Lake Tanganyika Fisheries Organization (LTFO). The first phase of the Program will be implemented over a period of 31 months (March 2011-September 2013). The overall objective of the program is to contribute to an increased level of social, economic and environmental development and deeper regional integration in the ESA-IO region through the sustainable exploitation of fisheries resources. The expected results and outcome of the program falls into the following five categories: fisheries governance; fisheries management; monitoring, control and surveillance; regional fish trade and food security. This study falls under the module of Result 4 related to initiatives to enhance capabilities for regional trade for existing and emerging processors and traders.	
Issues to be addressed	The specific task is to: Planning, organizing, implementing and monitoring processor interventions in the region as described above. Prepare reports and presentations as required.	
Activities of the Consultant	Utilization options for inland small-pelagic fishery and marketing • In collaboration with STE responsible for organizing the SMARTFISH Regional Trade Event, prepare a checklist / questionnaire to collect data on existing products, specifications quantity demanded and constraints to current supply, demand and sale of fish and fishery products and occurring changes during market survey field visits to Kenya, Rwanda and DR-Congo • Identify existing progressive /emerging producers of improved quality and value-added small-pelagic products based on their business plans, available information and discussions for purposes of up-grading. • Describe the opportunities for support to individual businesses including opportunities for capacity building, provision of equipment, materials, marketing or other support to upgrade standards and prioritise these according to SMARTFISH requirements and objectives. • Plan and undertake at least one prioritised intervention with one of the identified processing businesses and assess the uptake and impact of the intervention. • Assess the potential for a small-pelagic processor business and make recommendations for representation at the SMARTFISH Trade Event in 2012. • Working with existing improved processor groups explore all-weather improved and alternative processing techniques for small-pelagics. • Obtain samples of value-added products to take to regional markets for purposes of identifying potential market outlets e.g. mining companies and Supermarkets	

	• Describe the regional market opportunities for value-added small-pelagic fish products from Uganda. • Obtain a list of materials / specification for the construction of the "Senegal" improved dryer discussed at the FAO meeting on fish handling and quality, Seychelles, 2011. • In conjunction with an identified established processor in Uganda, construct an improved dryer and field test it with local processors including BMU ACP Fish II trainers from Mukene landing sites. • In collaboration with processors, modify and adapt the drier based on sources of appropriate energy, fuel efficiency, fish drying capacity, cost of construction and other product needs and specifications. • Collate information on the underutilised small pelagic resources of Lake Albert namely "muziri "(Neobola bredoi) and "ragoge" (Brycinus nurse) and suggest opportunities for handling, processing methods and marketing opportunities for these species. • Determine nutritional analyses of the muziri and ragoge using an in-country laboratory. • Based on the activities and the results prepare a presentation for the SMARTFISH Trade Event. • Submit comprehensive final report to SMARTFISH.	
Expected outputs	Outputs • Delivered interventions as described above • Submit a comprehensive report that outlines all the activities undertaken, results and recommendations • Prepare meeting and trip reports as required • Prepare presentations to be delivered at the SMARTFISH trade event planned for April 2012	
Format of each report	The reports to be produced using MS WORD (and other MS Office software, if necessary) and be available in hard copy / electronic form	
Report to be reviewed by	Chris Short, Key Expert for Regional Trade Result	
Duration	**Estimated time allocations for the activities described above**	**Working days**
	(i) Planning, organizing, implementing and monitoring processor interventions described above	38
	(ii) Travel in the region to selected countries (Rwanda, Kenya and DR Congo)	14
	(iii) Presentations preparation and delivery at Trade Event in April	4
	(iv) Final Report preparation	5
	Total	**61**
	Total input days: **61 working days**	
Start date	Approx Start: Mid January 2012	Completion: End April 2012
Completion dates for Reports and fee payment schedule	Draft output	Various scheduled throughout the period
	Comments from PCM	Within 1 weeks after reception
	Final Output	2 working days after receipt of comments by IRFS/PCM
	Final Output basis for relevant payments	
Experience and qualification	Qualifications and skills: - fluency in one of English - Expertise with product processing and development, value-addition, marketing and food technology - Experience working with EU projects an advantage	

Locations and travel	Home Base, travel in East /Central Africa
Requested: Project Team Leader Date:	
Validated: Programme Manager, for IOC-RAO Date:	

ANNEX 2: CHECK LIST: REGIONAL TRADERS

QUESTIONAIRE ON SMALL PELAGICS AND OTHER FISH PRODUCTS WITHIN ESCA (regional trade)

SMARTFISH in collaboration is in the process of collecting information on the type of fish product, markets, demanded quality and quantities within the region. Your participation is greatly appreciated.

Date…….

GENERAL INFORMATION
Name of respondent: ……
Country ……
City/Town ……
Address ……
Contact (Mob) ……
Type of business ……

Type of fishery product (s) ……

Quantity

1. What types of fish (species, products) do you process?……..
2. What quantity of fish do you process per day? ……..
3. How many times do you process fish/product in a week? …….....
4. What is the unit of measurement for unprocessed (wet) and processed (dry)?

Unprocessed a)…… b)…… c) …… d) ……

Processed a)…… b)…… c) …… d) ……

5. What quantity do you buy each time? (a) Unprocessed ……..; (b) Processed ……..;
6. How often do you buy this product? …….....
7. Do you buy different amounts at different times of the year?

If yes, when are the times you buy the;
   a) Most ……..,

   b) Least ……..

