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Short-term research support: Rapid Assessment of the Aquaculture Sector in the DRC

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Decision Support Unit (DSU)

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About the Decision Support Unit (DSU)

The DSU is a UK Department for International Development (DFID)-financed project implemented by Oxford Policy Management (OPM) in the Democratic Republic of Congo (DRC). It is designed as a support function to DFID's overall management of its Private Sector Development (PSD) programme. The DSU provides evidence and analysis aimed ultimately at improving the programme's overall impact of increasing incomes for the poor in the DRC. In addition, the DSU provides an external learning role targeting improved implementation practices of the broader development community working in the field of economic development.

As part of a broader assessment of the context in which the PSD programme operates in DRC, the annual *problematique* review, the DSU is mandated to provide short-term research support as one of its deliverables. The aim of the research activity is to support the PSD programme by conducting research on issues requiring more detailed investigation as identified through other workstreams, or requested by DFID DRC or the PSD programme component projects (currently ÉLAN, Essor, and the DSU), and agreed with DFID.

This study was developed by Andrew Parker (Imani Development) with direct support from Abudala Napuru (Imani Development), Arlette Nyembo (DSU Country Coordinator) and Marcus Jenal (DSU Research Lead). It has been further reviewed by Hamish Colquhoun (DSU Team Leader), Jonathan Mitchell (DSU Project Director) and Alistair Grattidge (DSU Project Manager).

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List of abbreviations

ACF	Action Contre la Faim
ACP	African, Caribbean and Pacific countries
CBO	Community-Based Organisation
CBT	Cross-Border Trade
CGIAR	Consultative Group for International Agricultural Research
DFID	Department for International Development
DRC	Democratic Republic of Congo
DSU	Decision Support Unit
FAO	Food and Agricultural Organisation of the United Nations
ICRC	International Committee of the Red Cross
IIED	International Institute for Environment and Development
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
(I)NGO	(International) Non-Governmental Organisation
IUU	Illegal, Unreported and Unregulated (fishing)
MT	Metric Tonnes
SENAQUA	Service National d'Aquaculture (National Service for Aquaculture)
SME	Small & Medium-sized Enterprises
TiLV	Tilapia Lake Virus
UDPTK	Union pour le Développement des Pécheurs de Tilapia au Kivu (Bukavu Fisher Association)

1. Executive Summary

Figure 1: Farm ponds, Nyakabera, South Kivu

1.1. Overview

Aquaculture in the DRC (around 3,000 MT per year) is still a small fraction of total fish production (230,000 MT in 2011) (FAO FishStat 2011). Almost all production is consumed within the country and supplemented with increasing volumes of Chinese and African (Egypt, Namibia, Kenya, Tanzania, Rwanda, Uganda) imported fish. Understanding the market system opportunities and constraints could help the aquaculture sector actors to increase their supply into this large market. This rapid assessment looks at the Kivus, Kinshasa and Tanganyika to describe those factors.

Despite a collapse in the capacity of aquaculture production in the DRC in the 1980s, there is still underlying clustered activity in South Kivu and a more commercialised hub around Kinshasa. There is ongoing demand for large volumes of fish, currently supplied by wild catch fisheries and imports. There is scope for developing aquaculture in Kinshasa, North & South Kivu, and possibly Tanganyika, though many of the initiatives would be pre-commercial investments (supporting import of inputs, setting up early hatcheries, training) without a strong network of businesses providing market services and production currently existing.

1.2. Key Messages

Feed: Currently, the import of high quality and affordable feed from Southern and East Africa is a prerequisite for effective growth, even in Kinshasa where commercialisation is more highly developed. Supporting pooled buying by linking cooperatives with commercial importers may be an effective route to securing the quality feed on which the growth of the sector will depend. In the longer term, investing in the capacity of proximate industries (e.g. agro-processing) to enter into the production of fish feed would increase the resilience of the wider market system.

Capacity Building: The Government's SENAQUA (Service National d'Aquaculture, or National Service for Aquaculture) lacks sufficient capacity and funding to provide effective services beyond core compliance and registration. Strengthening public sector capacity to provide relevant guidance and support for small and large industry actors alike will be key to ensuring that the necessary technical knowledge and extension services needed for the sector to thrive are in place.

Pro-poor impacts: Though small-scale fish farming may enhance food security and nutrition on a subsistence level, access to land and skills are effective barriers to the ultra-poor. Supporting small-scale fish farming will create casual youth employment opportunities on farms as well as opportunities for women traders. However, the support required would be on a pre-commercial level, and therefore not entirely consistent with the intervention logic of a market systems programme.

Market Development: Support to medium-sized cage and pond producers, particularly around areas where market demand for fish is high (Kinshasa, Goma & Lubumbashi), has strong potential to generate a good return in trade and employment opportunities. Trade routes are key to the development of the sector; access into Goma and Bukavu for high quality feed is crucial for commercial development in the Kivus. Eliminating trade barriers for feed and other inputs is recommended for supporting institutions.

1.3. Conclusions and recommendations

There is a good long-term development opportunity for aquaculture in the DRC due to high demand for fish protein, a growing population, and sufficient wealth in key regions. However, production gains would require a commitment to long-term investment to increase capacity across the value chain and at an institutional level. This would need to be based on an integrated, cross-sectoral approach which bridges different models of production. Support would be required across all parts of the market system, i.e. along the whole value chain, in the supporting functions (both public and private) and also on the level of rules and regulations.

While there are some entry points available within the current market system actors, the strengthening of public-sector capacity (including research and development, education and training, and extension services) is required in the long term to provide adequate support and guidance for disparate actors across the different modes of production. In addition to IITA coverage there is some evidence of development support (Action Contre la Faim; ICRC; FAO supporting training for SENAQUA) but this seems relatively piecemeal for any structured development of the sector.

Any commercial developments in the aquaculture sector in the Kivus should be focused on the viability of fish farming production (cage or larger scale pond farming) using the best quality inputs, often sourced from or through East Africa. There is a strong entry point through the Bukavu fisher association and a number of emerging private enterprises.

Market systems development in the Kinshasa region should focus on improving the cold chain and/or market access, otherwise there may be limitations to growth under the current distribution model, while also supporting the emerging seed producers and providers. Collaboration between producers is advisable in importing good quality feed and achieving other efficiency gains to help them be competitive in the fish market.

The capacity of fish farming in Tanganyika appears to be very sparse and would require pre-commercial investment (that is, investment that may not be possible through private sector funding alone).

2. Introduction and sector overview

The purpose of this study is to deliver a rapid assessment of the aquaculture sector in the Democratic Republic of Congo (DRC) in order to better understand its structure and dynamics. The objective is to support decision-making regarding "the potential for DFID to support the sector with a view on both reducing poverty and improving nutrition among the poor population in the country".[1]

Aquaculture today in the DRC is largely informal and integrated with other income-generating activities, as yet lacking the necessary organisation and investment to significantly increase production. Fish farming is most often a secondary activity conducted by smallholder farmers who are primarily growing crops or raising livestock. Constraints such as lack of access to wider markets and high rates of failure (in the context of lack of support) can make people unwilling to do it as a sole income activity, instead using it as part of a diversified portfolio of farming activities. There are often synergies between these farming activities such as efficiencies in time allocation between tasks and use of waste farm produce as fish feed. In the Kinshasa region only 21% of fish farmers focus on fish farming alone (Kinkela et al 2017). Similarly, fish farming in the Kivus is usually a secondary activity, with crop production or paid work as the primary source of income (IITA 2018). This suggests that fish farming in the DRC is currently primarily about diversification of income and subsistence food production.

Though the contribution of fish and related products to food security in the DRC is significant, fish production is reportedly stagnating or declining, and the overall contribution of aquaculture to total volumes of fish produced is currently marginal (Breuil & Grima 2014). Approximately 3,000MT of fish is produced annually through aquaculture, compared with 230,000MT coming from fisheries (FAO FishStat 2011). The fisheries and aquaculture sector accounts for 12% of the DRC's agricultural GDP (Kurien & Lopez 2013). Despite producing a significant volume of fish overall, the DRC is one of Africa's biggest importers of low-value fish. Tanzania, for example, considers the DRC "a very important market", reportedly accounting for 17% of the value of Tanzanian fish exports, a figure which is likely to be underestimated given the existence of significant informal trade (Tanzanian Ministry of Livestock, Fisheries & Agriculture 2016).

The public supporting functions (both extension services and inputs) are provided by the government agency SENAQUA, which is part of the Ministry of Agriculture and Livestock. Its services are, however, severely constrained by a lack of capacity and funding. International non-governmental organisations (NGOs) and multilateral actors are currently filling some of the gap in supporting functions. In particular, the International Institute of Tropical Agriculture (IITA) is providing extension services and inputs to fish farmers and takes up research and development functions in collaboration with a sister Consultative Group for International Agricultural Research (CGIAR) centre, 'Worldfish'.

Scaling up aquaculture production in the DRC where more than 13 million people are currently considered severely food insecure may therefore be a promising prospect (FAO 2018). This assessment brings together a review of relevant literature with insights gained through targeted fieldwork. In doing so it provides a basis for deciding if there is potential for DFID to support the sector with a view to both reducing poverty and improving nutrition among the poor population in the country.

[1] From Terms of Reference – see Annex 1

3. Methodology

The study was undertaken by the Decision Support Unit (DSU), supported by Imani Development. The study team's field work was supported by staff of the IITA[2] who have been supporting aquaculture activities through project and research work in South Kivu and Kinshasa regions and thus have considerable knowledge of the sector in these regions. In assessing aquaculture nationally, the study covers South Kivu, North Kivu, Kinshasa and Tanganyika. Of those regions, South Kivu and Kinshasa constitute the largest loci of production and constitute the focus of interviews through field visits. North Kivu had a mix of field and remote interviews; due to timing and flight constraints, Tanganyika interviews were conducted remotely. Beyond the common national and international literature about aquaculture in the DRC (see annex), where appropriate the study team have stated where there may be common findings across the country. A good summary of the fisheries and the aquaculture sectors across DRC is found in the SmartFish DRC Country Review (2014).

The study is using M4P / Market Systems research questions as an analytical framework, nested within an impacts framework (the Sustainable Livelihoods Approach, or SLA). This integrated approach has been used extensively by Imani to identify the two-way relationship between the market system and the asset base of the local economic context.

