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National food safety control systems in Sub-Saharan Africa: Does Uganda's aquaculture control system meet international requirements

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ABSTRACT

Stringent food safety requirements set by developed country markets, which require exporting countries to establish effective national food control systems (NFCS) that guarantee safety of the products to the market, pose a challenge to Sub-Saharan countries in development of aquaculture products as alternative exports following the decline of capture fisheries. In the study, four components of Uganda's NFCS including legislation, competent authority, inspection services, and laboratory services were evaluated for compliance with FAO/WHO, European Union (EU), and the United States (US) market recommendations for guaranteeing aquaculture product safety. Using a checklist, component elements were benchmarked and scored, and components ranked for compliance with the recommendations. On a scale of 0–5, where 0 denotes none, 1 very low, 2 low, 3 some, 4 almost total, and 5 full compliance, only laboratory services had a barely acceptable score of 3.3 (some compliance). The rest including legislation which is central in setting the level of controls by the other three components scored below three, and the combined score for all components was only 2.2, indicating that Uganda's NFCS was still short of the requirements to allow entrepreneurs to access markets in the EU and other developed countries. The low score is partly attributed to the dynamics of this country's fledgling aquaculture industry and the rapidly evolving food safety requirements in the international markets.

Introduction

The last two decades have seen a general increase in the trade of fish and other high valued food commodities from developing countries to industrialised countries where they are in high demand and can fetch premium prices (Jaffee and Henson, 2004). Such increase in trade has led fish exports in some Sub-Saharan countries to overtake traditional tropical cash crops such as coffee, cotton, tobacco, cocoa, palm oil, and rubber which previously dominated the African exports (Jaffee, 2004; Ponte et al., 2007). The increased demand for fish by the industrialised countries, which cannot be satisfied by the dwindling wild stocks worldwide (FAO, 2004, 2007), provides an opportunity for Sub-Saharan countries to learn from their Asian counterparts in developing an aquaculture industry to maintain or even increase their fish export revenues. However, the desire to develop such an aquaculture industry for export in developing countries requires attention to food safety concerns of consumers in the importing countries. This is because of an increased awareness of emerging and re-emergence of food-borne hazards around the world due to the rapidly changing technologies for food production, processing and marketing; the fear that some technologies could introduce food hazards in the food chain; and an actual increase in reported food borne illnesses (Mitchell, 2003). African countries stand to be most affected by these policies since food safety has not been a major factor to date for domestic trade, yet other nations selling aquaculture raised fish are aware of many of the standards and have already developed policies to respond to these (Hanak et al., 2002; Henson et al., 2000; Unnevehr and Roberts, 2003), especially for the EU and the US which are the major markets for African fishery products (Ponte et al., 2007). Following the Uruguay round of negotiations (1986–1994) and the signing of the General Agreement on Tariff and Trade (GATT) that established the World Trade Organization (WTO) in January 1995, many tariffs that characterised international trade were removed (Asche and Khatum, 2006; Croome, 1995). However, the policies introduced through both the WTO Sanitary and Phyto Sanitary (SPS), and Technical Barriers to Trade (TBT) agreements are potentially new trade barriers to especially developing countries that cannot easily meet their requirements (Pinstrup-Andersen, 2002). These sanitary measures and standards are seen to be used by trading blocks, especially the EU and US, as

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unjustifiably imposed export bans or import restrictions on developing countries' fishery products and sometimes disguised as a means for protecting local producers (Muhammad, 2006). Additionally, apart from being trade barriers, there are other consequences of standards imposed by developed countries on developing countries as conditions for trade, where the country's meagre resources are allocated to achievement of the requirements for the export markets with lack of attention to the safety and quality of the locally consumed products (Donovan et al., 2000).

In Uganda, the negative effects of food safety measures and standards were felt when the EU, which dominates Uganda's fish exports (Muhammad, 2006), imposed three successive fish export bans in the period 1997–2000 for fish caught in lake Victoria due to allegations related to a cholera outbreak, Salmonella contamination of fish products and harvesting of fish through poisoning of the water (Balagadde, 2002; Ponte, 2005; UNIDO, 2003). Despite the claims by the EU that the fish from Uganda were unsafe, there was no scientific evidence that this was true (Ponte, 2005). Instead, the perceived poor performance of Uganda's regulatory and monitoring system for capture fish was used to justify the ban (Ponte, 2005; Ponte et al., 2007). The ban was lifted by the EU in 2000 after the Ugandan government developed the necessary regulations, with appropriate inspection systems and testing laboratories (Ponte, 2005). As a result of these export bans, the capture fish industry declined in terms of volume sold and revenue generated with an estimated loss of US$ 36.9 million (Marriot et al., 2004) (Table 1).

The bans on Uganda's exports also affected neighbouring countries, Kenya and Tanzania that share Lake Victoria where most of the Ugandan exported fish came from. The EU's allegations for Kenya and Tanzania mainly pointed to: poor procedures for approving fish processing plants exporting to the EU; methods of issuing health certificates for individual export consignments; overall hygiene standards; and the possibility of fishing through poisoning in Lake Victoria (Henson et al., 2000).