7. Do you have a storage facility for the product?....Yes/No ……..

8. What is the capacity of the existent storage facilities? ……..

9. Are there any costs involved in storage of the product (storage fees)? ……..
If yes how much? ……..

10. What are the difficulties faced in the fish supply chain? ……

Quality

11. Do you know of any quality specification set for the product being marketed? If so, list them
    ……
    ……
12. What is the most common quality defect you fail to eliminate from your product being sold or you notice in the product you usually purchase?
    ……

13. Do you offer less for a product with a quality defect? Yes /No…….....
If yes, by what margin? …….....

14. What do you use the product for when you buy a product with a quality defect? ……
    ……
15. Who is producing quality fish products in this area? …….....

16. Do you like the package and label being used? …….....

17. Does the type of packaging influence marketing of your product? If so, how?

……..
……..
18. Is there anything about the product that you would like to see improved? If so, what? …….....
    .....
19. Do you purchase any other product on account of quality?

If yes, what is it? ……and what is the comparative advantage? …….....
……
……

Markets

19. What fish products are currently available on the market?

Local.....
Regional.....

20. where do you normally sell/buy your fish (Market outlets or destination)?

21. Who are your major customers?
    ……
    ……
22. What are the limitations in marketing and sale of fish products?
    ……
23. Are there any new developments in the fish sector of your locality?
    ……
24. What improvements would you like to see at the market?
    ……

Price

25. What is the market price (unit cost) of the
    a) Unprocessed (wet) product? …….
    b) Processed (dry) product? ……..

26. Would you purchase the product at that price? …….
If no, why ……..……..…
……
27. How much are you willing to pay for the product? …….....
    .....
28. Does the product price change at different times of the year?

If yes when is the price;
    a) Highest? …….....
    b) Lowest? …….....

ANNEX 3: RESPONSES TO QUESTIONNAIRE

Note: The following table is continuous

Table I: Types of fish species, quantity handled and frequency

Species	Quantity processed /day	Period processed	No. of respondents		Nationality
			M	F	
Dagaa/Omena	20(2kg fins)	once/wk.	0	5	Kenyan
Tilapia	180kg	4/wk.	2	1	Kenyan
Tilapia, Dagaa	20kg	daily	1	3	Kenyan
Tilapia, Nile perch and Dagaa	90kg	4/wk.	2	0	Kenyan
Tilapia, Nile perch	10kg	2/wk.		2	Kenyan
Dagaa/Omena	1MT	1 wk.	2	3	Rwandan
Dagaa/Omena	>5MT	1wk	2	1	Rwandan
Dagaa ,Tilapia and Nile perch	15kg	1/wk.	1	0	Kenyan
Total no. of respondents			10	15	
Rwandans			4	4	
Kenyans			6	10	

Table II: Unit of measurement, quantity purchased and frequency

Unit of measure	Fish species	Quantity bought	Period bought	Frequency
Unspecified	Dagaa/Mukene	4Mt	month	5
Kg		Unprocessed-90kg & Processed-nill	Daily	3
Kg and pieces	Dagaa &Tilapia	50-pieces & 60kgs	Daily	4
Tins, kg, sack	Dagaa/Omena	Unprocessed-90kg & Processed-120kg	Daily	2
Kg, sack, tin	Dagaa/Omena	Unprocessed-10kg & Processed-nill	Daily	2
Tins	Dagaa/Omena	Unprocessed-12000kg & Processed-nill	2-4 trailers/wk.	5
Kg	Dagaa/Omena	Uprocessed-28tons & processed-nill	28tons/wk.	3
Kg	Dagaa/Omena	15kg Unprocessed & Processed-nil	once/wk.	1

Table III: Presence of storage facility, storage capacity, cost involved, and difficulties faced

Presence Storage	Capacity(storage)	Cost involved	Difficulty faced	Country
No	_	None	low supply	Kenya
Yes	4 tons	1000sh/day	transport	Rwanda
No	N/A		storage	Kenya
Yes	small	200ksh/day	transport, unstable prices	Kenya
Yes	small	200ksh/day	transport/drying	Kenya
Yes	200tons	_	theft on road	Rwanda
No	_	_	poor quality/drying	Rwanda
No	_	_	No policy on fish pricing	Kenya

Table IV: Quality specification, common defect, offer for defect, profit margin, and defect use

Quality specification	Common defect	Offer for defect	Profit Margin	Defect use
No	_	_	_	_
fresh, clean & preserved	None	No	_	animal feeds
N/A	spoilt tilapia	Yes	50%	animal feeds
No	N/A	Yes	Depends on deficit	domestic consumers
No	_	Yes	50%	chicken feeds
stone free	stones &small fish	_	_	animal feeds
selling salted fish from Uganda	poor drying	Yes	after discussion	animal feeds
No	_	Yes	20%	disposed monthly

Table V: Quality fish around, package and labelling, influence to market and product improvement

Quality fish around	Packaging &Labeling	Influence Marketing	Product Improvements
N/A	N/A	N/A	_
Tilley fish products	Yes	Yes-cans & tins	_
lake Victoria	_	_	storage
_	Yes	Hygiene	packaging& preservation
lake Victoria	No	No	Quality
AAA	Yes	N/A	Quality
Uganda but in small size	Yes	Yes	Drying system
lake Victoria	N/A	N/A	Handling & storage

Table VI: Purchase other products, advantage, fish on market, and market

Purchase other products	Advantages	Fish on market	Market	Country
N/A	N/A	Tilapia, Nile perch, Dagaa, smoked fish	Kaloleni	Kenya
Yes-cleanliness	Good processing plant	Obudi, Fulu, Monge, Daaga, Mumi	Gikomba & Barma	Kenya
No	_	Nile perch, Tilapia, Dagaa, smoked fish, and mud fish	Victoria and Gikomba	Kenya
Yes	_	Nile perch, Tilapia, Dagaa, and mudfish	Victoria and Gikomba	Kenya
Yes	_	Nile perch, Tilapia, and Dagaa	Gikomba	Kenya
yes-salted	_	Small pelagic s	Nyabugogo, &Kimirinko	Rwanda
_	_	Small pelagic s	Nyabugogo, &Kimirinko	Rwanda
No	_	Nile perch, Tilapia, smoked and fish Omena	Victoria and Gikomba	Kenya