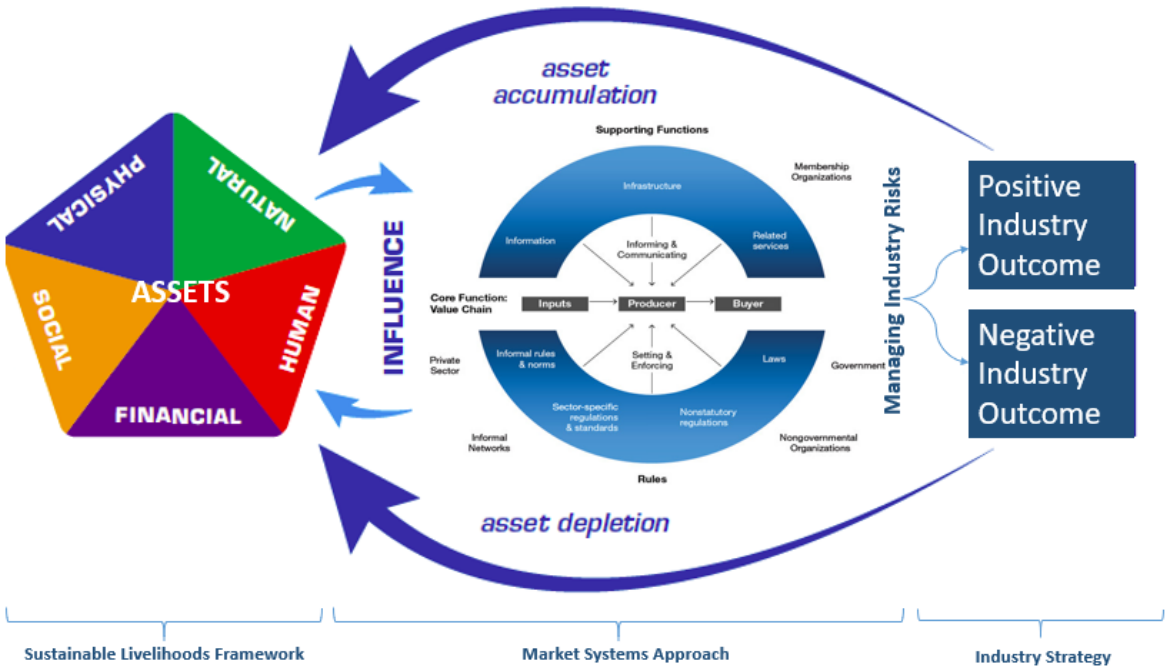

Figure 2: Integrated Sustainable Livelihoods and Market System Framework (Source: Imani Development)

A literature review was undertaken to survey the available research into aquaculture in the DRC, based on sources identified by the DSU in advance, input from IITA, and study team research[3]. The study team considered a range of sources identified through a targeted online search, including academic journal articles, multilateral and NGO reports, and national strategy papers. Sources of limited relevance to the study were rooted out through an initial brief reading, whilst those with direct relevance were taken forward for in-depth consideration. The review process

[2] http://www.iita.org/

[3] See Annex 2 for a summary of core and wider literature

revealed that the literature on aquaculture in the DRC can be of variable quality and usefulness for assessing the sector, for the following reasons:

- Studies can aggregate across the whole country, when there are relatively separate market systems between Kinshasa in the West and regions in the East of the country (which are influenced by the East African supply routes);
- Production figures on aquaculture in DRC and other African countries can be unreliable due to working with historical data;
- Some studies such as the IITA-produced baseline for South Kivu are extensive at a farm production level but less focused on the wider supply chain and market system. Two Kinshasa fish market studies are being finalised, one of which targets producers, marketers / traders and consumers.

The literature review provided preliminary insights into the aquaculture sector in the DRC which formed the foundation of the team's approach to the research. Based on insights from the literature review, a topic guide was designed to facilitate the interview process by directing attention to themes important to the market systems and sustainable livelihoods analysis, whilst remaining open-ended enough to allow new or unanticipated themes to emerge. The topic guide was used to assess feasibility of operations, though the questions were adapted to the different stakeholders interviewed.

Beginning in South Kivu, informants (consultees) were identified by Arlette Nyembo (DSU) and IITA, based on requests for interviews with relevant value chain actors made in advance by Andrew Parker (DSU - Imani). Further respondents were identified through a snowball sampling technique[4] on the ground (following contacts prompted during interviews). Informants in Kalemie and North Kivu were sought from South Kivu interviewees, who stressed the limited extent of aquaculture activity and development in both regions. The informants identified in North Kivu included a SENAQUA official, a trader/distributor, and a small market player/operator. The team met with each of these, as well as with market systems development expert Theo Mbayi (internal contact – ÉLAN), enabling an overview of the main activity in the region and consideration of agro-processing market systems capacity.

A limited flight schedule to and from Kalemie meant that visiting the Tanganyika region would have entailed a minimum 4-day trip. Based on repeated references to very limited aquaculture activity in the area by informants in South Kivu, the team decided that such a visit would be uneconomic.

For Kinshasa, a list of informants was compiled based on information arising from the literature review, as well as leads from a pre-study visit conducted by Marcus Jenal and Arlette Nyembo (both DSU), and insights provided by a pre-study call with Paul Matungulu (IITA). The Kinshasa leg of the study confirmed one of the key findings from the literature review relating to the marked East/West divide in aquaculture market systems. It therefore provided an opportunity to explore some of the similarities and differences in actual and potential aquaculture developments resulting from regionally specific factors (as compared with the South Kivu context). Regional differentiation extends to marketing of fish products emanating from Eastern DRC (e.g. 'Bitovo' and 'Ndakala') going into Kinshasa.

[4] https://research-methodology.net/sampling-in-primary-data-collection/snowball-sampling/. Snowball sampling must rely on the networks of initial contacts, but in a rapid assessment was considered the most effective method for scoping the sector.

4. The Market System

*Research Question: What are the **structure of and main product flows** in the aquaculture value chain in DRC (including import and export of aquaculture product, particularly imports coming from Asia)? How are they distributed geographically? What are the supply and demand conditions in the sector and where are gaps between demand and supply? What is the connection with the fisheries sector and what part of the current flow of relevant products are from the wild catch?*

*What **rules, regulations, norms and customs** are relevant for the sector? What are the main governance and business enabling environment issues?*

4.1. Regional diversity in the sector

A summary on the status of fisheries and aquaculture in the DRC can be found in the Smartfish DRC Country Review (2014). Research into the status of aquaculture in the DRC faces the challenge of the country's scale, whereby the industry structure can vary strongly in different regions. Some industry functions are common to different regions, e.g. the lack of availability of nationally sourced feed or the capacity of the formal public extension and support services. Due to the collapse in the formal industry and support services, the government body SENAQUA is constrained to providing only the most basic regulatory functions and putting its name to supporting appropriate partnership initiatives. Currently, the IITA is providing more of the support services (such as extension support, supply of fingerlings) than SENAQUA. The IITA has a hub in Kalambo outside of Bukavu, and an office in Kinshasa. Other systemic factors are more unique to specific regions, for example the capacity and know-how in regional supply routes or downstream market access.

The Kivus are strongly influenced by East African supply chains and knowledge sources, importing inputs and farmed fish from East Africa and Asia. This contributes to efficient production and market access for consumers. Kinshasa's industry structure is quite different, with larger farms acting as a small private sector cluster, though still with limitations in access to the right inputs, e.g. requiring imported feed and equipment. A market does exist in Kinshasa, though it is largely disorganised. The production of fingerlings is not consistent, in part because it is informed by unplanned demand. According to the IITA, Kinshasa has a number of privately established catfish and tilapia hatcheries that seek bought-in technical assistance from private freelancing consultants. Procuring consistent quantity and quality of inputs, particularly feed and fingerlings, tops the list of challenges. Demand for fish is met through a common marketing system of wild caught fish, farmed fish and imported fish. In addition, Kinshasa Province receives two to three fish species: big salted Tilapia ('Bitoyo'); dried Limnonthrisa Miodon ('Ndakala'); and 'Mikeke', a species endemic to Lake Tanganyika. All these are sold in a municipal market called 'Zigida' that has specialized in those fish species airfreighted in from North and South Eastern DRC. These comprise the wider East African distribution routes.

Tanganyika remains with very limited aquaculture production and appears to be more reliant on wild fisheries (and imported fish). To put fisheries in context, a 2011 survey revealed that there was a total of 93,000 fishers on Lake Tanganyika, of which 51,650 were Congolese (55.4% of total), operating with 21,330 fishing vessels (Smartfish 2014). Increasing pressure on wild fish stocks suggest that developing cage or pond aquaculture could present a promising alternative livelihood for artisanal fishers in the area. Entry points are available through potential transfer of knowledge from South Kivu fishers who have links in Tanganyika. As with South Kivu, success would depend upon East African and Zambian supply chain linkages for inputs to achieve competitive commercial production. Small scale farm linkages would be harder to facilitate – transferring aquaculture knowledge is proving limited even in South Kivu where more links exist, due to road and human capital constraints. The most likely entry point for small scale farm-based aquaculture would be through integration with other agriculture initiatives.

4.2. Different production models

Kivus: Aquaculture in and around the Kivus can be segmented as operating in three production systems:

- ***Ponds within a smallholder farming system:*** whereby smallholder farmers are producing fish alongside crops in a diversified subsistence and local sales structure. Up to 1,550 smallholder farmers near Bukavu are producing tilapia in this manner. The IITA has supported these smallholders through extension services and inputs. Their budget is not known (and possibly overlaps across different initiatives). IITA project staff propose that supporting input provision could produce a tenfold increase in value at final sale (e.g. the provision of $100 worth of fingerlings could produce about $1,000 in final sales). Increasing the number of practicing farmers by 1,000, for example by moving from around 1,500 (current) to 2,500 farmers (target within IITA's current project) could generate a pro-poor return of between $500,000 and $1m per year. Scaling this beyond the current groups of farmers could be possible but would entail another magnitude of challenges of engaging across remote areas and the lack of skilled implementers. The human capital, transport and organisational costs of such support across poorly connected districts means that project costs are likely to go much beyond the cost of inputs supplied and more extensive commercialisation stemming from the supported producers is unlikely.
- ***Cage aquaculture within a fisheries system:*** whereby fishers are diversifying their fishing operations into cage aquaculture. Fishers in Bukavu are currently successfully trialling production and aim to scale up. Fish are sold into a network of women fish traders – this direct trading role in the value chain tends to be taken by women, with men involved in fishing activity. Women traders in the Kivus and their Rwandan counterparts crossing into the DRC can organise into associations (yet, the main commercial distributor interviewed in Goma was male).
- ***Fully commercialised cage aquaculture:*** in Rwanda, a fully professional cage aquaculture company (Kivu Tilapia Farm Ltd.) is operational at Kamembe, opposite Bukavu across the border. It is supplying 15-30 metric tonnes (MT) of fish per week into Bukavu and Goma. A farm company called Olive near Bukavu, and a similar one at Minova near Goma (awaiting a licence from the Ministry of Planning), are setting up aquaculture production using cages, but the study team understands from interviews that the cages are not yet producing fish for the market. The future achievable scale is not known.

Kinshasa: In Kinshasa, the industry structure for production is quite different: around 10 larger pond farms of up to 60 hectares are producing more at scale, and farm owners are organising to find common efficiencies (for example in feed):

- ***Commercial, larger scale farm pond system:*** whereby wealthier farmers with greater capacity are generating volumes for large urban markets (where sellers can achieve good prices, but upper price limits and volume uptake were cited, beyond which demand started to tail off).
- ***Ponds within a smallholder farming system:*** used in the outer regions of Kinshasa (e.g. Kimwenza, Kinkole, N'Sele, Maluku, Bibwa, Mampu, Mbankana, Mongata). These produce catfish (preferred) and tilapia, with a reported investment of approximately $730 per pond.

Figure 3: Fish ponds, N'Sele and Kimwenza, near Kinshasa

- ***Tanganyika:*** As mentioned above, aquaculture production in Tanganyika is very limited and the province appears to be more reliant on wild fisheries.