Although Uganda's inspection, monitoring and control systems have progressively met the minimum requirements for fish trade with the EU and the US, improved controls for fish exports has only occurred for products from the wild but not aquaculture (Ponte, 2005). In order to access prime markets for aquaculture products, Uganda and Sub-Saharan countries would require to develop an effective official National Food Control System (NFCS) that is in line with international guidelines for ensuring efficient quality and safety monitoring and controls for aquaculture facilities and practices.

The components of the national food control systems may vary from country to country depending on their unique situations and potential sources of food hazards in the value chain (FAO/WHO, 2003). However, an analysis of the EU and US regulations indicates that essentially there should be four components to an effective oversight system: food laws and regulations (legislation); national food control management, inspection services; and laboratory testing services. In addition, there should be a national process aimed at imparting knowledge and skills to key players in food safety control and management through education and training, and exchanging relevant food safety information by communication with the relevant stakeholders; this can be considered as a fifth cross-cutting component (FAO/WHO, 2003; SFI, 2003; Jukes, 2003; Vytelingum, 2003).

Table 1
Impact of EU fish export ban on Ugandan economy for period April–August 1999.

Losses	Figures
Export earnings	US$ 36, 900,000
Income of fishermen community (US$ 850,000 per month) due to reduced prices and fishing activities	US$ 4250,000
Factories that closed down	3 out of 11
Factories that reduced their labour force by 2/3	8 out of 11
Jobs lost in fish factories (1/3)	2000
Jobs lost in fishing activities (1/3)	32,000
Persons that lost 2/3 of their income	68,000
Affected family members and relatives living on the same income	300,000

Source: UNIDO, 2003.

The EU has adopted the most comprehensive food safety control system in the world with the most stringent legislation and regulation towards food safety (Lupin, 2000). The EC regulation No. 178/2002 identifies the objectives of a good food law, and EC regulations No. 854/2004 and No. 882/2004 give conditions required for effective national food control management, inspection services, and the need for laboratory testing services. To some extent the US HACCP regulations and the Bioterrorism Act of 2002 (Weick, 2006) also put restrictions on how food should be imported to that country.

It is also important that a national legislative body develops the capacity for coordination of food safety policies with an operational arm of an appropriate authority to foresee the food safety control function. This authority should have an effective leadership for its administration with clearly defined accountability mechanisms to the legislative body (Mutukumira and Jukes, 2003). A national level government institution, agency, or department typically is nominated as competent authority (CA) to oversee these functions (Mutukumira and Jukes, 2003; Goulding and Porto, 2006).

The specific details of requirements for national inspection services applied to fish and aquaculture products in the EU market are laid down in the EC manual of inspection for fish and fishery products (Goulding and Porto, 2006), while for the US market, requirements for inspection are covered in the procedures for HACCP inspection of seafood and aquaculture contained in US Federal Code of Regulations CFR 123 section 21 (US FDA, 1995). Both the EU and the US markets have set maximum residue limits for potential contaminants of fish and aquaculture products, and the regulations require food control management to depend on reliable laboratory testing services which should be coordinated with a monitoring programme, necessary for providing information and intelligence on the sources and presence of hazards in fish and aquaculture products (Mutukumura and Jukes, 2003).

The objective of this paper is to assess the compliance of Uganda's official national food control system with international requirements for guaranteeing the safety of aquaculture products to the markets.

Status of fish industry in Uganda and importance of aquaculture

Uganda's oversight system for fish products is through the Department of Fisheries Resources (DFR) in the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF). The country's fish exports have grown in weight and value from 4751 tonnes worth US$ 5.308 million in 1991, to the highest level of 36, 614 tonnes worth US$ 143.6 million in 2006. This growth made fish exports the second largest source of export revenue. Save for the decline in fish export revenues due to export bans that occurred in period 1997–2000, Uganda's earnings from fish exports had been on the increase until 2006 when another remarkable and steady decline in fish exports occurred (Table 2).

This recent decline is more attributed to the dwindling stocks and diminishing quantities of landed fish from Lake Victoria and other Ugandan lakes, especially the economically viable species – Nile perch and Nile tilapia which constitute fish exports rather than bans by importing countries (Muhoozi et al., 2008).

Table 2
Uganda annual capture fish exports from 1991 to 2007.

Year	Total fish landed (000 MT)	International (MT)	Value (000 US$)
1991	219.57	4751.00	5308.70
1992	224.10	4831.00	6450.50
1993	224.35	6037.10	8806.90
1994	218.94	6563.00	14, 768.90
1995	227.00	12,970.90	25,902.80
1996	218.40	16,396.40	39,780.90
1997	218.40	9839.00	28,800.00
1998	217.10	13,805.25	34,920.79
1999	229.51	13,379.98	36,608.30
2000	219.50	15,876.38	34,363.14
2001	220.72	28,672.17	80,398.47
2002	221.89	25,169.14	87,574.36
2003	241.81	25,111.60	86,343.28
2004	434.753	30,057.46	102,917.25
2005	416.757	36,614.80	143,618.24
2006	367.174	32,855.47	136,850.87
2007	374.485	28,394.27	117,364.07

Source: Department of Fisheries Resources statistics (2008).

Table 3
Profitability of Aquaculture in Uganda: gross margin of poly-culture of African catfish and tilapia on a commercial pond 3200 m^2 pond.