Table VII: Type of customers, limitation, developments, and improvements needed

Customers	Limitation	Developments	Improvement needed	Country
Households	lack of constant market	new fish stalls	_	Kenya
Colleges, hotels, & schools	Poor Storage &transport	None	market opening, storage ,& processing methods	Kenya
Local consumers	unstable prices	No	cleaning points, & registration of mongers	Kenya
Local consumers	Poor transportation	No	price regulation, &storage facilities	Kenya
Local consumers	Poor transportation	No	open up regionally	Rwanda
DR-Congo & Burundi	_	_	_	Rwanda
DR-Congo & Burundi	_	_	_	Rwanda
Local consumers	High prices& poor storage	No	new storage facilities	Kenya

Table VIII: Price per unit, Purchase price, and Willingness to pay in each country

Type of product	Price unit	Purchase price	Willing to pay	Country
Unprocessed	-N/A,	No-no profit	100ksh/tin	Kenya
Processed	Ksh 120			Kenya
Unprocessed	Ksh 300/kg,	Yes	500-600ksh	Kenya
Processed	Ksh 600/kg			Kenya
Unprocessed	Ksh 250/kg	Yes	200-250ksh	Kenya
Processed	Ksh 300/kg			Kenya
Unprocessed	Ksh 200	Yes	As indicated	Kenya
Processed-	Ksh 250/kg			Kenya
Unprocessed	Ksh 200/kg	Yes	200-300ksh	Kenya
Processed-	250ksh/kg			Kenya
Salted dagaa	2000 Rf/kg,	_	1U$ (1U$=600 Rf)	Rwanda
Unsalted dagaa	1000 Rf/kg	_	_	Rwanda
Unprocessed	Ksh 300/kg			Kenya
Processed	Ksh 350/kg	Yes	200-250ksh	Kenya

ANNEX 4: LIST OF ATTENDANCE FOR THE ABAKENE GROUP

SN	Name	Contact
1	Nakisekka Rehema	0787269931
2	Sifa Kalema	0755147794
3	Nayiga Madina	
4	Ayisa Nanono	
5	Shakira Namyonsa	07515655115
6	Baseka Kizza	0774965603
7	Nalusajji Viola	
8	Muyinda Judith	0777060350
9	Nakanwagi Dorothy	0703455663
10	Nalukwata Jane	
11	Namirembe Sarah	0752585841

ANNEX 5: SWOT ANALYSIS OF POTENTIAL PROCESSORS FOR UP-GRADING

	Internal and External factors			
Name of Company	**Strengths**	**Weaknesses**	**Opportunities**	**Threats**
KASAVEX	• The only supplier of wide range of high quality products in the district. • Key managers trained in various aspects • Have connections and market in Europe • Capacity to diversify into other income generating activities • Have a Bank account.	• Family based • Board of directors too narrow • Lack of awareness amongst prospective customers • Need to refurbish production unit • Absence of strong sales/ marketing expertise • Lack of information on certification and labelling • Lack of mechanised processing unit	• Focus of development partners on small pelagic fishery • Expert markets offer great potential • Distribution channels seeking new products • Scope to diversify into related market segments • Other funder have expressed interest in financing related projects	• Major player may enter targeted market segment • Market may become price sensitive • Several potential competitors have entered the market • Willingness to pay premium price for high quality product.
ABEKENE	• Located at a source of raw materials • Products marketable regardless of quality status • Members have been trained on product diversification • Group has a Bank account hoisted with Stanbic commercial Bank – Masaka	• Lack of exposure coupled with naivety to venture beyond Kisuku landing site • Long distance to market outlets and the cost involved • Lack of cohesion among group members • Poor sanitation and hygiene • Poor quality products • Lack of focussed leadership and membership	• Growing demand for high quality Mukene products • Draft policy on Mukene in place • Food insecurity in Dr-Congo and S. Sudan which allows WFP to buy sand-free mukene • Several developmental partners available and willing to intervene in the Mukene fishery	• Vulnerability to a serious contender • Industrial large scale processors • Effects of climatic change

ANNEX 6: TRANSLATION FROM FRENCH TO ENGLISH OF PROF NDIAYE'S PAPER ON IMPROVED SENEGALESE DRIER

IMPROVED METHOD FOR POST-HARVEST LOSS REDUCTION IN COMPARISON WITH NATURAL DRYING

Prof. Oumoulkhairy Ndiaye

Abstract:

The coal drier with electric ventilation, of Cambodian origin and adapted in Indonesia was tested at the National Training Centre of Fisheries Technologies (CNFTPA) in Dakar, Senegal, within the framework of the FAO Technical Co-operation Research programme in improved post-harvest reduction technologies. The constraints to the use of this drier in artisanal fisheries have led to the design of a new system of furnace equipped with a manual forge, built from Parpaing or Banda oven, 2 tools widely known in these fisheries communities.

The results from the trials have been very conclusive compared to natural drying, and this improved method is all-weather user friendly, it hence addresses the problematic of high post-harvest losses during rainy season, high humidity and cold weather.