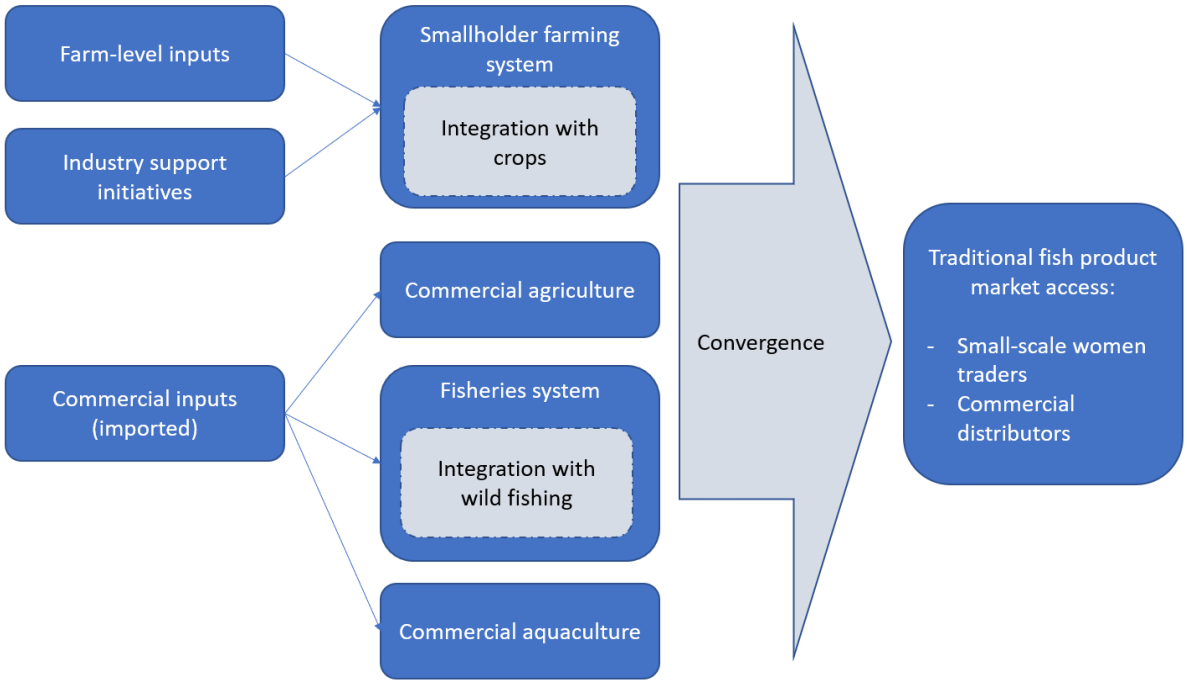

Figure 4: Basic Market System Structure

Figure 4 shows that wild fishing is one of the entry points into commercial aquaculture, and this method shows good potential for scaling up within fisher association structures. However, it may be limited by the requirements for organising training and advice, which has been successful at a small scale but may be more challenging to replicate across a large fisher association or between associations. The flow of product emanating from fisher-aquaculture is streamlined into the associations' market system, with women traders buying farmed fish alongside wild caught fish at the association site.

At the top of figure 4, small scale agriculture can integrate aquaculture ponds within the farming system.

4.3. The core market

Prices: The demand for fresh fish in Bukavu and Goma appears to be sufficient to attract new entrants into production (in Rwanda and DRC). Fish is the main source of animal protein for both poor and rich households in these areas. Home to a sizeable international community including United Nations[5] forces, disposable income in Goma in particular is high. A direct sales and distribution model operates in Goma and Bukavu, with prices reaching $3.50 to $5 per kg for producers selling to intermediaries with known regular customers. Informants stated that such prices are achievable even in rural areas (in South Kivu) where access to alternative markets is more limited – it is expected that this insulation of supply through poor roads would apply to other regions.

[5]United Nations Organization Stabilization Mission in the Democratic Republic of the Congo (MONUSCO): https://monusco.unmissions.org/en

Intermediaries can be a) women traders (who occupy a similar value chain role for many products) and b) distributors who will buy in larger volumes for on-sale. For distributors (such as 'Freddy' in Goma, who has two outlets and a van), prices can reach $10 / kg, and after basic processing (gutting, filleting) it can reach $14/kg ($12 for fillets, $2 for remaining bones). Sales through an open market model appear to be more price sensitive and with less certainty of clearing available stock – this suggests the direct sales model may be reaching the most lucrative end of the market, below which there is a greater sensitivity to price and volume demand. Interviews around Lake Kivu (Goma, Bukavu, Rwanda) confirmed that fresh and frozen fish is imported from Kamembe (Rwanda), Uganda, Tanzania and China, entering through the Gisenyi-Goma border and the Cyangugu-Bukavu border. In Tanganyika, interviewees noted demand for smoked and salted fish from the lake fisheries.

Figure 5: Freddy's fish van, Goma

Market segments: Large fish may be sold to restaurants and hotels, and wealthier buyers. Smaller fish are sold to poorer consumers and families who may wish to provide 'a fish each' to more people, i.e. they are looking for more small fish as opposed to fewer large fish for a given weight at a lower cost.

Imported fish: Farmed Chinese, Ugandan and Rwandan tilapia is imported into the market. Chinese fish is considered to be of lower quality, possibly due to incidences of spoilage through the cold chain. Rwandan farmed fish can be sold fresh or frozen and is considered, like the currently small volumes of farmed DRC fish, to be strongly preferred on quality grounds, and can command a higher price.

Hyper-local markets: The rural market for farmed fish is likely to have relatively good impacts on providing protein, with farmers consuming in the household and selling to local buyers (as soon as there is a fish harvest, traders and neighbours will buy through word of mouth).

Women traders: The network of women traders is an important part of the market system at this stage in the sector's development. The fisher association of 300 members has a women trader network of 70, giving it a ratio of around 4 male fisher association members to 1 female trader (the gender split is understood to be 100%). This demonstrates that although production may be male-dominated, the whole value chain impact for women can be advantageous and promises good impact in (semi-formalised) jobs and income generating opportunities. Congolese women traders

on the border of Rwanda are organised into associations[6] and will make trips across to Kamembe and Cyangugu to buy fish and import them, both wild caught and from Lake Kivu Tilapia Ltd.

Kinshasa: In Kinshasa, marketing remains focused on supplying local, fresh fish. Whilst frozen fish is available to buy in supermarkets, this is largely imported (though Mont Tabor, a Kinshasa-based farm, occasionally sells frozen fish). The team saw two cold rooms in Kinshasa, only one of which was operational (Mont Tabor). Smoked, salted and dry fish enter the city from neighbouring towns. This gives some indication of the scope for this market – growth of fresh fish markets may be at the top end of demand, and to expand further, farms may need to develop frozen distribution systems, since both producers and traders noted that too high prices led to a falling of demand. The scope for expanding 'fresh' fish to reach new demand may be limited in the current model and depend on cold chain networks including vans and storage. It is expected that processing and higher value realisation is possible among higher income markets in other regions as it is in Goma (where filleting adds value), and Bukavu.

Besides supermarkets, Kinshasa has wholesalers (e.g. 'SOCIMEX', 'Congo Futur') who supply frozen, smoked and salted fish from Namibia and Europe. Fresh and frozen stock from Asia, Europe, Egypt and regional fish have been found in IITA surveys. A South African owned fish farm 'Ngolo Moseka' is selling locally produced catfish, and a Lebanese owned fish farm using indoor production in Limete district of Kinshasa is aiming to produce 300 MT per annum.

4.4. The input market

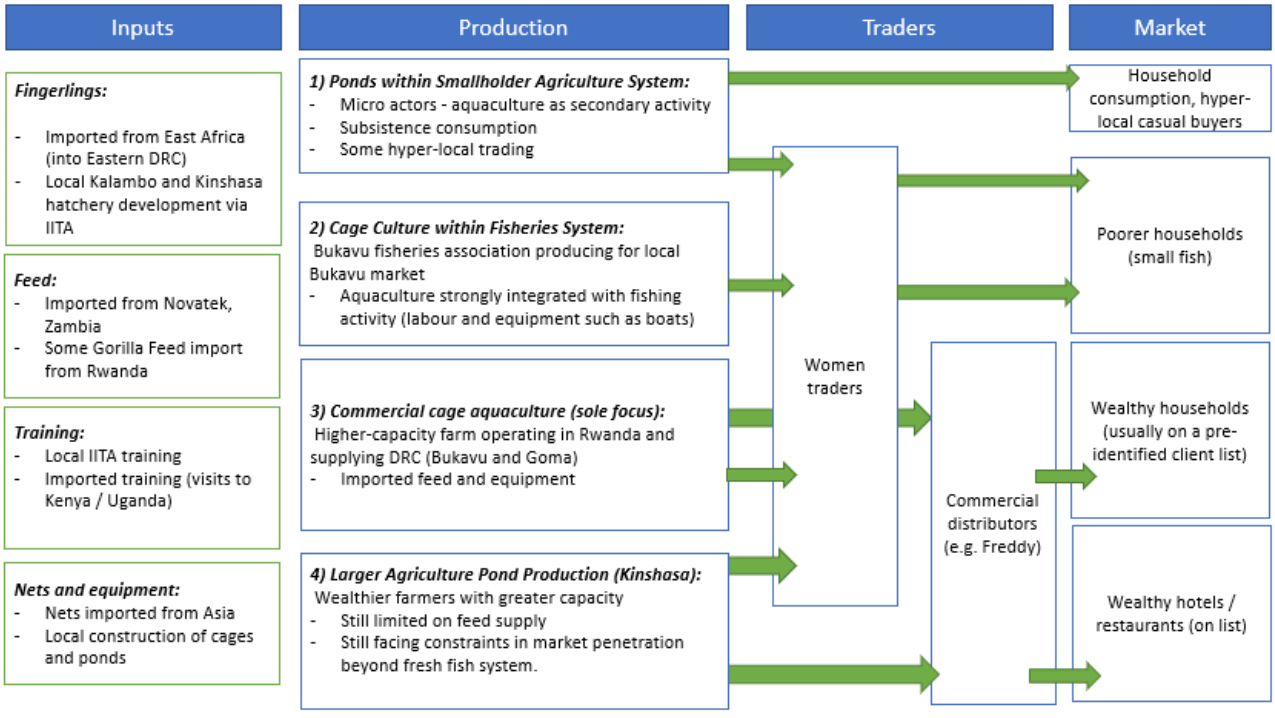

Figure 6: Value Chain Schematic for DRC Aquaculture

Feed: Feed supply is critical for high quality fish farming. In the Kivus, feeding on small-scale farms is currently limited to farm waste within an integrated system. Feed is not currently produced in the Kivus, and while IITA is trialling feed production, it is not yet up and running, and there is no guarantee it would be as cost-effective as imported feed. No processors are available to produce feed commercially – this is evident in both fish feed and in proximate sectors (poultry, wider agro

[6] Information is available through Trademark East Africa (TMEA) work on Cross Border Trade. https://www.trademarkea.com/press-releases/construction-of-rusizi-modern-cross-border-market-facilities-take-off/

processing). Fishers and professional cage aquaculture operators in the Kivus are importing feed from Zambia (Novatek) and Rwanda.

Lessons from Kinshasa's greater scale are also instructive for approaches to feed supply. The quality of the local feed supply being limited, imported feed is preferred, and comes from Belgium, France (Arthemia), South Africa (Skretting), Uganda and Zambia (Novatek). Some farms are trying to produce their own feed but are struggling to achieve the right balance/combination of ingredients. A private consultant based in Kinshasa is training local fish farmers to produce their own feeds using locally available ingredients, however the quality and effectiveness of these is yet to be ascertained. Access to high quality ingredients is also a challenge to those with limited means. The quality of local feed in Kinshasa therefore remains very poor (often just a combination of two or three ingredients e.g. rice bran and maize). Where it has been used it has significantly compromised production.

Evidence across regions, then, confirms that even when operating at larger scale and with more capacity, a strategy relying on local feed production in the short to medium term could pose significant risks to the efficient growth of the sector. For those regions close to Zambia and East Africa, there should be an advantage in being close to feed suppliers. In Kinshasa there is some evidence that local feed has been successful and replaced imported feed from Uganda. Where there is rural, small-scale production, feed may be unaffordable as well as unavailable, increasing the rationale for local supply using household agricultural waste. This can be a best-fit for households but is the main reason for poor productivity and reinforces the view among many farmers that fish farming is often not profitable.

A proportion of Kinshasa's catfish feed is supplied by a long-standing supporter of DRC aquaculture, Professor Mutambwe of Kinoise des Poissons (a hydrobiologist and aquaculture specialist and professor at the University of Kinshasa). Professor Mutambwe imports a sizable amount of catfish hatchery feed for his operation from Belgium, selling the rest on to other colleagues in the sector. This form of cooperation points to the potential for Kinshasa producers to source feed as a cooperative. Whilst Professor Mutambwe's contacts allow for the importation of smaller volumes than would usually be feasible, linking up with a commercial importer to buy higher volumes of quality feed and distributing this through a cooperative model may be a significant step towards addressing the feed quality issues in Kinshasa.