Poly-culture of 9600 Catfish + 6400 Nile Tilapia		Values (Ug. Shs)[a]
Revenue		
	Yield (kg) after 8 months	12,160
	Unit price	1500
Total revenue		18,240,000
Costs		
	Pond construction (30 years life span)	102,250
	Fish seed (fry/fingerlings)	3,192,000
	Organic feeds/fertilizers	48,000
	Supplementary feeds	10,944,000
	Labour (technical)	2,000,000
	Labour (un skilled)	480,000
Total costs		16,766,250
Gross margin		1473,000

Source: Nyombi and Bolwig (2004).
[a] Conversion factors from US Dollar and Euro to Uganda shilling in 2004 were 1800 and 2200, respectively.

Prior to 2006 Uganda had 17 fish factories in operation which exported Nile perch (over 80%) and Nile tilapia (20%) in various forms of products including fresh and frozen fillets, whole fish, head and gutted fish, fish portions, nuggets, processed fish skins, and bladders. About 60% of fishery products were fresh fillets or head and gutted whole fish, and 40% were processed into other products. The major destinations for fish and fishery products being Europe (73%), United States (7%), United Arab Emirates (6%), Australia (3%), Japan (2%), Hong Kong (2%), Singapore (1%), Israel (1%), Kenya (1%), and other 22 countries in Asia and Africa (6%) (MTTI, 2006). By 2008, the number of fish factories had reduced to 11 following the closure of six factories due to lack of sufficient raw material fish (DFR, 2008). The economic effect of reduced fish landings was felt by factories over the time with most factories progressively cutting the production volumes and operating below capacity. However, the main effect was experienced in 2007 when the fish landings dropped markedly resulting in closure of some of the processing factories with a loss of US$ 60 million in 2008, affecting whole communities in the Lake Victoria region (DFR, 2008).

In 2004, aquaculture was identified and promoted by the Ugandan government as viable for processing and therefore could be a feasible alternative source of raw material fish for export industry amidst the declining fish catches. Because of this, fish production from aquaculture has increased in the recent years. Official reports estimate aquaculture production in 2007 at 50,000 tonnes, and the number of fish farmers at 21,000 (DFR, 2008). However, these figures may not be too accurate because of the limited nature of the studies regarding the on-farm production (MAAIF/PMA, 2006; MTTI, 2006). The Ugandan operations may typically be considered small scale subsistence units (Jagger and Pender, 2001), but more recently there are over 500 farmers operating an estimated 4000 commercial ponds of sizes above 500 m^2, stocked in densities ranging between 4 and 20 fish per sq. m. (Bagumire et al., 2008; MAAIF/PMA, 2006). The fish farmers have focused on the production of two species – Nile tilapia (*Oreochromis Niloticus*) (20%) and African catfish (*Clarias gariepinus*) (80%). Farming for the Nile perch, being more difficult to cultivate, is probably several decades away (MTTI, 2006; Nyombi and Bolwig, 2004; MAAIF/PMA, 2006). Opportunities for exporting aquaculture require intensifying production of Nile tilapia which already has an overseas market generated by the fish companies utilizing the capture fish product. This species does well in aquaculture both in Uganda and most other Sub-Saharan countries. Ugandan producers could also increase export opportunities by exploring market in Europe, including prime markets for African Catfish, which is also widely produced in Uganda. Given the collapsing wild catches, Nile Tilapia and the African Catfish are the main realistic options for supporting fish industry operations in this country. The profitability of poly-culture of African catfish and Nile tilapia farming in Uganda was evaluated by Nyombi and Bolwig (2004) (Table 3).

From the table, more than 10% of the capital invested was reported as the profit margin for the first year of aquaculture investment using data provided by MAAIF (2003). Given that there has been substantial increase in prices of fish on both the domestic and international markets, doubling from the time the evaluation was done 5 years ago, profit margins could be much higher today considering the current annual inflation rate of 14%. Since maintenance of the pond infrastructure and other fixed assets has little or no expenditure in the subsequent years after investment, aquaculture remains one of the most economically viable enterprises in Uganda.

The opportunities in Uganda's aquaculture sector has attracted new foreign direct investments, some of which are already being undertaken and others planned with government targeting annual production of up to 150,000 metric tonnes of fish by the year 2011, of which 15,000 tonnes is expected to be exported to prime markets abroad (DFR, 2008). Basing on the current world prices, the projected quantity of fish would be valued at over US$ 70 million and if this ambitious goal is to be achieved, Uganda may need to invest in institutional mechanisms that ensure that the farmed fish meet international standards for food safety. Any laxity in achieving food safety controls could jeopardize the livelihoods of an estimated 200,000 people currently benefiting from aquaculture (DFR, 2008), and thus posing a serious setback for this new direction of Uganda's fish industry. Thus, there is an urgent need to assess the government capacity and oversight roles for food safety by the DFR, as well as the status of food safety programmes by existing aquaculture farms in Uganda to explore how well they meet the goals of the export markets, particularly those in Europe and the US.