IINTRODUCTION

The natural drying under the sun is one of the ancient methods of conservation of foodstuffs and the most used in developing countries. The principle is very simple and consists of putting the fish in contact with hot and dry air. The air brings the necessary heat to vaporize the water contained in the fish. The fish loses, its humidity are high and hence weight loss. This method is little laborious and long as a result the post harvest losses are high especially in rainy and cold seasons. Once the climatic conditions do not allow easy natural drying, we can act on the temperature, the speed of circulation of air and the thickness of the products to be dried by adopting better procedures. The idea of experimenting on the coal drier was discussed during the meeting of the experts in the utilization and quality assurance of fish technology organized by FAO at Agadir from 24 to 28 November 2008. This drying oven of Cambodian origin adapted in Indonesia within the framework of the FAO project is similar to the concrete or cylinder oven. The air is supplied by a ventilator but the accessibility to electricity poses a problem for the fishing community. In order to make this coal drier utilization practical and performing, the experts have had to exchange the possibilities of producing air and integrating it into a system of natural ventilation which is sustainable, ecological and economical. It is in this context that the CNFTPA put out a prototype of coal drier with the installation of a forger for the ventilation permitting the drying of fish products throughout the year without worrying about the climatic conditions. The CNFTPA cylinder / concrete oven and the making of the furnace equipped with a forge constitute the elements of a coal drier. The forge is a non electric machine destined to project air with force into the furnace containing some embers. Four trial series have been realized in order to master the parameters of drying, to appreciate the organoleptic quality of the products and the performance techniques and economics.

METHODOLOGY

II-Material and method
II-Material

- Four batteries

Fig. 1 Cylinder/ concrete oven

The concrete oven built / constructed in an aerated zone is rectangular in shape with a length, width, and a height of 5m × 1m × 90cm respectively. It is divided into two compartments each provided with a fire place. The distance between the center/ heart of the fire and the grate/wire mesh is 70cm. It is equipped with a re movable grate/wire mesh made of stainless materials that facilitate the cleaning and are resistant to heat, and a metallic cover. The oven has a capacity of 400kg of fish.

Fig 2. Furnace of the coal drier and the blower

The dimensions of the embers furnace made with the help of a local blacksmith are 1m length, 1m width and 24cm height. (1m × 1m × 24cm). This furnace is equipped with 4 wheels for displacement, an aeration tube and a forger for fanning the fire and projecting the air into the interior of the oven.

Other materials (balance, Digital thermometer and hygrometer) served to follow the technical parameters during drying trials.

II-2-Method
Comparative trials of natural drying and improved drying with coal drier have been effected in order to appreciate the new innovations better. Washed, lightly salted and drained prawns were used in the drying trials. The principle consists of spreading the product to dry on a slab put in the concrete oven, heating up the drying air with the help of a furnace equipped with a forge hence allowing the temperature and the air mass to increase inside the oven.

At the beginning of the drying, the quantity of the embers is reduced. The product is put away from the embers and the temperature is controlled so as to fluctuate between 35 and 45 °C at the maximum in order to avoid cooking of the prawns on one hand and crusting on the other. This step takes one hour on average.

After this step, the prawns are returned to make them homogenous and the quantity of the embers is increased in such a manner as to raise the temperature to around 60°C and relative humidity to between 60% and 70% hence accelerating the drying process.

The natural drying was effected on an upraised grid for a complete cycle of drying that was achieved after 7 hours at 30°C with a relative humidity of 85%. The grid is covered with mosquito nets so as to avoid contamination of the product by flies.

RESULTS AND DISCUSSIONS

Performance techniques

After two hours, the product was totally dry, with an attractive lustre, reddish in colour and was tasted and appreciated by the panelists. The natural drying effected in the course of the month of August, which is a rainy period, lasted two days while that one realized in the coal oven took only two hours.

The coal drier has permitted dried prawns of good quality to be obtained within 3 hours time and the operator is less exposed to the climatic hazards. This procedure offers possibilities of drying great quantities of fish even in rainy seasons. The problems of Crusting and cooking of the product are managed by good aeration and a great reduction in the quantity of the embers.

Table 1 : Parameters of drying

Parameters	Coal drier	Natural drying
-Temp at beginning of drying	35°C	30°C
Relative-Relative humidity	70%	85% Drying at proximity of the sea
-Air distribution	more or less homogeneous	Heterogeneous
Control of production operations	Easy	More constraining in rainy seasons
-Duration of drying	-3 hours	7 hours in dry season and 2 days in rainy season
% water loss	60%	55%
Output	40%	45% but decreases to 30% during rainy season
Final quality of product	Very good and appreciated	Good in dry season and slightly mouldy in wet season
Number of possible production sessions per day	5	2 in dry season
Capacity	400 kg	20 capacity grids 20kg each
Space occupation	Little space (5 m2)	Too much space (40 m2)

Economic performances

Table 2 : Account of exploitation for a production session

Costs of production for a session		
Items	**Coal drier**	**Natural drying**
Prawns	100 kg x US$ 3	100 kg x US$ 3
Salt	1 sachet x US$ 0,5	1 sachet x US$ 0,5
Coal/charcoal	10 kg x US$4	-
Labour	1 person × US$2	2persons × US$ 2
Total cost	US$ 310,5	US$ 306,5 $
Cost price	40 kg x US$10	45 kg x US$ 8
-Total cost price	US$ 400	US$ 360
Net benefit for a session	**US$ 89,5 $**	**US$ 53,5 $**

- The average cost for making a coal drier is about 600$ for a 400kg capacity oven and US$ 104 for the furnace.
- 20 drying grids are necessary in order to dry the same quantity under natural drying. The grid made at CNFTPA from scrap materials cost US$ 50.
- At equal capacity the total cost of natural sun drying grids come to US$ 1000. The estimated duration for the oven is at least 10 years while the furnace is 5 years. The latter should be re-painted with anti-rust inhibitor paint at least every year.
- The cost of a coal drier is paid off into 15 sessions of production while that of natural sun drying could go beyond 6 months. The economic comparative analysis of the two types of drying show that generated benefits of dried products from 100kg of fresh prawns is 1.7 times more for coal drier than for natural sun drying.