'Seed' (production of fingerlings through hatcheries): IITA has supported a local government-initiated demonstration site at Nyakabera, outside Bukavu, where fingerlings are distributed to farmers across three rural regions. However, SENAQUA, due to funding limitations, appear not to have any more than a nominal role in the site, with IITA effectively managing operations with their cooperation. Separately, but nearby, SENAQUA itself has a reproduction station near Bukavu, responsible for supplying fingerlings to the whole Eastern region. However, this is rarely operational due to a lack of finance and electricity issues.

The IITA centre at Kalambo is setting up a hatchery for catfish and for tilapia, due for completion in December 2018. While it is necessary to have hatchery tech and skills at Kalambo, the distance (around 10km over poor roads) from Nyakabera is a limitation. Fishers are importing seed from Uganda and Rwanda, though importing live fish raises non-compliance trade issues (there are requirements across species to protect against disease, though regional trade integration may allow for greater movement of these in future).[7]

In Kinshasa the government is supporting the production of catfish and tilapia fingerlings through the hatchery they built in 2013, in collaboration with Professor Mutambwe of Kinoise des Poissons. Professor Mutambwe has entered into a partnership with the government to supply fingerlings to farmers in Kinshasa and rehabilitate abandoned fish farms and ponds in the two former Kasais,

[7] See World Bank Great Lakes Trade Facilitation Initiative (http://projects.worldbank.org/P155329/?lang=en&tab=documents&subTab=projectDocuments)

Kinshasa, Bas-Congo and Lubumbashi. The agreement between Professor Mutambwe and the government is that Kinoise des Poissons should grow, produce and distribute 1,000,000 fingerlings to farmers for free. However, farmers are not yet well informed of this offer and only half of the agreed number have been produced to date. It is still the case that most of the Tilapia fingerlings found in Kinshasa are imported from Zambia, Belgium and Uganda.

The team visited two on-site hatcheries in Kinshasa, one of which is still under construction. The other, owned by Mont Tabor, produces fingerlings on demand (generally 10,000 – 20,000 catfish per reproduction cycle). Two new hatcheries for catfish and tilapia are also under construction at the Ratalbi farm in Kinshasa, due to be operational by the end of January 2019. This is an initiative supported by the IITA, designed to improve access to quality fingerlings.

Human Capital: The knowledge base for aquaculture is very thin in the Kivus, where up to 60% of fish farmers may never have received any formal education and are often out of contact, far from relevant support services (IITA & WorldFish 2018). SENAQUA is unable to provide training, noting that their own staff are limited in experience and would themselves require training to support others. It was indicated that SENAQUA may have received some FAO training in the past, but the nature and extent of this was unclear and not thought to be adequate to cover local requirements or those in nearby regions. Expansion of feed and seed production in this context of a severely limited knowledge and skills base would rely on far greater training capacity. The farm system is reliant on the core work of IITA to provide training and quality support. Hence, expanding the farm system with hatcheries and extension services would be limited by the lack of broad and specific aquaculture knowledge.

The Bukavu fisher association has travelled to Kenya to train its core staff and is seeking to establish a network of capacity both locally within its association, and across sister organisations in the region. Training and aquaculture technical support is predominantly available in Uganda, Kenya and Zambia.

In Kinshasa, where private sector activity is more developed, some private consultants are offering training services. Ratalbi farmers have received some training from WorldFish on pond maintenance and feeding practices. IITA also has plans to develop a training programme in this region, though this will likely be smallholder farmer-focused.

Organisational capacity: The Bukavu fisher association has achieved organisational cohesion which can support expansion and efficiencies in production. Rural farmers may benefit from a private sector actor which can support aggregation of supply, but such an actor does not appear to exist (in time, perhaps small producers could link with nascent companies such as Olive farm). There is an equivalent association in Kalemie but they do not currently practice aquaculture, though have expressed interest in support from the Bukavu group. Equivalent groups in Goma and other lake areas may be available and serve as good entry points for production (river currents would determine viability around Kinshasa for cage aquaculture based on fisher groups).

Physical infrastructure: Road infrastructure is sufficient in the Kivus for cage aquaculture, as is boat access from Bukavu port to potential cage aquaculture sites. Cages are constructed locally using nets imported from Rwanda (and likely in turn from Asia).

Road access for farming regions in the Kivus is limited, as is electricity supply, and to overcome this, the siting of local hatcheries that do not require power or long supply chains would be required. Again, to do this would rely on large investment in local skills and infrastructure that do not currently exist, including regular extension services by trained staff, transport solutions (transport of hatchery stock is challenging over rough roads) and physical equipment. Use of information technology has the potential to (at least to some extent) mitigate the impact of infrastructural constraints, helping farmers in inaccessible areas to receive relevant training, information and advice.

Support in Kalemie would likely be in the form of satellite support from South Kivu, and this would amplify the challenges and constraints.

4.5. Supporting functions and regulation

4.5.1. Supporting Actors

The supporting functions for the aquaculture sector are weak, even in South Kivu where a semblance of capacity is in place through SENAQUA and IITA. IITA are providing meaningful knowledge, inputs and structure which is recognised by SENAQUA and government officers.

Figure 7: Provincial Inspector, South Kivu

- ***Government:*** SENAQUA falls under the remit of the Ministry of Agriculture and Livestock. The Inspection Provinciale de L'Agriculture, Peche et Elevage (South Kivu) is realistic about its limitations in terms of lack of outreach capacity (staff), training and expertise of staff (there is a risk they offer poor advice to producers), transport (funding for vehicles). It is understood by the team that they hold the SENAQUA aquaculture remit for the wider region: the North Kivu inspectorate does not have equivalent capacity. With current capacity they are focused on core compliance and regulatory functions (e.g. issuing a farm licence, monitoring the site), and facilitating initiatives by IITA and other actors.
- ***IITA:*** IITA is part of the CGIAR initiative providing the core technical capacity in the Kivus, supporting the Nyakabera site, training / outreach for farmers, and hatchery services. It is implementing a value chain support programme covering these functions and further market analysis (in 2019).
- ***NGOs:*** There are a number of organisations (e.g. Action Contre la Faim, ICRC) that have initiated support for aquaculture by smallholder farmers as part of diversification of production. Often inputs have been given free (though often without adequate training), which, in the context of deep political insecurity and challenges, may be appropriate but in turn farmers may be less likely to buy inputs in future. Poor quality inputs can also be off-putting for farmers investing in external inputs in future.
- ***CBOs:*** Community-Based Organisations were cited as credible implementing partners because they have the trust of rural communities and have experience in effective communication with farmers.

The management of development of aquaculture sites is approved by SENAQUA (it is not known how this is managed between national and regional level), following a satisfactory Environmental Impact Assessment from the Ministry of Environment (see below).

4.5.2. Security

In the Kivus, views about the impact of political insecurity and theft were mixed: the Bukavu fisher association stated that they have the support of government, and had guards sleeping overnight at the shore by the cages. Most consultees, however, saw theft as a significant risk to operations, both in the Kivus and Kinshasa. The study team's view is that risk of criminal theft and political capture would increase as operations went to scale.

4.5.3. Regulation, taxation and corruption

The development of aquaculture sites at a small scale appears to be relatively unhindered by regulatory blockers or taxes, in that it has not prevented development. Corruption in transactions with officials was cited by interviewees as being less expensive than legitimate taxes, though the two were often blurred through lack of understanding of the rules, or if payment costs were transparent, the formal cost would be higher than the informal cost, encouraging the payer to choose the informal payment which may lack paperwork. The import of feed and seed in any formal quantities is prone to such costs, as is the formal import of fish for sale in Bukavu and Goma. Reducing trade barriers for these inputs would be valuable to the effective development of the sector – while actors such as the fisher association members believed they could manage under the current system, they found that importing inputs was time-consuming and more expensive than necessary.

While experiences with border officials suggested an improving climate for crossing between DRC and neighbouring countries, small-scale cross-border trade (CBT) is often inhibited by poor relationships between border officials (predominantly men) and traders (predominantly women). Research conducted around four of the DRC's border points (with Uganda, Rwanda and Burundi) found that border officials perceive poor cross-border traders as "smugglers" and as such, traders are subject to significant risk of violence, threats, sexual harassment, and almost mandatory payment of bribes (Brenton et al 2011). Congolese and Rwandan women interviewed by International Alert highlighted the prevalence of informal taxes on the Congolese side of the border as one of the key factors inhibiting their trade.

5. Main Actors

*Research Question: Who are the **main actors** in the sector? What are the relationships between the actors? How is power distributed?*

The main actors in the fisheries and aquaculture sector in the DRC include a mixture of small-scale and larger players. However, these players do not work on discrete levels. For example, whilst small-scale farmers and women traders could be considered relatively minor actors, they play a significant and fairly consistent role in the structure and function of the market system. Furthermore, when integrated into cooperatives, fisher associations and trader associations, the reach and influence of these smaller players is extended.

Development actors are limited to the meaningful and focused presence of IITA (hatcheries, extension support, research) and some NGOs (e.g. ICRC, Action Contre la Faim) who have identified aquaculture as a useful means of supporting disadvantaged groups such as communities with refugees.

Small-scale farmers (primarily South Kivu and Kinshasa): around 1,500 farmers are believed to be active around 3 areas of South Kivu, but are not grouped together in strong organisations, and are reliant on IITA activities. There are reports of some small-scale ponds in North Kivu (near Masisi) and it is likely there will be some disparate activity in other regions, though often previous

known activity can have ceased with lack of support. In Kinshasa and its surroundings, around 100 farmers are known to be active, though in the 1960-80s it was believed that up to 120,000 ponds existed. No recent census has been conducted to know exactly how many farmers exist to date.

Figure 8: Woman trader with approx. $70 worth of fish

IITA (South Kivu, Kinshasa): IITA is developing hatchery facilities for long term development of the sector. It is also implementing value chain development initiatives to support feed production and market assessment. However, these are largely focused on the rural farm pond system that delivers subsistence and hyper-local sales to neighbours and nearby villages (IITA & Worldfish 2018). While this is a perfectly legitimate market to support, the prioritisation of local feed production may hinder the effective growth of the sector rather than support it. This is because the economies of scale achievable using imported feed, on grounds of quality and price, make importing good quality feed a more realistic prospect for catalysing the growth of the sector. Nevertheless, IITA contest that since feed is such a high proportion of cost, local production is still a priority for them on the basis they may be able to reduce overall costs.

Women traders (all markets): Women traders are central to the current market realisation for farmed, wild-caught and imported fish, both in importing through cross-border channels and local direct sales. FAO statistics suggest that though there is strong involvement of women in fish processing and trading in the DRC, women are less involved in fishing and aquaculture (Breuil & Grima 2014). There are undoubtedly good opportunities for women in cross-border trade, particularly those involved in women's trading groups which can also mitigate personal security risks (Mwanabiningo 2015).

The South Kivu IITA & WorldFish baseline report indicates that there is some involvement of women in aquaculture at the household level, but that the work seems to be predominantly undertaken by men. However, recent studies in Kenya and Rwanda also make a strong case for female empowerment through better integration into aquaculture production systems (Agbebi et al 2016; Farm Africa 2016).