Methods and materials

Research design and instruments

A detailed checklist of the ideal conditions for a national food control system for guaranteeing safety of aquaculture products was developed from the existing FAO/WHO (2003) Guidelines for Strengthening of National Food Control Systems (NFCS) and the

EU Regulations on Official Food Controls (EC Reg. Nos. 178/2002; 854/2004; 882/2004). The checklist was also developed by considering the key requirements for the import of fish and fishery products to the US as stipulated in the US Code of Federal Regulations (CFR) 21, Section 123 which sets forth specific regulations for sanitary processing and importation of fish and fishery products (US FDA, 1995). The checklist contained conditions for appropriate food legislation, competent authority for control and management of food safety, inspection services, and laboratory testing services. Conditions specific for aquaculture production legislation, inspection and monitoring were obtained from FAO/WHO Codex Alimentarius Commission – CAC (2005) Code of Good Hygiene Practices for Aquaculture Products and other manuals and guidelines that incorporate EU and US market requirements for fish and aquaculture products (Helder da Silva, 2006; US FDA, 2001). A checklist for control points and criteria for compliance with integrated aquaculture assurance (EurepGAP (2005) (now Global GAP), was another source of information. From these data bases, nine elements were used to evaluate the legislation component, five for the competent authority, 32 for inspection services, and three for availability of qualified laboratory testing services. The number of elements used for each component depended on the recommendations of the requirements in the data bases. For each element, evaluation criteria and recommended conditions (RC) were included in the checklist.

Data collection

Given that most of the elements of the national food control system for aquaculture in Uganda reside in the Department of Fisheries Resources (DFR), in the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) which is the competent authority (CA) on matters of fish and aquaculture products, this study considered DFR as the key respondent institution. Meetings were scheduled with the head of DFR and staff of the two units in DFR responsible for implementing the food control policy including inspection of aquaculture operators and fish processors and ensuring that the residue monitoring programme for aquaculture products is implemented. The head of the CA was selected to provide information on the general overview of the organization, extent of official controls for aquaculture products, existing challenges, gaps in official controls, and the planned strategies to fill these gaps. The Quality Assurance Unit staffs, who together with the Aquaculture Unit staff were implementing the official food control for aquaculture products, were selected on the basis of their experience in monitoring control activities for export of capture fishery products that had been successfully exported to several countries including the EU, US, Japan and Australia. In separate meetings, question and answer sessions were conducted with six staff of this unit, and all the five staffs of the Aquaculture Unit where the state of the elements for the components of the NFCS for aquaculture products in Uganda were explained by the inspectors and scored by comparison with the ideal conditions for the elements (recommended by international markets) already detailed in the checklist. The scoring was carried out by two individuals who had acquired relevant training and experience in aquaculture and food safety assurance, and the use of the checklist. They awarded scores to the elements after understanding the state or conditions of the elements for the components of NFCS in Uganda as compared to the ideal conditions in the checklists. A scale of scores from 0 to 5 was adopted for recommended conditions in the checklist, where five denoted full compliance and 0 total none compliance. Degrees of partial compliance were also categorized based on state of the elements that were evaluated (4: almost totally compliant; 3: some compliance; 2: low compliance, and 1: very low compliance). This ranking helped to determine how close or far each element was to meet full compliance with the ideal conditions given in the checklist. After going through the checklist, with the staff, the two people who were scoring met to harmonise their scores into one set of results in the checklist. In cases where consensus was not reached, the average of the two scores for the element in question was used. To minimise the effect of possible bias on the part of CA staff that could be potentially impacted by the result of the evaluation, the responses provided by the staff were cross-checked with other sources and scores adjusted accordingly. The information was cross-checked by holding focussed discussions with other stakeholders including relevant members of the academia (2 in number), representatives of fish processors (2) and fish farmers (2), officials from independent laboratories (1), and private practitioners such as consultants that had been involved in related activities with CA (2). Also independent review of the food safety control and inspection reports available at the CA, independent laboratories and some aquaculture (3 in number) and fish processing establishments (1) as well as available official documents such as the National Fish Policy, National Fisheries Sector Strategic Plan, The Fish (Quality Assurance) Rules 2008, The Fish (Aquaculture) Rules 2003, the Manual of Standard Operating Procedures (SOPs) for Fish Inspection and Quality Assurance (MAAIF/DFR, 2008), and the Manual of SOPs for Inspection of Aquaculture Establishments and Production Practices (MAAIF/DFR, 2006) was carried out. Published research work from an independent study with relevant information on the operation of food controls in fisheries sector in Uganda (Ponte, 2005) was also consulted.

The scores in the two checklists that were based on information provided by both aquaculture and quality assurance staff were integrated into one set of results by determining the average of score for each of the elements.

The final scores of the recommended conditions for each of the element were summed and average of the scores was determined to be the compliance score of the element. The scores for the elements used to evaluate each of the components of national food control system were also summed and average determined to be the compliance score of the component. To determine the compliance of the entire national food control system, the scores obtained for each of the components were summed and average obtained as the overall score of compliance for the national food control system for aquaculture in Uganda.

Results and discussion

Compliance of the legislation for aquaculture with the international recommendations

Out of the nine elements of food law that were evaluated, the aquaculture legislation in Uganda (The Fish (Aquaculture) Rules 2003) was found to be in full compliance (score = 5) with none (Table 4). Only two exceptional elements of legislation, which do not have direct and immediate effect on the health of the consumers: "Promotion of fair practices in food trade" and "Transparency and public consultation during development of the rules" obtained average scores above three implying some compliance. The rest of the elements that were evaluated had average scores below two, denoting low compliance. This shows that generally the Ugandan aquaculture legislation did not fully integrate the international principles of good food law. The implication is that enforcement of the legislation in its current form may not assure safety of the products at the level of protection envisaged by international recommendations. Most of elements of legislation that have immediate and direct effect on the health of consumers obtained very low scores. For instance the element of public information, where the law is expected to have provisions for the CA to provide the public with information regarding risk associated with aquaculture

Table 4
Compliance of aquaculture legislation with requirements of good food law.