The great reduction in duration of drying; 3hours for coal drier and 7hours for natural sun drying when atmospheric conditions permit it; 2 or no days of drying at all in rainy seasons.

Number of daily sessions; 5 for coal drier and 2 for natural drying.

With regard to quality of the finished product, it is better when coal drier and slightly moldy for natural drying in rainy seasons

The fact that it can also serve as a smoking oven and a storage place for finished products until they are sold off.

IV- Conclusion and recommendation

The utilization of improved procedures of drying which take into account the climatic hazards are interesting and even indispensable especially in rainy seasons. The coal drier constitutes a simple system of drying, efficient, adapted to all climates and occupying a reduced space. It brings much facility in the production of dry products and better gains in revenue. Its adoption could be a consequent support for fish processors. While recommending the documentation and dissemination for drying of the species whose trials have been conclusive, it would be important to carry out experiments on other fish products which are generally put under natural drying.

ANNEX 7: PAPER PRESENTED AT LUSAKA TRADE EVENT

Small pelagic fishes in ECSA region: Value addition and product development

Agrotec

M. Masette

IOC/SMARTFISH Trade Fair 26-27 April 2012, Lusaka- Zambia

INTRODUCTION

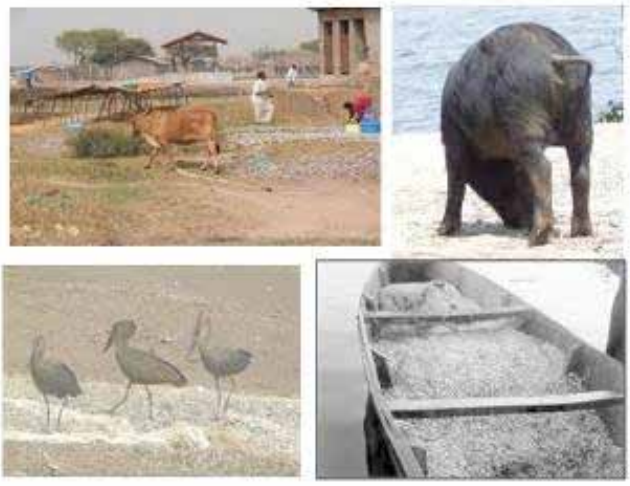
- There are over 10 species categorized as small pelagics in East Central and Southern African (ECSA) region.
- They include *Rastrineobola argentea* (Omena/ Dagaa/Mukene), Haplochromines (Fulu, Nkejje), *Limnothrissa moidon* and *Stolothrissa tanganicae* (Kapeta) *Poecolthrissa mweruensis* and *Poecolthrissa bangweluensis* (Chisense), *Brycinus nurse*, (Ragoge) *Neobola bredoi* (Muziri)
- Average length 7cm and weight 20g.

Tntro.....

- Traditionally preserved by sun-drying on a myriad of surfaces varying from bare ground to raised racks
- Contributes substantially to national economies as source of income and employment
- Source of nutritious animal protein esp for the vulnerable.
- However, over 80-90% of total catch used for animal feed despite the declining per capita fish consumption, food insecurity, frequent environmental calamities and high post-harvest losses.

High post-harvest losses in pelagics: Contributory factors

- Narrow utilization base
- Inappropriate preservation methods e.g. open sun-drying that's weather dependent
- Consumption by wild birds and domestic animals
- Social stigma associated with consumption of sun-dried pelagics. ***Reasons:-***
  - High levels of adulteration
  - Bony structure and small size
  - Rancid off flavours
  - Association with low income earners



Loss mitigation measures in small pelagics

- Improved handling practices
- Improved drying surfaces and rates
- Attitude change i.e. removal of socio-stigma
- Product diversification
- Marketing strategies

Improved post-mortem operations

Well equipped rig

- Spacious enough to conduct onboard post-mortem operations
- Unperturbed by weather elements

- Containerized to reduce risk of textural damage
- Easy to handle and spillage is low when off-loading
- Simplified calculation of post-mortem treatments

Improved drying surfaces

- Raised drying racks
- Dust-free floor
- Portable drying trays/racks
- Perimeter fence
- Access to fairly clean water
- Walk ways

Improved sun-drying on raised racks

- Dagaa dries on raised racks faster than other surfaces and therefore retains the silvery lustre which market demands
- Product free from extraneous materials including dust, sand, soil and parasite
- In case of rain showers, product can be covered.
- Due to market demand, product sells at 3 times the market price. Markets extend to Southern Africa

What's value-addition?

- Processes that improve the worthiness of something in terms of money or culinary attributes.
- In food industry, it is usually associated with quality, functionality, form, place, time, and ease of possession.
- In fish industry, value-addition refers to several operations categorized into 3: -
  - Primary
  - Secondary
  - Tertiary

- Primary – washing, sorting/grading, descaling, gutting, beheading
- Secondary- **industrial** (freezing, blanching,) **Artisanal –** preservation for shelf-life extension and culinary Improvement
- Tertiary- milling, fortification and extrusion for ready-to-eat products e.g. weaning foods.

- Packaging of primary, secondary or tertiary products in market desired packs increases product value.

Product development

- Transformation of raw materials into market-stable and consumer-desired items
- Designed to increase utilization options essentially through preservations – either increase or decrease T° which inactivates enzymes and spoilage bacteria.
- Preservation methods categorized into 2:
  - Artisanal – *low cost* e.g. boiling/blanching and drying, deep-frying, smoking, fermentation
  - Industrial – *fairly expensive,* yet to take root but there is great potential.
    - ✓Chilling – Use of melting ice
    - ✓Freezing

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Improved Artisanal technologies

SMOKING

Sun-dried

Pelagic (Ragoge), dried on raised rack.