Medium scale farmers (Kinshasa):

- **Ratalabi:** Mr Innocent Nda Ngiye is a private fish farmer based on the outskirts of Kinshasa. The fish farm was established in the early 1970's and he raises both tilapia (O.niloticus) and catfish. The fish farm is less than 10km from Kinshasa city centre. The farm is right at the foot of a hill and it is serviced by a total of at least 4 water springs. There are 52 fish ponds at the farm, each pond averaging 400m^2, with some larger ones at 2,000-3,000 m^2. The site is very strategic in terms of accessing and producing fingerlings and table-sized whole fresh tilapia and catfish from the farm.
- **Montabor Farm:** This catfish hatchery, operating since the 1970's, is located on the periphery of Kinshasa near the university. It is a large-scale farm with around 10-15% put over to aquaculture, and has an indoor built hatchery occupying about 100m^2 area. They produce between 10,000 and 20,000 catfish fingerlings per cycle, depending on the order. With a permanent source of water and close proximity to markets for both fry and fingerlings, this farm is ideally situated.
- **Kinoise des Poissons:** Professor Mutambwe of Kinoise des Poissons is an aquaculture specialist and professor of agronomy at the University of Kinshasa. Kinoise des Poissons imports catfish hatchery feed for its operation from contacts in Belgium, selling the rest on to other actors in the sector. This form of cooperation points to the potential for Kinshasa producers to source feed as a cooperative.

- **Clery fish farm:** In Maluku, rural Kinshasa, situated some 50 km from the town centre on a 60 hectare farm with a natural river that is used for fish ponds. Clery has stocked 160,000 Tilapia fingerlings imported from Uganda and is in the process of erecting a cold room on the fish farm. The farm was started with imported fish feeds from Uganda (Skretting) and has moved to using solely locally produced fish feeds.

- **Kasongo fish farm:** In Mbankana (rural Kinshasa) with integrated 'agri-food' activities and ponds covering 300 hectares.

National Service for Aquaculture (SENAQUA): SENAQUA is the agency responsible for aquaculture production sites and aquaculture extension in the DRC. In practice it has very limited capacity and as a result has focused on basic compliance functions including the correct taxation of fish products. Harmonisation of standards with East African countries, and reduction in barriers to trade, could ensure that these limitations are mitigated (for example through the World Bank Great Lakes Trade Facilitation Initiative).

Figure 9: Fisher Association with imported Novatek feed

Kivu Tilapia Farm Ltd. (supplying North and South Kivu): European owner-operators *in nearby Kamembe, Rwanda*, with an extensive team of operations staff (and security staff), are producing 15-30 MT per week and exporting most over the border to Bukavu and Goma through a distributor (Freddy). This produces an estimated $1.5-2m in revenue, and sales to consumers and restaurants exceeding $3m.

Novatek (all markets): A feed supplier in Zambia, Novatek is considered the best and most cost-effective option for both the Rwandan and DRC cage producers and is one of the commonly preferred suppliers of feed regionally. Other feed suppliers exist regionally (e.g. Gorilla Feeds in Rwanda) but Novatek is preferred and considered price-competitive.

Freddy (importer, Goma): has a distributor agreement with Kivu Tilapia Farm to sell across Gisenyi and Goma. While Freddy has only been trading for 1 year, he is confident of strong profitability and seeks to grow the business. There is the potential that if Kivu Tilapia Farm seek to develop more direct marketing methods, this could pose a threat to Freddy's business model since there are few if any comparable suppliers.

It is worth noting that Freddy operates two offices, one in Goma, the other in Gisenyi. This is a 'hedging of bets', whereby market access in Goma can benefit from some presence in Rwanda. It also suggests that the security situation (and risk of political interference) remains a strategic risk.

Bukavu Fisher Association (Union pour le développement des pecheurs de tilapia au Kivu – UDPTK): The Bukavu Fisher Association is separated into satellite (or 'antennae') groups. One such group operates a cage fish farm in the lake – the group comprises 40 fishers within a total association level of 300 fishers (13%). The 300 fishers are linked to 70

Figure 10: Fisher Association leaders, Bukavu

women traders.

The group demonstrated clear research and training investment, attention to feed quality, and plans for growth.

Minova cage farm project, near Goma (Mme Musangania): An owner / operator, Mme Musangania, has submitted a request to the Ministry of Planning to implement a tilapia cages project on Lake Kivu and is currently awaiting approval. She has a fish farm in Buremano in the Masisi area of North Kivu, operational since 2014. She produces tilapia at a small scale that she sells to hotels and restaurants in Goma (20-30 fish per harvest). Minova received seed from the paramount chief who received them from an INGO. Mme Musangania and her colleagues have never received any formal training in aquaculture and have recently experienced a heavy loss due to soil erosion in the ponds which killed almost all the fish they had. They are now experimenting with a new system of connecting the ponds to Lake Kivu and in this way collecting fingerlings.

Research: Lubumbashi and Kinshasa universities run aquaculture courses and research which should in principle align with current industry requirements under SENAQUA guidance. While they were not raised in interviews with implementers, the proximity of Lubumbashi to Zambia (which has a more developed commercial sector) would have possibilities for knowledge transfer and training. There was no evidence in consultation that the Lubumbashi area had any significant aquaculture activity, except that the former governor has run a large-scale farm in the past. It is expected that small ponds exist in the area, but the proximity to Zambia will be more relevant.

6. Environmental impact and Natural Capital

*Research Question: What are likely **environmental implications** of a growing aquaculture sector – both in terms of land use, water pollution, as well as import and cultivation of potentially invasive species and the connected risks.*

The environment, as the natural capital on which aquaculture is based, plays host to the sector as it develops and grows. The activity can be extensive or intensive with various forms and scales of technology supported by inputs and use of natural resources, and there are necessarily different levels of impact on the rivers and lakes being utilised. However, good production models can mitigate risks, most importantly through the correct selection of farming sites and species; implementation of the most appropriate culture systems; use of the best feed and feeding practices; use of bioremediation systems; decreasing dependence on fishmeal and fish oil; adequate management of effluents; achieving certification of compliance with sustainability standards; improving research and legislation related to evaluation and solutions for aquaculture impacts. Implementation of these practices would depend on the particular circumstances of any farm, including its geographical setting and the husbandry practices in place. Fortunately, there are reports of some aquaculture farms around the world working sustainably, suggesting that with the right technologies supported by the right attitudes this is achievable with minimum impact on the environment. The ability of the sector to implement sustainable practices critically depends, however, on strong public sector support institutions as well as active research that supports the adaptation of global sustainability practices to local circumstances.

Aquaculture should also be considered in relation to fishing and its impact on wild fish stocks. Reduction in fish populations in Tanganyika and Bukavu areas were mentioned in consultation and mitigating this reduction through aquaculture is advisable to ensure local fish supply.

SENAQUA representatives rely on an environmental assessment being undertaken and approved by the Ministry of Environment (tests are undertaken and submitted, though it is not known whether to the national or regional office) before they can issue a licence for a fish farm. The quality and effectiveness of this assessment is not clear, however.

Invasive species pose an economic and ecological risk when they are introduced intentionally or accidentally into a water body. On the economic side it means the farm or business would have lost in terms of sales due to less yield, and hence profitability. On the ecological side it implies that the genetic make-up of the natural environment risks being altered. Escape events may come as a

result of theft, damaged nets by predators or heavy storms. The impacts of some events can be mitigated but others are very hard to tackle. The significance of fish escapes as a factor affecting the ecosystems varies from country to country. In some countries, fish escape is perceived by some as positive as it is thought to strengthen wild populations of fish, a perception that over time may prove incorrect. In other countries, fish escapes are proven to affect important wild fish resources in a negative manner, which has significant socio-economic impacts and can damage the reputation of the farming industry. Nile tilapia is available in Lake Kivu, though the possibility of bringing fast growing strains from Asia or other African countries may bring diseases. It is therefore the role of the government and its research bodies to assess the likely impacts of such a move before its implementation.

Lake Kivu's geography is quite particular in determining the prospects for fish farming – it is very deep, and it is considered to have low oxygen levels below 5 metres. There is a low risk of nutrient build up as a result of uneaten fish feeds and faecal matter. Impact on water quality was not cited as a concern. To guide placement of cages on the lake a series of suitability studies ought to be conducted followed by zoning of suitable sites for cages so that those would be potential investors can make informed decisions. The studies would also inform the carrying capacities of the identified sites.

Regionally, the issue of disease is an ongoing concern, particularly following outbreaks of tilapia lake virus (TiLV) in at least eight countries in recent years. Literature shows that it is likely that at least 10 countries in sub-Sahara Africa have imported TiLV infected tilapia fries and fingerlings from hatcheries in Thailand. Burundi, the DRC, Mozambique, Nigeria, Rwanda, South Africa, Togo, and Zambia are now suspected to be infected with TiLV with Tanzania and Uganda recently confirmed (Hounmanou et al 2018). The DRC is listed as one of 40 countries with a high risk of TiLV spread through translocation of infected fingerlings (Dong et al 2017).

In recent years, reduced catches have been experienced in some parts of the DRC where fish stocks are reported to have collapsed (Petit & Shipton 2012). This is particularly pronounced in the extreme north and south parts of Lake Tanganyika. Research done in conjunction with a regional FAO project showed that pelagic fish stocks are likely overexploited in the waters between Burundi and the DRC, partly as a result of illegal, unregulated and unreported (IUU) fishing. However, the report also emphasises that fish stocks are still abundant in many (particularly more remote) parts of the lake. On Lake Tanganyika, various initiatives have sought to alleviate pressures on fishery resources, including a Framework Fisheries Management Plan and a Strategic Action Plan, culminating in the ratification of the Convention for the Sustainable Management of Lake Tanganyika in 2007 (van der Knaap et al 2014).

Newspapers reports suggest that IUU fishing is a common problem on Lake Kivu and that rudimentary methods used by some fishermen, including substandard nets, is damaging fish stocks. There are also reports that conflict in North Kivu has had an impact on fish stocks, and that armed groups have overfished Lake Edward, affecting the livelihoods of local fishermen.

In terms of land use, the profitability of successful and well managed ponds is considered to be higher than alternative uses – a 700 sqm set of ponds may produce over $2,000 of fish with less maintenance than other crops. However, access to land in the Kivus is strongly determined by conflict and areas of security, though the radius of safety for South Kivu currently extends well out of Bukavu.

The archipelago of islands in the south end of Lake Kivu could pose a promising environment for developing cage production. Security and theft considerations may be minimised, and the network of bays could be conducive to production. However, access to electricity, skilled labour and likely restrictions on accessing islands from the Rwanda side would make this prospect unlikely.

7. Profitability

The summary below outlines small scale pond profitability, expected to be valid for that production model nationally. Costs and profitability for farms in Kinshasa are not known but interviewees indicated that they would struggle to remain profitable below current prices. However, a market analysis being finalised by IITA (2018) reports higher profit margins of $500 for tilapia and up to as high as $8,000 per farm per annum for catfish. To realise these margins, however, requires strong organisational capacity and larger scale, which would not likely be attainable in all cases.

Smallholder farmers: Production costs for smallholders have been set out in the South Kivu baseline report, but this team has conducted a basic sensitivity analysis as follows:

- Total potential revenue = up to $2,000 per farm (400 kgs at $5 per kg sold)
- Costs of production and income (indicative, based on interviews identifying a typical 700m^2 pond-based system):

Item	Cost ($)
Feed	800
Fingerlings	200
Labour over 6 months	300
Total Cost	1300
Gross Margin	***$700 (2000 minus 1300)***

The $2,000 income from a 700m^2 would be viable from a best-case scenario throughout the production cycle. While the stated figures for smallholders are indicative based on estimates from consultees, it is believed that potentially positive margins are quite vulnerable to small changes in assumptions as follows:

- **Total output:** in the event of lower than expected output or a production shock (disease, pond collapse), the realisable value could quickly drop below cost.
- **Timing and quality of feed supply:** If the feed is obtained later when the production cycle has started, or runs out before the cycle is over, or the fish farmer runs out of money to procure more feed, the expected margins will not be realised.
- **Valuation of production:** the team assume that the value of fish to the farmer is equal to the market price, but fish consumed by the farmer's household will not be realised in cash. This will likely affect perceptions of profitability when traded off against other options (including savings, school fees, etc).
- **Cashflow commitment:** paying for feed and labour up front (and fingerlings if paid for) requires a considerable investment at some risk, even if the payoff is attractive.