Element evaluated (EE)	Number of recommended conditions (RC) used	Number of recommended conditions where compliance score is zero (%)	Number of RC where compliance score is between 1 and 3 (%)	Number RCs where compliance score 4 or 5 (%)	Over all average score
Food safety and quality responsibilities	2	1(50)	1(50)	0(0)	1.5
Protection of human life and health	39	22(56)	10(26)	7(18)	1.4
Protection of consumers' interests	10	2(20)	7(70)	1(10)	1.1
Protection of animal and environment	3	2(67)	0(0)	1(33)	1.7
Promotion of fair practices in food trade	3	1(33)	0(0)	2(67)	3.3
Ensuring effective risk analysis	13	10(76)	2(15)	0(0)	0.4
Precautionary measures to protect health of consumers in times of scientific uncertainty	5	3(60)	2(40)	0(0)	1.0
Transparency and public consultation during development of the rules	7	2(29)	0(0)	5(71)	3.3
Public information	1	1(100)	0(0)	0(0)	0

products had all the recommended conditions (100%) scoring zero indicating total non compliance. The element where the legislation should be based on risk analysis had an average score of 0.4, and that on precautionary measures had score of 1.0. This could be partly explained by the fact that the Fish (Aquaculture) Rules of 2003 were developed at the time when Uganda had not anticipated exporting aquaculture products to markets in developed countries where risk-based legislations are emphasised. Most of the provisions included in the aquaculture legislation at that time were aimed at increasing production of aquaculture products and were largely targeting local market. Moreover, at the time the rules were developed, the new regulatory system in the markets that are currently being targeted, especially the EU which emphasise risk analysis in the entire food chain from farm to table, had not come into force.

Uganda like many other countries of the world, has adopted a legal system where the main food legislation does not necessarily contain the details of the practices and health conditions to be complied with by stakeholders in the food industry, but general regulatory directions and a clause that empowers responsible duty bearers to issue specific guidelines which contain the details (FAO/WHO, 2003; Goulding and Porto, 2006). Such clauses exist in The Fish (Aquaculture) Rules (2003) where the head of CA is empowered to issue guidelines for aquaculture. On the basis of such clause a Manual of Standard Operating Procedures (SOPs) for Inspection and Verification of Aquaculture Establishments (MAAIF/DFR, 2006) was developed incorporating some risk-based food safety requirements, but these in away contradict the legislation on which they are based, since the objective of The Fish (Aquaculture) Rules 2003 was not to ensure food safety but increased aquaculture production.

Another related issue of interest to legislation, but which falls outside the scope of this investigation, is that neither Fish (Aquaculture) Rules of 2003, nor the SOPs cover other crucial issues which impact on animal health (diseases and infections), animal welfare and environmental safety, which are also of interest to current international trade of food products from aquaculture. It is worth considering these issues when developing legislation and code of good practices since they form part of the sanitary measures covered by international regulatory system for trade in animal food products, and are therefore equally important for access of aquaculture products to international markets (Jahncke et al., 2002).

Compliance of competent authority for aquaculture products with international requirements

Except for one element "CA's empowerment" which scored five (full compliance), the rest of the elements evaluated for CA had average scores below three (Table 5) indicating that generally the CA did not meet requirements for guaranteeing safety of aquaculture products. The worst performing elements were: the organization of CA which had average score of zero (0); general obligations of CA regarding the official controls which had score of 1.5, delegation of specific tasks related to CA (1.5), and ensuring that the CA fulfils its mandated responsibilities (2.3).

The best performance for the CA's empowerment was because of the powers drawn from the basic Ugandan legislation (Fish Act, 1964) which gives the mandate of controlling fish production and post-harvest fisheries activities to the Department of Fisheries Resources (DFR) – the CA, with directions for enforcement of the Act's provisions laid out. These powers have already been used in carrying out official controls for fishery products from capture sources and can be drawn to control aquaculture as well. The CA's organization was not in compliance because the organization structure of the official controls conducted by the CA was lacking in the legislation as required by international guidelines (Goulding and Porto, 2006). This requirement is meant to ensure that the CA structure is not arbitrarily changed as and when it fits the purpose of administrative decisions. It also helps the CA to adhere to the rules by conforming to the requirements of the law. The details of organization of controls like sampling and testing, registration

Table 5
Compliance of CA for aquaculture products with international guidelines.

Evaluated Element	Number of recommended conditions (RC) used	Number of RCs that scored zero (%)	Number of RCs where score = 1–3 (%)	Number of RC where score = 4–5 (%)	Overall average score
CA's legal empowerment	1	0(0)	0(0)	1(100)	5.0
Organization of the CA	1	1(100)	0(0)	0(0)	0
Responsibilities of the CA	46	8(13)	28(65)	10(22)	2.3
General obligation of CA with regard to organization of official controls	11	2(18)	8(73)	1(09)	1.5
Delegation of specific tasks related to official controls	15	5(33)	4(27)	6(40)	2.2

and approval of establishments and certification ought to be adequately described, and this was not the case in Uganda. The basic legislation (Fish Act) and/or the subsidiary (the Rules) would need to be reviewed to provide for the definition of the roles of DFR as a CA on matters of aquaculture products and lay out the organization and structure of all the official controls conducted for aquaculture products.