Clean and sand-free

Blanched and sun-dried

Ragoge

Muziri

Pelagic blanched in brine for 4 minutes at 70C° then sun-dried on raised rack. Less off flavours, clean and sand-free

- Milling for human consumption

Boiled, dried and milled product

Smoked and milled product

Powder

Pelagic washed, cooked into paste (addition of spices optional) then dried on raised rack. Dried product is milled to a fine powder and stored in dry cool place. Shelf-life , about 3 months.

- Yield ≈ 40%
- May be commercially viable if overheads are managed
- Potential consumers were decisive

Fish crisps

Pelagic minced with spices + salt+ wheat/cassava flour. Rolled into thin sheet and dried on polythene sheet. Dried product deep fried in vegetable oil.

- Yield = 20% therefore not commercially viable
- Besides, potential consumers were hesitant

INDUSTRIAL PROCESSING

- Requires high capital investments
- Regular supplies
- Niche markets
- Examples include: -
  - Fortified and extruded products targeting vulnerable members of society (children under 5, invalids, elderly and people living with HIV/AIDS
  - Frozen whole pelagic/
  - Canning

Why bother with pelagics in ECSA?

- Least valued and therefore low investments
- And yet there are several opportunities offered by the sector
- However, there are also challenges that can be translated into opportunities thru research, investment and harmonization of various policies.

OPPORTUNITIES

- Increasing population in Sub-region & therefore market availability
- Chemical composition

Chemical constituent	% CONTENT	g per 100g
Ash	13.99	13.99±0.14
Moisture Content	10.06	10.06±3.43
Crude fat	11.13	11.13±0.30
Dietary fibre	1.02	1.02±0.15
Carbohydrate	7.15	7.15±0.65
Crude protein	60.71	60.71±0.87
Energy Kcal/100g	4.79	4.79±0.14

Fatty acids Composition.

Fatty acid	Name	% composition
14:0	Myristic acid	2.8 ± 0.4
15.0	Pentadecanoic acid	0.7 ± 0.1
16:0	Palmitic acid	22.7 ± 1.8
17:0	Margaric acid	0.8 ± 0.3
18:0	Stearic acid	9.8 ± 0.3
16:1n7	Palmitoleic acid	5.5 ± 0.2
17:1n9	Heptadecenoic acid	0.7 ± 0.4
18:1n7	Plasmallogen acid	9.6 ± 0.6
18:1n9	Oleic acid	6.3 ± 0.8
18:3n6	Gamma-Linoleic acid	3.8 ± 0.3
18:3n3	Alpha-Linolenic acid	6.4 ± 0.2
20:4n6	Arachidonic acid	6.1 ± 0.7
20:5n3	Eicosapentaenoic acid (EPA)	5.2 ± 0.3
22:4n6		3.8 ± 0.5
22:5n3	Docosapentaenoic acid (DPA)	4.6 ± 0.8
22:6n3	Docosahexanoic acid	5.8 ± 0.7

Mineral composition

Type of mineral	Average content (%)	Recommended daily intake
Calcium	38125	0.9g
Magnesium	93.3125	
Zinc	265.625	11.4mg
Sodium	3062.5	3.4g
Iron	700	14.0g

CHALLENGES

- Fishing ground: -
  - Inshore waters – High % of by-catch (juveniles of Nile perch & tilapia and haplochromines. Size of pelagic decreases
  - Offshore waters – low % of by-catch and size usually larger.
- Contamination with heavy metals

Challenges……

Ill-equipped fishing boats

Mixed hauls and stowage

Challenges …..

- Enforcement of quality policy
- Harmonization of quality policy across the ECSA region
- Tools of measurements (volume or weight?)
- Market requirements dictate drying surface, quality and type of product.

WAY FORWARD

- Development of drying technologies that are less dependent on weather conditions but ensure quality
- Diversification of commercially viable products
- Fast-tract enactment and enforcement of harmonized regional quality standards (policy) for small pelagics
- Improve trade infrastructure
- Sensitization of key-actors along the value chain
- Government commitment to provide conducive environment for large-scale investment
- Investment in Packaging urgently required

ACKNOWLEDGEMENT

- Small Pelagic Fisher communities
- Fish traders
- Fisheries Extension staff
- Indian Ocean Commission
- Smartfish
- Agrotec

ANNEX 8: CONCEPT NOTE

Title: Mechanical drying for small-sized pelagic fish species in East, Central and Southern African region (ECSA)

Introduction

The small-sized pelagic fisheries in Eastern, Central and Southern African (ECSA) countries, is always caught in large quantities. Rastrineobola argentea (Omena/ Dagaa/Mukene), Haplochromines (Fulu, Nkejje), Limnothrissa moidon and Stolothrissa tanganicae (Kapeta) Poecolthrissa mweruensis and Poecolthrissa bangweluensis (Chisense), Brycinus nurse, (Ragoge) Neobola bredoi (Muziri) are the other fish species caught using the same practice. Due to their small size, they are predominantly processed by the traditional open sun-drying method which is weather dependent and at same time requires a large drying area. Consequently, during the rainy season, the post-harvest losses are unacceptably high estimated at 90. % (DFR, 2008). Yet there is declining per capita consumption of fish protein, increasing food insecurity and unsustainable population explosion among communities who obtain their animal protein mainly from such fish species. The per capita fish consumption within the Lake Victoria basin is between 8 – 12 kg per annum, which is significantly below the World average of 16 kg per annum (LVFO, 2010). All schools of thought attest to the fact that spoilage of harvested fish is partly caused by the inappropriate preservation methods and storage facilities which culminates into poor quality and shortened shelf life of the processed products. Consequently, the marketing time is not only shortened but the quality and safety standards are also highly compromised which does not augur well with the various actors along the value-chain. Inevitably, most of the catch is processed for animal feed production rather than for human consumption. For example, within the Lake Victoria Basin 80% of the total Dagaa catch is transformed into animal feeds and only 20% enters the direct human consumption chain. The scenario has been replicated for almost all the small-sized fish species within the region. Besides, the ECSA region is faced with climatic changes (drought, floods) food insecurity, displacements and other unforeseen circumstances that affect fish trade. Although the region is rich in fisheries resources, the utilization options of the catches is generally poor.