Price: while prices seem quite strong even in rural areas ($3.50 to $5 per kg), and with urban prices rising to nearly $15 per kg for filleted fish, in practice it is still likely that lower quality fish or unsold fish will affect the total realisable revenue.

Women traders: women traders can buy fish for $5 / kg and sell for $10 / kg, with an estimated 15-20 kgs over 2 or 3 trips a week. A conservative valuation of sales at $300-350 could still yield over $150 per week gross margin before time and working capital costs.

Fisher Association: attaining $5 / kg, though the very large size of their fish suggests that they are feeding fish for longer than may be profitable (usually fish are fed for 6 months to a certain size then removed). This could be improved through extension support. Costings for the 40 participating fishers in the satellite group are harder to assess, since they use fishing boats and equipment to service the cages: this achieves considerable economies of scale, though at some point would entail more full-time aquaculture staff. They are obtaining feed at $1 per kg, which at a feed conversion ratio of 2:1 should be proportionate to returns.

Gorilla Feed's distributor imports chicken feed which is a proximate supply chain – it can even be used to feed fish – from Kigali into Bukavu at $28 for 50kg, and $26 per kg for starter feed. The current importer is tied to one brand and would not import other feeds – though the supply route suggests that it is eminently possible to import feed at a comparable price.

Kivu Tilapia Farm Ltd.: Led by European expatriates Charles and Damien, the company employs 25 farm staff and 19 security staff. Turnover estimated at between $1-2m, producing up to 30 MT per month.

The business strategy of the company is informative – they import high quality feed from Novatek (Zambia) and deem Rwanda to be a safe production environment. Given that many of their inputs need to be imported anyway, they see little benefit to being based over the border in DRC, and many additional challenges by way of corruption / trade barriers and insecurity. Congolese women traders and their distributor bear this risk.

That said, while they have contacts (and Freddy as a distributor) in DRC, they have not been able to travel to visit and assess the situation directly. It is believed they may have sought to explore setting up in DRC but informal payments deterred them, however this is unconfirmed. If they were able to visit to advise others, their experience would be very valuable to those in Bukavu and elsewhere (however since they would be competitors it is not clear that this would be feasible).

In summary, there appear to be profitable and worthwhile fish farming business models at each level of scale, from smallholder, to commercial farmer, to fisher group, to commercial cage aquaculture, though smallholder profitability assumes a valuation of household consumption. Nevertheless, profitability is likely to be very sensitive to supply shocks and any attrition through lack of training, which will significantly reduce performance and increase risks.

8. Competitiveness

*Research Question: What are **competitive advantages and disadvantages** of the sector (the analysis can compare different regions in DRC or the whole of DRC with neighbouring countries, depending on where competition mainly happens)?*

The DRC is considered a lucrative market for fish, achieving high per kg prices. The limitations that act against production in the DRC also act to insulate its market – this applies to large towns where demand for good quality fresh fish is relatively strong, and to rural areas where communities cut off from other sources of fish may pay high prices to buy what is available locally.

In production, operating in the Kivus is considered to be more expensive and riskier than in nearby countries such as Rwanda. Given that final importing of fish is considered viable, external commercial operators are more likely to invest in Rwanda and export the fish into the DRC market. Those already invested in DRC markets will be better placed to handle risks of operating, but crowding in external support may prove difficult, from importing feed, to fingerlings, to staff. In Kinshasa, security is less of a concern but imported fish provides a competitive pressure, even if not preferred to fresh local fish.

Across regions, Chinese fish was mentioned as a 'default' source of frozen fish which is supplying the same markets. It was considered to be less desirable due to a lower perceived quality and likelihood of spoilage or damage through freezing and transport.

The key challenge to improving competitiveness and consequently to extending production in the DRC is likely to be the degree to which human capital can be harnessed. Training attained by study trips to East Africa (Uganda, Kenya, or Francophone countries) is advisable in the absence of widespread skills and knowledge in the country today – even among the government bodies responsible for the industry, there is a significant capacity shortage. However, even training selected lead farmers would have some cost. Though high-quality extension services have potential to improve productivity, to date simple factors such as a lack of financial, human and physical resources needed to carry out extension work have inhibited progress in this area (Ragasa et al 2016). Currently, IITA is maintaining a formal knowledge and capacity that allows the sector to survive – this was corroborated by government who acknowledged there was limited support otherwise. Some projects (led by ICRC, IFAD and NGOs) have run programmes to provide some inputs to rural areas as part of wider agricultural support initiatives, but there was limited evidence of significant presence. Informally, association training has been gained through direct links outside the country, offering an alternate channel for implementation. In the long run, though, a strong institutional underpinning in education, research and development, and extension services would need to be built up locally to reduce reliance on ad-hoc training of extension staff, service providers and fish growers themselves.

Advantages
Proximity to market: • ***Kivus:*** East African producers, and DRC traders importing Chinese tilapia, are all seeking to access the DRC market. However, spoilage and lack of fresh quality mean that fresh local fish is still strongly preferred. • ***Kinshasa:*** local fresh fish production is viewed positively by buyers including high-income markets such as hotels and restaurants. • ***Tanganyika:*** limited production reported by respondents, with fish demand focused on wild fish which is salted and smoked for sale in local markets. It is not clear how much fish is imported from the East.

Disadvantages
Rule of law / risk from theft: despite some assurances, many consultees in South Kivu cited security concerns around theft. Political insecurity in the Southern regions of South Kivu would stop commercialisation there, and interviews suggest a risk of political interference / capture if the scale of commercial production became bigger. Around Bukavu and Goma, supply chains would be more secure and dependent on reduction of informal taxation risk at the border for fish and inputs trading. However, larger farms in Kinshasa are fenced with higher security than smaller farms and have fared better.
Transport constraints on fingerlings: transporting fingerlings is challenging over rough roads and long distances, requiring local production. However, this local production is in turn constrained by lack of electricity and staff.
Lack of skilled / experienced staff and lead farmers: local supply of seed and production requires an extensive eco-system of skills and experience that is currently very thin.
Import constraints on feed: while not significant, the cost of extra time effort of importing feed into DRC compared to Rwanda works against operating in DRC (corroborated on both sides of the border), in the absence of pre-existing and established import channels. However, growth in volumes or better aggregation amongst producers should reduce this burden, or contracting to a third-party importer.

Lack of agro-processing market system for feed production: few agro-processors have capacity in the Kivus, and no proximate sectors (such as chicken feed) produce locally in South Kivu. Capacity may be stronger in Kinshasa, but even feed-producing countries often prefer non-local specific formulations, so any local feed should be of competitive quality and cost, with predictable supply volumes. Since feed is the largest cost of production, this will limit the local impact of the aquaculture sector. There is a risk that producing local feed at high cost and lower quality could hamper efforts to grow production.

8.1. Production Feasibility Framework

The feasibility of an industry depends on a number of factors that determine viability – the different production systems operating in the DRC are summarised below.

Feasibility factor	Farm pond system	Fisheries cage system	Professional / SME cage system (Rwanda, potential in DRC)	Kinshasa large farm production
Production	Limited	Scope for growth	Scope for growth	Scope for growth but hitting competitive pressure
Market	Hyper-local	Good prices and cautious / gradual scope for growth. Network of women traders distributes product, but this market may be limited and physical market trading faces price challenges.	Scope for growth but becoming price-sensitive	Scope for growth but becoming price-sensitive
Logistical	Very limited – lacking electricity for cold chain, roads.	Close to market, have overcome supply barriers at cost through imports.	Largely controlled – access to good quality inputs. Congolese distributor with managed risks.	Well connected, local to very large market, but still reliant on the direct sales, fresh fish chain rather than selling large volumes on the open market. Supermarkets sell frozen fish but the majority is expected to be imported from Asia, with some pelagic imports from Namibia and Mauritania.
Operational	Very limited.	Prospects for expansion through wider association network (and regionally).	Strong capability and operational knowledge from regional and international staff. Secure operations nearby the market.	Larger capacity and possible economies of scale through collaboration across firms, but also limitations through feed efforts.
Financial	Very limited.	Strong commitment to investment, backed by fishing income.	Unknown, but thought to be positive, and distributor deems importing of product to be profitable.	Wealthier producers with diversified income.
Growth	Possible (and advisable) for subsistence and hyper-local protein, but not for commercialisation at present.	Good scope – but risky (see below)	Good scope for growth, though comments that achievable price has a limit, and market may not be unlimited.	Large farmers with financial working together sharing information on production and importing inputs plus group marketing can ensure slow but steady growth

Systemic Risk	Risk of increased political insecurity through conflict; risk of lack of extension services. However, insulated market means it is likely that production and strong local demand would continue.	Risk of becoming a target of political capture if they grow to scale. Risk of systemic crash in a disease event or similar, though fishing activities would mitigate this.	Possible risk of disease event with limited diversification of geography of production. Risk of new barriers to importing fish into the DRC. Other risks deemed to be limited due to business environment in Rwanda deemed strongly positive.	Possible risk of political capture or informal taxation, particularly in limiting access to imported feed.

9. Development trajectory of the sector

*Research Question: What are the **current dynamics in and the development trajectory** of the sector? How has the sector changed over recent years, both in terms of structures and flows as well as actors and relationships? What are likely trajectories for the sector in the near future?*

The long-standing farm pond aquaculture activity appears relatively unchanged since the collapse of the sector in the 1980s. However, new hatchery capacity by IITA may provide some foundation for development of the commercial sector.

Feed supply, which can make up some 40% of costs, is not likely to be operationalised through DRC-based production in the near future. Processors in proximate industries (such as chicken feed) are absent, and so the best strategy is likely to be ensuring the open flow of good quality feed from Rwanda and further afield: Zambia's Novatek is considered the most cost-effective and high-quality option, and this is used by professional Rwandan Kivu producers.

This was supported by the evidence from Kinshasa, where the sector is further developed and yet still faces limitations in sourcing local good quality feed. If it cannot be achieved in Kinshasa to an adequate standard, it is less likely that local feed production in the Kivus will be competitive with established producers. This is unfortunate given the potentially high economic value of producing feed as a proportion of the sector, yet it should not be pursued at the potential cost of the producers who are seeking to build a viable industry.

Given these constraints, development efforts should focus on efficient production at scale, and be relevant to local production, using Nigeria, Zambia, Uganda and Rwanda as relevant comparators rather than e.g. China.

There are some indications of SMEs entering this production space e.g. Olive & Minova (though they are currently producing only at small scale in Buremano in the Masisi area) – early stage support for these emerging actors could be helpful in developing the sector. There may be potential for a private actor to act as an 'aggregator' of fish in a similar manner to Harvest Plus (NGO initiative) which supports the aggregation of agricultural production in DRC.

Demand is the strongest card in the market system – exporting to the DRC market is considered the most profitable option in neighbouring countries, and while there are limits on price growth, high prices are still achievable. However, current cross-border trade is based on penetrating the market using very basic supply routes (women traders delivering to known buyers) and one or two major importers. To go beyond this system into wider markets would require more complex chains including more cold storage capacity, accessing supermarkets, and traders taking longer to sell through traditional markets rather than having immediate cash sales.

Nevertheless, Bukavu and Goma populations stand at at least 2m and 1m, respectively, and affordability is not seen as a key constraint for many consumers, so it is likely that the market

would absorb higher levels of good quality fish production. There is certainly also a high demand in Kinshasa with a potential to further expand the market.

In summary, the trajectory of the Kinshasa cluster is promising with the core infrastructure being developed. South Kivu's focus on small scale farming may be positive for remote farmers but will rely on further development inputs rather than commercial investment. Some very early stage commercial developments are evident in South and North Kivu, particularly in cage fish farming. The fisher association in Bukavu shows a model for scaling production across fishers across the Great Lakes, but replicability will be a challenge.