The anticipated designation of Local Government (LG) staff as aquaculture inspectors to control aquaculture activities under their jurisdictions was responsible for low scores regarding delegation of specific CA tasks. Since these LG staffs are not trained in food safety, they lack knowledge of food safety issues in aquaculture; have no easy access to facilities like laboratory, testing kits and up-to-date information that is available to the staff of central CA; and are not under direct control of the head of CA since they are recruited by their respective local governments. As such, the LG staff cannot be adequately relied upon to ensure effective aquaculture controls and should therefore not be directly responsible for official controls in commercial farms that aim to export to markets with strict regulatory systems like the EU.

Lack of infrastructure including vehicles, computers and related accessories, human resource especially adequately trained inspectors, and financial constraints in the execution of regular and effective controls, is a common deficiency blamed for failure of Uganda's CA to fulfil its obligations regarding official controls and ensuring it's mandated responsibilities, as has been the case with CAs in other Sub-Saharan Africa Countries (Jukes, 2003; Mutukumira and Jukes, 2003; Vytelingum, 2003). Since aquaculture products have not yet entered the export markets, their official controls may further suffer low priority in budgets as compared to capture fishery as the case has been in most Sub-Saharan countries, and this could further exacerbate the already bad situation. Authorities may need to know that for a country to enter global prime markets for aquaculture products especially in industrialised blocks like the EU and US, official controls have to be first demonstrated as a means of guaranteeing product safety.

Compliance of Inspection services with international requirements

Out of 32, 23 elements of the inspection services (71%) had their evaluation criteria with average score below three, four (13%) of which having average score of zero (total non-compliance) (Table 6) implying that generally the inspection services were not meeting international requirements. These four main deficient elements

Table 6
Compliance of inspection services for aquaculture against international recommendations.

Element evaluated	Number of recommended conditions (RC) used in evaluation	Number of RC that scored zero (%)	Number of RCs that scored 1–3 (%)	Number of RCs that scored 4–5 (%)	Overall average score
Staff performing official controls	36	8(22)	27(75)	1(03)	1.8
Transparency and confidentiality by CA	7	1(14)	5(72)	1(14)	2.0
Control and verification procedures applied by CA	19	6(32)	3(15)	10(53)	2.9
General plan and contingency plans for crisis management	13	13(100)	0(0)	0(0)	0
Appointments of official control personnel	3	1(33)	0(0)	2(67)	3.3
Power of enforcement of the legislation	3	0(0)	0(0)	3(100)	5.0
Registration of all aquaculture establishments	3	0(0)	1(33)	2(67)	3.7
Approval of feed and aquaculture establishments	1	0(0)	0(0)	1(100)	5
Approval of initial ground plans of aquaculture establishments	9	1(11)	6(67)	2(22)	1.7
National registration numbers listed on official lists of approval	3	2(67)	1(33)	0(0)	0.7
Review of aquaculture establishment approvals	1	1(100)	0(0)	0(0)	0
Withdrawal for approval of aquaculture establishments	2	1(50)	1(50)	0(0)	0.5
Suspension of approval of establishments	1	1(100)	0(0)	0(0)	0
Approval of chemicals used in aquaculture	6	0(0)	2(33)	4(67)	3.7
Official lists	7	2(29)	5(71)	0(0)	0.9
Inspection of establishments	2	1(50)	1(50)	0(0)	0.5
Updated lists	1	0(0)	1(100)	0(0)	1
Interaction of CA/government with the feed and aquaculture producers in official controls	6	1(16)	5(84)	0(0)	1.3
The scope of the health control plans for aquaculture sector	3	0(0)	3(100)	0(0)	1
Management and updating of multi-annual national health control plan for aquaculture	7	2(29)	5(71)	0(0)	1.0
Content and Implementation of multi-annual national health control plan for aquaculture	18	6(33)	7(39)	5(28)	1.8
Annual reports on implementation of multi-annual national health control plan for aquaculture	6	5(83)	1(17)	0(0)	0.2
The scope of national environment and residue monitoring programmes	8	6(75)	2(25)	0(0)	0.5
Monitoring of sanitary soundness of aquaculture products	6	3(50)	3(50)	0(0)	0.5
Basis for controls for parasites	4	4(100)	0(0)	(0)	0
Scope of controls for chemical contaminants present in environments and products	16	3(19)	13(81)	0(0)	0.8
Sampling plans, sampling methods, and sample preparations for contaminants	8	7(86)	1(14)	0(0)	0.1
Records and data for residue monitoring programme	1	0(0)	1(100)	0(0)	2.0
The scope of control plan for production conditions in aquaculture chain	3	0(0)	2(67)	1(33)	2.3
Monitoring of the aquaculture production chain	24	3(12)	2(09)	19(79)	4.0
Health checks before harvests	2	0(0)	1(50)	1(50)	3.5
Records and dissemination of official control reports	6	0(0)	4(67)	2(33	3.7

of the inspection services were: lack of the general plan for crisis management for safety of products from aquaculture; failure to ensure continuous review of approved aquaculture establishments to identify any non conformity; failure to take measures and ensure that non conforming establishments collect deficiencies identified; and failure by inspection services to ensure that parasites in aquaculture fish are monitored basing on scientific studies and research.