The impractical nature of the drying method and land ownership at most landing sites in ECSA region call for interventions that are innovative, affordable, user-friendly responsive to gender and the environment. The present concept seeks to address the problem of drying during rainy season, land ownership and sanitation at landing sites by proposition of a mechanical drier which will use domestic waste strewed at landing sites as source of energy and a small compact structure for production of high quality sand-free product. The envisaged short-term outcomes include weather-proof processing method, improved sanitation and decreased wrangles over land ownership. In the long-run, regional fish trade will be promoted to invalidate the imbalances attributed to fish distribution, access, availability, security and nutrition to the consumers across various trade blocks.

Purpose of the project

The purpose of the project is to develop innovations that reduce high post-harvest losses in fish sector and improve quality of dry fishery products from small sized pelagic

Project objective

To develop efficient, low cost and environmentally responsive mechanical drier for small-sized fish species

Project scope

A small prototype of the mechanical drier will be fabricated and tested on station at National Agricultural Research Laboratories (NARL). The proto-type will be subjected to technical evaluation and assessing

the quality of the dried products. The fish test samples will be collected from one landing site along L. Victoria (most probably Kiyindi) and from Bugoigo landing site along L. Albert. The specific small-size fish will include Mukene (Rastrineobola argentea), Muziri (Neobola bredoi) and Ragoge (Brycinus nurse) respectively. With additional funding, the technology will be fine- tuned before fabrication of a big size prototype for recommendation at project landing sites.

Project timeline

		Annual quarters				
SN	Activity description	Q1	Q2	Q3	Q4	Est. Budget (UGX)
1	Conceptualization of the idea and literature search					0.0
2	Prototype design					0.0
3	Fabrication of the prototype					6,500,000
4	On-station testing of 1st Prototype					3,000,000
	Total budget					**9,500,000**

ANNEX 9: PEOPLE MET DURING THE STUDY

Name of person met	Name of Company	Type of business	Contact
	KENYA		
Mr. Alex Trachtenberg	Capital Fish Ltd	Fillets and related products from large fish	254 (20) 4348241/2
Mr. Karim Kurji	East African Sea Foods Ltd.	Nile perch fillets	254 (20) 533355,
Mrs. Munira Gilani	Peche Foods Ltd	Frozen Nile perch products	254(057)2021523
Mr. Nadir Jessa	W.E. Tilley Ltd	Nile perch fillets	254 (20) 8562203/4
Mr Japhet Anampiu	Fisheries Dept	Aquaculture	+254-722-316333
Mr. Okumu Mak'Ogola	Director of Fisheries, Ministry of Fisheries Development	Administration and Policy	+254-733252032
Ms Rosaline Daisy Karimi Muriuki	Fisheries Department	Fish marketing	+254-722-349913
Ms Beth Wagude	Executive Director AFI-PEK	Export Association	+254(20)4440858
Mr Simon Warui	Fisheries Department	Focal person (SMARTFISH-Kenya)	+254-729-989530
Mr G. Njoroge	Nakumatt	Marketing	+254-733-632-130
Traders	Gikomba market	Omena	
	RWANDA		
Ndorimana Claude	Fish Depart	Focal person (SMARTFISH-Rwanda)	+250788435119
Mr GATETE Bénoit	Kimironko market	Extension	+250
Mr. Cyakabare J.Pierre	Nyabugogo stores	Extension	+250
Ms Hadidja Nzamukosha	Kimisagara market:	Extension	+250
Traders (9)		Dagaa	
UGANDA			
Dr A. Kiggundu	Director NARL	Research & Admin	+256-414-567-649
Mr S. B. Wandera	National Fisheries Resources Reseach Institute (NaFIRRI)	Research Officer Small pelagics	+256-772490517
Mr. J Wandanya	Department of Fisheries Resources		+256-772-482076
Mr. Paul Omanyi	Department of Fisheries Resources	Fisheries Inspector	+256-772630661
Ms Sarah Bawaye	Department of Fisheries Resources	Fisheries Inspector	+256-772668626
Ms Daisy Achiro	Department of Fisheries Resources	Focal Person (SMARTFISH Uganda)	+256-772-636438
Mr. P. Borel	Greenfields	Fish processing	+256-414-320-716
Ms C. Newumbe	Self-employed	Translator	+256-712-963156
Mr K. Neville	AAA, Kiyindi	Mukene processing	+256-776-674-824
Mr Tom Bukenya	District Fisheries officer Masaka	Co-ordination of extension services	+256-772-476148

Ms M. Namusisi	District Fisheries officer Buliisa	Co-ordination of extension services	+256-772-343493
Mr Umar Agaba	Director Umaga (U) Ltd	Small-pelagics processing on L. Albert	+256-75241501
Mr Joseph Rubalema	UIRI	Technical Manager	+256-782-048295

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23. *Preparation of Draft Kenya Fisheries Management and Development Bill:* REPORT/RAPPORT: SF/2012/23. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

24. *Une Analyse Globale de la Chaîne D'approvisionnement de la Pêcherie du Crabe de Mangrove (Scylla serrate) à Madagasar.* REPORT/RAPPORT: SF/2012/24. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

25. *Analyse Globale de la Gouvernance et de la chaîne D'approvisionnement de la Pêcherie du concombre de mer à Madagasar.* REPORT/RAPPORT: SF/2012/25. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

26. *Processing and Marketing of Small-Sized Pelagics in Eastern and Southern Africa.* REPORT/RAPPORT: SF/2012/26. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

27. *Report of the Second Steering Committee Meeting of the SmartFish Programme.* REPORT/RAPPORT: SF/2011/27. August/Août 2012. SmartFish Programme Indian Ocean Commission.