10. Pro-poor Impact

*Research Question: What are the **situation and role of poor people** in the sector – both as producers and consumers? What is the role and status of women in the sector? What is the role of youth and other vulnerable people?*

The economic benefits of production, if not consumption, are determined by land ownership, which in turn provides a bias towards older men, with women tending to occupy trading functions (men to women farmers are around 10:1 ratio), and youth as workers – often the youth within the household (IITA & WorldFish 2018). The involvement of children and youth in aquaculture, particularly informally as unpaid family labour, raises questions around child labour. These can include such issues as potentially hazardous working conditions and negative impacts on school attendance (FAO 2017). Low levels of female involvement in aquaculture are symptomatic of customary tenure arrangements. Though these vary throughout the country, historically women have been unable to own or inherit land, enjoying what limited access is enabled through affiliation to male relatives (Samndong & Nhantumbo 2015). International Alert report that "in the majority of ethnic groups in the DRC, women do not have a right to land. This is particularly dramatic in a conflict situation marked by the dissolution of numerous homes and where women lose their status as a wife and thus find themselves with nothing" (2016, p.27). This statement demonstrates the constraints faced by many women, though in some circumstances, widows do inherit land left by husbands, or at least have effective control over its use.

The main consumers of farmed fish are wealthier individuals who can afford to buy the fish at a relatively high price ($10 per kg at final sale). However, smaller fish captured at the same time can be sold to poorer families who are happy to take smaller sizes and share them among children etc. For the same reason, poorer households buy frozen horse mackerel and dried products (9kgs of salted and dried cod is sold at $50 to retailers, while splitting the pack to 130 separate pieces means it can be sold at $80).

At a farm pond level in rural areas, household consumption of fish is common, and combined with local sales it is expected that there is some food security and nutrition benefit to those with some means, though it is likely that those who are ultra-poor or more economically vulnerable may still be unable to buy fish, and are unlikely to be effective producers given that there are investment barriers such as land, pond construction, feed investment and training.

In summary, there is a case for aquaculture in strengthening nutrition and food security in rural subsistence farming, but it is not definitive in guaranteeing income generation for the poorest, and/or youth employment beyond casual employment. Cage aquaculture and larger scale pond farming, in contrast, does have routes to poorer consumers and can be a source of employment for hundreds of workers. As mentioned above, the scope for women to operate profitable trading activity is high, but this also poses dangers in terms of personal safety that should be properly considered, particularly in crossing the border between Rwanda and the DRC. Indeed, World Bank research indicates that opportunities for women traders are often "undermined by high levels of harassment and physical violence at the border" (Brenton et al 2011). This is an everyday reality for Congolese and Rwandan traders who are often afraid to confront border service agents

(International Alert 2018). Programmes to address cross-border trade risks are underway and these should be supported along with internal DRC initiatives that protect women traders.

11. Conclusions & Recommendations

There is a good long-term development opportunity for aquaculture in the DRC due to high demand for fish protein, a growing population, and sufficient wealth in key regions. However, production gains would require a commitment to long-term investment to increase capacity all along the value chain and on an institutional level. This would need to be based on an integrated, cross-sectoral approach which bridges different models of production. Support would be required across all parts of the market system, i.e. along the whole value chain, in the supporting functions (both public and private) and also on the level of rules and regulations.

Common nationwide challenges and overarching themes point towards several key focal areas for future interventions:

1. **Feed is the highest priority**. Low grade feed is currently a serious constraint on the growth of the industry. In the longer term there may be opportunities to improve local feed-production capacity, with some progress and scale being achieved in Kinshasa, but under the current conditions securing the supply of good quality feed imports is a much better prospect.
2. **Supporting pooled buying of feed** is a means of securing this supply. The particular feed and supply route will vary by region, but the benefits of **linking organised cooperatives with commercial feed importers** holds across regional contexts.
3. Aquaculture interventions should **lend support to industries which will strengthen feed value chains** (e.g. chicken feed), tying in with other agricultural capacity programmes (i.e. proximate industries where targeted investment will lead to mutual benefits, increasing capacity for complementary sectors/industries beyond what would be achievable by any one individually). **Integration with other agro-processing industries** will ensure that capacity is strengthened in value-addition activities as well as in primary production.
4. Availability of **quality fingerlings** is an ongoing issue. Whilst new hatcheries are under development in both South Kivu and Kinshasa, it will take time before the benefits of these are realisable, and their geographic reach into rural areas and other regions will be very limited. Also, they will require strong management of plant and distribution to provide impact.
5. In order for the benefits of an improved fingerling supply to be fully realised, extension services will need to be strengthened. A first step is to focus on **strengthening the capacity of SENAQUA personnel**, who with limited technical knowledge are themselves unequipped and under resourced to support both smallholder farmers and the formal industry as it develops.

While there are some entry points available within the current market system actors, the strengthening of the public-sector capacity (including research and development, education and training, and extension services) is required in the long term to provide adequate support and guidance for disparate actors across the different modes of production.

From a ***pro-poor rural resilience perspective***, there is evidence that farmed fish is contributing to protein consumption in the diet of some lower income groups, particularly those engaged in small scale agriculture, though there is a risk that poorly managed ponds can be unprofitable and will displace other crops. Working capital and requirements for land as well as human capital through trained farmers means that ownership even of small-scale pond aquaculture leans towards those with more resources – labour requirements for the youth may not exceed agriculture labour, and hyper-local sales would limit gains for women traders. A well-supported aquaculture programme

can still contribute to poverty reduction (through sales of fish) and improving nutrition (through household consumption) among poor populations. Nevertheless, quick wins would be quite limited, and not entirely within the intervention logic of a market systems programme as they will require the supply of inputs and direct training to farmers.

From an economic development perspective that looks to support ***market systems*** (contributing to pro-poor outcomes through job creation or income), larger-scale fish farming can provide direct jobs (in a professional system around 1 job per 8-10 MT of production), and strong pro-women income and jobs through trading functions. Opportunities in hatchery operations and feed may be desirable but should come second to the attainment of the best quality feed and seed possible. In Kinshasa there is good scope for commercially viable hatcheries, but elsewhere they may not be commercially viable themselves until the sector is better developed. In all areas, locally produced feed is a second-best to having good quality imported feed. The good news is that regionally produced feed (from Zambia) is available while demand in the sector grows.

The rationale for market systems programme could focus on supporting the development of medium-sized cage and pond producers around the main areas of market demand for fresh fish (Kinshasa, Goma and Lubumbashi). Discussions with the East African Community (EAC), Southern African Development Community (SADC) and associated trade initiatives could facilitate the importation of quality feed (by far the most expensive component of production). The development of private sector hatcheries for the supply of quality fingerlings is underway with some actors (private and supporting, like IITA), though market system-related barriers of distribution and commercially viable management of these facilities will require ongoing support.

There are different/specific implications for developing aquaculture market systems in South Kivu, where small and medium-scale production already exist, in North Kivu where demand but little production exists, and in Kinshasa with a maturing, medium-scale production is supplying a large potential market, as outlined in the following sections.

The Kivus

Any commercial developments in the aquaculture sector in the Kivus should be focused on the viability of fish farming production (cage or larger scale pond farming) using the best quality inputs sourced from or through East Africa. Currently, efforts at import substitution for feed may hinder rather than help producers, given that the cost of feed and its quality are central to the industry's development at this stage. Fingerling supply is being addressed but will also remain a limitation.

Fisheries Cage System (and its commercialisation): Support for the Bukavu fisher association to expand operations could build on commercial drivers, first to their other satellite groups (they are currently 40 in aquaculture production, of a wider association of 300) through funding training for other members, then possibly through their fisher network to other regions such as North Kivu and Tanganyika. Work with trade facilitation initiatives to support larger scale import of appropriate feeds from other countries would reduce cost and increase efficiencies – local production limitations risk being an insurmountable barrier to the sector at this stage. Encourage knowledge transfer from Uganda, Rwanda and Zambia to association and any new private sector entrants, though competitive drivers may limit this.

Farm Pond System (for food security and rural development): From a nutrition safety and farm resilience perspective, there is a case for supporting the local farm pond production of fish in South Kivu in the manner IITA is doing. With the right inputs and training, and in a best-case scenario, increasing the number of practicing farmers by 1,000 could generate a pro-poor return of between $500,000 and $1m per year. However, scaling significantly beyond that number (for example into North Kivu where farmers are operating in areas currently in insecure regions) would prove a challenge.

To achieve this, focus would be on the small scale and based on local and subsistence markets rather than larger commercial ones.

- Rehabilitation of Nyakabera in South Kivu;
- Capacity-Building of Government and IITA Extension Services;
- Grow demand for feed for better production, though localizing production is limited in the short to medium term;
- Consider 3 or 5 satellite hatcheries with the best farmers;
- Support training, though focus on training that is fit for purpose (likely regionally sourced, or through IITA in the absence of other viable training locally).

These latter interventions, however, would not be applying the principles of market systems development and might not be in line with the objectives of private sector development. For a PSD programme, it is therefore recommended to focus on medium to larger (pre-)commercially viable business models like the one featured by the Bukavu fisher association.

Kinshasa

Market systems development in the Kinshasa region should focus on improving the cold chain and / or market access, otherwise there may be limitations to growth under the current distribution model, while also supporting the emerging seed producers and providers. Collaboration between producers is advisable in importing good quality feed and achieving other efficiency gains to help them be competitive in the fish market. The supply of fingerlings is being partially addressed through IITA hatcheries, though as yet there is no national brood stock available. Hatcheries are therefore dependent upon imported seed (Belgian, Ugandan, Zambian). Establishment of a brood stock reference centre would enable new hatcheries to obtain brood stock of known origin and performance. Without this, each level of aquaculture production is vulnerable to low quality genetic material, and this can reinforce the likelihood of production being unprofitable.

Pond production: Focus on industry organisation and pooling of buying power and effective marketing, alongside basic hatchery capacity.

Tanganyika

The capacity of fish farming in Kalemie appears to be very sparse and would require pre-commercial investment (that is, investment that may not be possible through private sector funding alone). However, two clear entry points exist for its development – IITA presence (albeit non-aquaculture), and fisheries association links. The fisher association could be willing to expand their reach to Kalemie, though it would face challenges in terms of adequate knowledge transfer between groups, which would likely need to be extensive. IITA have been working in Kalemie for 1.5 years, though in agriculture only. Nevertheless, the capacity in South Kivu could support initial Kalemie developments.

Wild caught fish is dried and smoked and in strong demand – as in other regions the fisheries marketing channels should adequately take up aquaculture product in this take-off period of the sector's development in Tanganyika.

Supporting the emergence of aquaculture production in Tanganyika would not be a quick win but the South Kivu entry points, viability of imports, and existing market for fish should provide a basis for production in the same manner as in Bukavu.

Bibliography

Agbebi, F., Kibogo, A., Ngirinshuti, L. and Mindje, M. (2016) Contribution of Women to Aquaculture Development in Rwanda. IIFET 2016 Scotland Conference Proceedings.

Brenton et al (2011) Facilitating Cross-Border Trade between the DRC and Neighbors in the Great Lakes Region of Africa: Improving Conditions for Poor Traders [online]. Available at: http://documen ts.worldbank.org/curated/en/358501468192868232/Facilitating-cross-border-trade-between-the-DRC-and-neighbors-in-the-Great-Lakes-region-of-Africa-improving-conditions-for-poor-traders

Breuil, C. and Grima, D. (2014) Baseline Report DR Congo. SmartFish Programme of the Indian Ocean Commission, Fisheries Management FAO component, Ebene, Mauritius.