Other elements which had exceptionally very low compliance scores and therefore considered equally deficient included: implementation of the environment and residue monitoring plans with score of 0.5; ensuring that the sampling plans and sampling methods used in environment and residue monitoring programme for aquaculture products meet required criteria (0.1); ensuring that residue monitoring programmes monitor all banned and non-permitted substances in aquaculture (0.8); development and implementation of multi-annual health control plans for aquaculture products and ensuring that the annual reports are produced and kept (0.2); regular inspections to verify that aquaculture establishments are operating according to approved plans (0.5); withdrawal of aquaculture establishment approvals from non conforming establishments (0.5); issuing of approval numbers to approved aquaculture establishments (0.7); and maintaining approval lists for approved fish farms, hatcheries, fish breeders, fish feed producers, approved chemicals and fertilizers (0.9).

Of the 32 elements of the inspection services, only two (6%) obtained average score of five denoting full compliance and included "being empowered by law" and "availability of verification procedures for approval of establishments". The empowerment by law was contained in the clause in the subsidiary legislation (Fish (Aquaculture) Rules of 2003) giving authority to the inspectors to enter, inspect and search any aquaculture establishment at any time to ensure that the rules are complied with, among others. The verification procedures were already contained in the new manual of SOPs for Inspection and Verification of Aquaculture Establishments and Practices (MAAIF/DFR, 2006). Other elements of inspection services which scored relatively highly included: monitoring and control plans for health conditions in aquaculture which covered almost all control points in aquaculture chain with score of four; keeping the records and disseminating the aquaculture monitoring and health control information (3.7); implementing procedures for approval of chemicals and drugs used in aquaculture (3.7); having in place measures for registering all aquaculture establishments and keeping an updated list of all establishments (3.7); and ensuring that aquaculture operators and inspectors inspect aquaculture animals before harvest and products before sale (3.8).

The deficiencies identified in the inspection services are attributed to the fact that the inspection activities were still in initial stages, having been introduced two years prior to this evaluation. Major challenges are mainly related to training and staffing. In addition to having few inspection staff in the area of aquaculture, the inspectors also lack sufficient knowledge of food safety. To execute effective official control activities in aquaculture sector, it is necessary that the inspectors have knowledge and experience of both aquaculture and food safety. It is hoped that Uganda's CA will draw lessons and experience gained from the development of already existing world rated inspection services for capture fishery products as a means to institute effective and efficiently working inspection services for aquaculture products.

Compliance of laboratory services for official control of aquaculture products in Uganda with international requirements

Uganda has several laboratories that can be utilised for routine checks by aquaculture producers and CA. They include: The National Forensics Laboratory (NFL) under the Ministry of Internal Affairs; the National Water testing laboratory under the Ministry of Water and Environment, Fish laboratories at the Department of Fisheries Resources (DFR) in the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF); laboratories at the National Bureau of Standards (UNBS) in the Ministry of Trade, Tourism and Industry (MTTI), various laboratories in the faculties of Science, Veterinary Medicine, and Agriculture at Makerere University – Uganda's largest and oldest University; and a private lab which is a branch of Chemiphar laboratory based in Belgium. By the time of the evaluation, most of these laboratories had acquired some level of capacity to conduct either microbiological or chemical tests or both. However, some could not be used to carry out tests on samples for official control purposes since they had not yet obtained international accreditation. For instance Chemiphar laboratory was the only accredited lab for carrying out chemical and microbiological analyses. Although the microbiology lab at the UNBS had been accredited, the UNBS's chemicals lab was still undergoing the process of accreditation, and so was the microbiology laboratory at DFR. Chemical laboratories as compared to microbiology ones are more of a necessity in conducting official control activities for aquaculture products during pre-harvest operations where residues of veterinary drugs, environmental contaminants like pesticides, heavy metals, polychlorinated biphenyls (PCBs) and dioxins and furans are normally regulated.

Of the three elements used to evaluate the laboratory services for their availability for official control purposes, the designation of the reference laboratories by CA scored high (3.8) followed by designation of the official laboratories for testing samples taken during official controls (3.6) and having a list of laboratories approved for use by industry and CA for official control purposes (2.5) (Table 7).

The fairly high average score obtained for the designation by the CA of the reference laboratory(ies) necessary for collaborating with official control laboratories on matters of competence (3.8) was because Uganda has Chemiphar Laboratory, an accredited chemical laboratory already being used as official control laboratory for capture fishery products, which could handle aquaculture products as well. The laboratory has capacity of testing controlled residues in aquaculture and is also already linked to its Belgium head quarters, which in turn has links with other reference laboratories in Europe, most of which are recommended reference labs for the substances tested in aquaculture by the European Commission (EC). The relatively low average score obtained for the criteria of the element on list of laboratories approved by the CA to handle samples from aquaculture operators or CA for official control purpose (2.5) is be-

Table 7
Compliance of laboratory services for testing aquaculture products.