28. *The Farming of Seaweeds.* REPORT/RAPPORT: SF/2011/28. August/Août 2012. SmartFish Programme Indian Ocean Commission.

29. *Culture d'Algues Marines.* REPORT/RAPPORT: SF/2011/29. August/Août 2012. SmartFish Programme Indian Ocean Commission.

30. *Report of the Focal Point Meeting of the SmartFish Programme – Livingstone, Zambia, 28th – 29th February 2012.* REPORT/RAPPORT: SF/2011/30. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

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32. *A Review of Bycatch and Discard Issues in Indian Ocean Tuna Fisheries.* REPORT/RAPPORT: SF/2013/32. 2012 SmartFish Programme. Indian Ocean Commission.

33. *The Feasibility of Aquaponics in Mauritius.* REPORT/RAPPORT: SF/2013/33. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

34. *National Governance and Value Chain Analysis of Shark Fisheries in Madagascar.* REPORT/RAPPORT: SF/2013/34. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

35. *Partners Meeting on Fisheries Strategy for the Esa-Io Region.* REPORT/RAPPORT: SF/2012/35. July/Julliet 2013 SmartFish Programme. Indian Ocean Commission.

36. *Potential for Energy Saving Measures in the Tuna Industry in the Southern Eastern Indian Ocean Region.* REPORT/RAPPORT: SF/2013/36. August/Août 2012 SmartFish Programme. Indian Ocean Commission.

37. *Gestion des Ressources en Eau pour l'Industrie du Thon.* REPORT/RAPPORT: SF/2013/37. Octobre/October 2011 SmartFish Programme. Indian Ocean Commission.

38. *Implementation of a Regional Fisheries Strategy ESA-IO.* REPORT/RAPPORT: SF/2013/38. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

39. *Initial assessment of laboratories and quality control authorities in Eastern and Southern Africa.* REPORT/RAPPORT: SF/2013/39. 2012 SmartFish Programme. Indian Ocean Commission.

40. *Inland small-pelagic fisheries utilization options, marketing and opportunities for support.* REPORT/RAPPORT: SF/2013/40. June/Juin 2012 SmartFish Programme. Indian Ocean Commission.

La bonne gouvernance et de la gestion des pêches et de l'aquaculture permettent d'améliorer la contribution du secteur à la sécurité alimentaire, au développement social, à la croissance économique et au commerce régional ; ceci en assurant par ailleurs une protection renforcée des ressources halieutiques et de leurs écosystèmes.

La Commission de l'Océan Indien (COI) ainsi que la COMESA (Common Market for Eastern and Southern Africa), l'EAC (East African Community) et l'IGAD (Inter-Governmental Authority on Development) ont développé des stratégies à cette fin et se sont engagés à promouvoir la pêche et l'aquaculture responsable.

SmartFish supporte la mise en œuvre de ces stratégies régionales en mettant l'accent sur le renforcement des capacités et des interventions connexes visant à :

- mettre en place des mécanismes pour la gestion et le développement durable des pêches ;
- développer un cadre de gouvernance des pêches au niveau régional ;
- renforcer le suivi-contrôle-surveillance pour les pêcheries partagées ;
- développer des stratégies et supporter des initiatives propres à accroître le commerce régional du poisson ;
- contribuer à la sécurité alimentaire en particulier par la réduction des pertes après captures et la diversification de la production.

SmartFish est financé par l'Union Européenne dans le cadre du 10ème Fond Européen de Développement.

SmartFish est mis en œuvre par la COI en partenariat avec la COMESA, l'EAC et l'IGAD et en collaboration avec la SADC. Une collaboration étroite a également été développée avec les organisations régionales de pêche de la région. L'assistance technique est fournie par la FAO et le consortium Agrotec SpA.

By improving the governance and management of our fisheries and aquaculture development, we can also improve food security, social benefits, regional trade and increase economic growth, while also ensuring that we protect our fisheries resources and their ecosystems.

The Indian Ocean Commission (IOC), the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Inter-Governmental Authority on Development (IGAD) have developed strategies to that effect and committed to regional approaches to the promotion of responsible fisheries and aquaculture.

SmartFish is supporting the implementation of these regional fisheries strategies, through capacity building and related interventions aimed specifically at:

- implementing sustainable regional fisheries management and development;
- initiating a governance framework for sustainable regional fisheries;
- developing effective monitoring, control and surveillance for transboundary fisheries resources;
- developing regional trade strategies and implementing regional trade initiatives;
- contributing to food security through the reduction of post harvest losses and diversification.

SmartFish is financed by the European Union under the 10th European Development Fund.

SmartFish is implemented by the IOC in partnership with the COMESA, EAC, and IGAD and in collaboration with SADC. An effective collaboration with all relevant regional fisheries organisations has also been established. Technical support is provided by Food and Agriculture Organization (FAO) and the Agrotec SpA consortium.

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