Dong, H.T., Ataguba, G.A., Khunrae, P., Rattanarojpong, T. and Senapin, S. (2017) Evidence of TiLV infection in tilapia hatcheries from 2012 to 2017 reveals probable global spread of the disease, *Aquaculture* 479: 579 – 583.

FAO (2018) Democratic Republic of the Congo: Situation Report October 2018. Available at: http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/1156574/

FAO (2017) Eliminating Child Labour in Fisheries and Aquaculture: Promoting Decent Work and Sustainable Fish Value Chains [online]. Available at: http://www.fao.org/3/CA0177EN/ca0177en.pdf

FAO FishStat (2011) La République Démocratique Du Congo [online]. Available at: http://www.fao.org/fishery/facp/COD/fr

Farm Africa (2016) Gender Impact Study of the Kenya Market-led Aquaculture Program, Nairobi.

IITA & WorldFish (2018) Technical, Socio-economic and Environmental Situation of Fish Farming Activities in South Kivu/Eastern DR Congo: A Baseline Survey Report.

IMF (2013) Democratic Republic of the Congo: Poverty Reduction Strategy Paper. IMF country report No. 13/226, July 2013.

International Alert (2016) Through the Citizen Lens: Local Involvement in the Management of Public Affairs: Lessons learned from the Tufaidike Wote project about the relationship between social cohesion and social accountability in eastern Democratic Republic of Congo, December 2016.

Kinkela et al (2017) Diversity of farming systems integrating fish pond aquaculture in the province of Kinshasa in the Democratic Republic of the Congo, *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 118(1): 149–160.

Kurien J. and Lopez Rios, J. (2013) Fisheries and Food Security in the ESA-IO Region, *DRC Country Brief*, IOC-SmartFish Programme, FAO.

Micha, J. (2013) Fish Farming in the Congo Basin: Past, Present & Future, conference paper presented at the International Conference on Nutrition and Food Production in the Congo Basin.

Mwanabiningo, N.M. (2015) Deriving Maximum Benefit from Small-Scale Cross-Border Trade Between DRC & Rwanda. Research paper commissioned by International Alert, Pro-Femmes, Twese Hamwe and TradeMark East Africa.

Petit, P. and Shipton, T. (2012) IUU Fishing on Lake Tanganyika. SF/2012/15. IOC-SmartFish

Samndong, R.A. and Nhantumbo, I. (2015) Natural Resources Governance in the Democratic Republic of Congo: Breaking sector walls for sustainable land use investment. IIED country report, February 2015.

Van der Knaap, M., Katonda, K.I. and De Graaf, G.J. (2014) Lake Tanganyika fisheries frame survey analysis: Assessment of the options for management of the fisheries of Lake Tanganyika, *Aquatic Ecosystem Health & Management*, 17(1): 4–13.

A. Terms of Reference

1. Background

1.1. Context and rationale

DFID DRC has expressed an interest in supporting the aquaculture sector in DRC, believing that there is a potential to reduce poverty and improve nutrition for the poor. From a resource perspective, DRC has a certain potential to support an aquaculture industry, as its territory covers approximately 50% of Africa's freshwater resources. The aquaculture sector has the potential to provide both income to fish farmers and strengthen the supply of a nutritious food source for the country. This latter point is of particular import as the World Food Programme estimates that 7.7 million people, approximately 10% of the country's population, is food insecure. This figure rose by 30% in the last year and is complemented by a high incidence of nutrition insecurity.

As the first step, DFID DRC wishes to commission a rapid review of the aquaculture sector in DRC to understand its structure and dynamics. The findings of this review will be used to inform a more in-depth study into the main constraints for aquaculture sector growth.

1.2. Audience and the use of findings

The principal audience of this research is DFID DRC, which funds a £100m Private Sector Development programme in DRC, and may use the findings to inform future phases of the programme or its component projects. The existing programme's two main component projects – ELAN and Essor – may also use the findings of the study to inform adaptations to their existing implementation approaches. This research study (Phase 1) can be used as an initial study to see if it is worth undertaking a more comprehensive study in 2019 (Phase 2). The findings may also be of interest to other donors and practitioners that are considering how to better support a sector that appears to have strong potential for development which could help the poor and alleviate poverty.

2. Definition of Scope

2.1. Objectives

The purpose of this initial research study (Phase 1) is to perform **a rapid assessment of the aquaculture sector in DRC to better understand its structure and dynamics**. This assessment will provide the basis to decide if there is a potential for DFID to support the sector with a view on both reducing poverty and improving nutrition among the poor population in the country. The study will look at the whole country, but an in-depth look will be given into the three provinces of North and South Kivu and Tanganyika. If the sector is seen as potential, a more in-depth study (Phase 2) will be performed to better understand key constraints and leverage points and develop recommendations for interventions.

2.2. Research questions

Phase 1 of the research study will attempt to answer the following research questions (RQs):

- What are the **structure of and main product flows** in the aquaculture value chain in DRC (including import and export of aquaculture product, particularly imports coming from Asia)? How are they distributed geographically? What are the supply and demand conditions in the sector and where are gaps between demand and supply? What is the connection with the fisheries sector and what part of the current flow of relevant products are from the wild catch?

- What **rules, regulations, norms and customs** are relevant for the sector? What are the main governance and business enabling environment issues?
- Who are the **main actors** in the sector? What are the relationships between the actors? How is power distributed?
- What are the **situation and role of poor people** in the sector – both as producers and consumers? What is the role and status of women in the sector? What is the role of youth and other vulnerable people?
- What are **competitive advantages and disadvantages** of the sector (the analysis can compare different regions in DRC or the whole of DRC with neighbouring countries, depending on where competition mainly happens)?
- What are the **current dynamics in and the development trajectory** of the sector? How has the sector changed over recent years, both in terms of structures and flows as well as actors and relationships? What are likely trajectories for the sector in the near future?
- What are likely **environmental implications** of a growing aquaculture sector – both in terms of land use, water pollution, as well as import and cultivation of potentially invasive species and the connected risks.

While these RQs are quite comprehensive, it is not the aim of the rapid assessment to answer them in great detail. Rather, it is the aim to get an initial understanding of the areas outlined in the RQs and know where knowledge and data about the sector are available and reliable and where there are gaps.

B. Literature

Core reading

IITA & WorldFish South Kivu Baseline Report (2018)	Recent & informative breakdown of small-scale pond systems in South Kivu including technical, social & environmental considerations.
Smartfish DRC Country Review (2014)	High level overview of fisheries & aquaculture in the DRC. Based heavily on most recent though still somewhat outdated FAO statistics.
IMF DRC Poverty Reduction Strategy Paper (2013)	Useful context for understanding how aquaculture & fisheries might fit into the broader poverty reduction strategy of the country.

Useful Reading

Study on the Potential of Aquaculture in ACP countries (2018)	Stirling Institute of Aquaculture report into ACP country aquaculture potential, containing fundamental considerations for developing the sector.
Fish Farming in the Congo Basin (Micha 2013)	Academic paper exploring historical context and regional trends.
Small-Scale Cross-Border Trade (Mwanabiningo 2015)	NGO-commissioned research paper exploring potential of CBT between Rwanda & DRC. Useful insights on opportunities & challenges of cross-border fish trade, particularly relating to gender.
Fish pond aquaculture in Kinshasa (Kinkela et al 2017)	Academic journal article - data on fish farming practices in and around Kinshasa and their alignment with other forms of agricultural production.
Natural Resources Governance in the DRC (Samndong & Nhantumbo 2015)	IIED country report providing useful context on natural resource governance issues such as land tenure and rights, and environmental law.
Women in Aquaculture - Rwanda (Agbebi et al 2016)	Overview of female empowerment and effective integration into aquaculture production in Rwanda – relevant learning for DRC.
Kenyan Aquaculture Gender Impact Study (Farm Africa 2016)	Study into traditional and cultural barriers to women's involvement in aquaculture. Useful learning with relevance to DRC context.
DRC Aquaculture Development Strategy (2012)	Basic aquaculture strategy, not comprehensive or funded but useful as a baseline of capacity under current structures. Cited by SENAQUA in South Kivu, no further information on authorship.

C. Description of Fieldwork

Field work took place between Sunday 2nd December and Wednesday 12th, with additional phone consultation in advance and following the trip. Andrew Parker and Abudala Napuru travelled via Rwanda, meeting consultees on the Rwanda side of Lake Kivu. Abudala's knowledge of Ugandan aquaculture and its DRC links, along with work on a previous DRC study, were also used to contextualise findings.

Field work in South and North Kivu was undertaken by Andrew, Abudala and Arlette Nyembo. Access to farming areas around Bukavu was considered secure and viable. Access to some areas cited in interviews for Goma (e.g. nr Masisi) would have been within areas of insecurity.

Field work in Kinshasa was undertaken by Abudala and Arlette. Due to flight constraints and initial findings from South Kivu consultees, Kalemie consultees were contacted remotely as the most effective use of time.

D. Interview Guide

Overview of the sector:

- Can you tell me about your work?
- Based on what you've said, what are the **top three factors** affecting the development of aquaculture in DRC? (+ and -)

Where and with whom they are working. Suppliers? Processors? Local, regional, national… Who do they supply? What's their main outlet? Is this regular or intermittent? Capturing changes over time.

Production:

- Is it possible to reliably produce the requisite quantity and quality (e.g. of fingerlings, of food, of fish, pond construction materials) at a reasonable cost?
- If not, why not - what are the main barriers? (e.g. lack of quality inputs, theft from fish ponds)
- How could these barriers be overcome?
- What are the current dynamics in the local economy? E.g. is there a ban on export / import? Is there competition locally or across the border?
- Factors affecting involvement of women, youth & vulnerable in production?
- Do you have access to extension services to help improve production?

Market:

- Is there a market for the outputs? (What is the overlap with the fisheries sector?)
- What kind of consumers? Income levels? Attitudes to the product & substitutes?
- Is market access possible? What are the barriers? (e.g. are there any important cultural or political intermediaries?)
- What are the current market demands/trends – local, domestic and export – for what's being produced? (Asian imports? Influence on domestic market?)
- What are the causes of variation in supply and demand? e.g. seasonal (are there perhaps seasonal lulls in wild catch that present opportunities for farmed?)
- Are there constraints to marketing of the product for local producers?
- Opportunities or constraints for women, youth & vulnerable both to market and as consumers
- Are there policy constraints to market access (e.g. not pro-poor?)
- Who are the primary decision makers and champions of change?

Logistical:

- Where are inputs currently sourced from? If imported, are there any barriers? (e.g. disease control)
- Can any relevant inputs be sourced in the local economy? (e.g. feed, fingerlings, pond liner)
- Is it possible to get outputs to in-country markets - both large urban & small village? (cost, timeliness, cold chain etc)
- What is the condition of infrastructure such as trunk and rural access roads?
- What are the infrastructural/logisitcal risks? (e.g. security)

Operational:

- Can fish farms, feed plants, hatcheries etc effectively manage operations (e.g. overcome electricity constraints)?
- What are management challenges? (e.g. necessary workforce)
- What are the regulatory requirements on health and safety in the work place?
- What skills are needed and what could be done about this?

Financial and Investment:

- Is the aquaculture sector in general financially sustainable?
- Where does financial capital come from? (i.e. who is investing?)
- Is there access to finance locally? What about high interest rates? Long term growth?
- Are there any significant barriers to accessing finance?
- What are typical mark-ups to ensure profitability?

- Do input prices vary a lot (e.g. maybe due to exchange rate fluctuations)

Growth:

- Can production be scaled-up?
- How should the upscaling be conducted?
- What are the barriers to scale-up production?
- What are the prospects for growth?
- What could be done to address the barriers?
- What are the opportunities to grow?

Market System:

- Is there a risk or added cost from having to make extra or unexpected payments?
- Are these security risks to consider?
- Are there any risks to personal safety? If so, when/how do these arise?

Would you now change your responses on the 3 most significant factors?