Evaluated element	Number of recommended conditions (RC) used in evaluation	Number of RCs that scored zero (%)	Number RCs that scored between 1–3	Number of RCs that scored between 4–5	Overall score
Designation of official control laboratories	5	0(0)	2(40)	3(60)	3.6
List of approved official laboratories	2	0(0)	2(100)	0(0)	2.5
Reference laboratories	4	0(0)	1(25)	3(75)	3.8

Table 8
Overall compliance of the four components of the Uganda's national food control system for aquaculture with international requirements.

Components of the national control system (CN)	Number of elements used in evaluation	Number of elements where more than 50% of the RC scored zero (%)	Number of elements where more than 50% of RC scored above 4 (%)	Overall mean on the average score of the elements (out of 5)
Legislation	9	6(67)	2(22)	1.52
Competent authority	5	1(20)	1(20)	2.2
Inspection services	32	11(34)	8(25)	1.73
Laboratory services	3	0(0)	2(67)	3.3

cause, apart from Chemiphar laboratory, the rest of the laboratories are not accredited for chemical analysis. Also these laboratories like most in Sub-Saharan countries may not have a sustained capacity to conduct necessary controls on regular basis due to lack of/or failure to maintain, the required equipment and obtain the necessary materials to conduct on-going analyses such as solvents and microbiological media. In addition, the approved government testing laboratory for certain contaminants, Chemiphar, already has its capacity overstretched from testing samples from the capture fish industry and other export sectors. It is expected that additional samples from aquaculture could result in delay of obtaining the results, which may in turn affect the effectiveness of the official controls.

Clearly, countries like Uganda which are aggressively promoting its emerging commercial aquaculture industry, need more accredited analytical laboratories to meet the growing demand for services from the fish processing industry, other related sectors, and the growing aquaculture sector to carry out tests required in environmental and residue monitoring and certification for aquaculture products. It is however hoped that by the time the number of the aquaculture farms that are ready to export increases in Uganda, more laboratories will have been accredited to cover the demand.

General compliance of the national food control system

The overall average score of all the elements was lower for legislation, followed by inspection services, and CA, with the highest score coming from laboratory services (Table 8). Similarly, the percentage of elements where more than 50% of recommended conditions scored zero was higher for legislation, followed by inspection services, competent authority and laboratory in that order, implying that legislation was the worst performing component of national food control system while laboratory services was the best performer.

Legislation being the worst performing component is particularly a challenge to the on-going official aquaculture control initiatives, since it is the one that sets the level of controls provided by other components, hence the need for its immediate review to incorporate requirements that guarantee safety of the products. It should however be noted that out of the four components evaluated, 3 (75%) had low compliance having obtained overall average scores below three, and the combined mean of the overall average scores for all the four components of the national food control system (NFCS) was 2.2 denoting low compliance. This indicates that generally the NFCS for aquaculture in Uganda did not comply with international recommendations.

Conclusions

This study indicates that apart from the laboratory services, Uganda's national food control system did not comply with the international recommendations, and therefore may not qualify to guarantee the safety of aquaculture products for potential consumers in markets, specifically for those that are most lucrative as well as restrictive like the EU. This situation hopefully is a temporary one since commercial aquaculture is still in its infancy in Uganda and also in many Sub-Saharan countries, where national control activities have recently been introduced. However, such governmental oversight requires assistance in the form of advice and funding from external sources, yet this is not a high priority area for donor agencies and national governments, who tend to spend the available resources for maintaining controls on commodities like capture fishery products that have already entered the export market. A change in current direction of government oversight is now required to stimulate the production of safe, high quality pond-raised fish to successfully reach important export markets like the EU. As capture fisheries decline through overfishing and un-sustainable fishing methods among other factors, aquaculture products will take their place, especially if consumers appreciate the value of products that are safe and wholesome.

Given the above, it is imperative that government in Sub-Saharan Africa, especially Uganda to:

- Review existing legislations for controlling aquaculture and incorporate provisions that introduce risk analysis in the controls. This is specifically important since the current legislations were established at a time when aquaculture exports to restrictive markets like EU and US were not envisaged, and as such most of the legislation were aimed at only reducing production constraints as opposed to quality and safety assurance, which are key in developing export potential for aquaculture that is increasingly of interest to some Sub-Saharan countries like Uganda.
- Develop the capacity of inspection services through recruitment and training of adequate numbers of inspectors targeting basic aquaculture and food safety skills. Aquaculture controls are unique to the inspection services in Sub-Saharan countries that are used to traditional post-harvest safety and quality assurance. To be able to effectively ensure food safety during the pre-harvest operations, the relevant authorities should integrate food safety and aquaculture skills in their training programmes targeting inspectors.
- Include in the CA budgets lines to support sustained controls in the aquaculture sector, which are currently suffering lack of political and financial commitment where most budgets are allocated to controls of capture fishery products that are already successful in export market.
- Invest more resources in maintenance of existing laboratories, most especially ensuring that the chemical laboratories that are vital in ensuring controls for aquaculture products achieve international accreditation such that countries like Uganda have adequate testing capacity for other exports and the growing aquaculture sector. Governments have to address the challenge of the technical gaps created when donor funded projects which support majority of laboratories in Sub-Saharan countries wind-up when the laboratories are still at the "Take Off Stage".

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