Aquaculture Labour Market and Educa on Programmes Analysis in Kenya

BUILDING A STRATEGIC FRAMEWORK FOR AQUACULTURE EDUCATION IN KENYA

TEAM PROJECT REPORT 2020

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Preamble

Aquaculture has enormous development potential in Kenya. Despite the potential, inadequate training of personnel who can tackle fast-evolving production systems and technologies geared towards sustainable aquaculture development has hampered the growth of the sector. Currently, the general aquaculture training landscape in Kenya and curricula are fragmented, do not meet labour market needs and are partially duplicative and sometimes designed in an *ad hoc* basis. Furthermore, the existing curricula do not sufficiently address specific training skills in an in-depth manner, leading to a general lack of proficiency of graduates in the aquaculture industry. These shortages are often compounded by an inadequacy of infrastructure and facilities and inadequate resources in the institutions teaching aquaculture and fisheries. The goal of the TEAM project was to tackle these existing challenges by putting in place well-crafted aquaculture education policy framework for the recognition of academic and vocational aquaculture programmes in Kenya, under the authority of the Commission for University Education (CUE), Technical and Vocational Training Authority (TVET-A), TVET Curriculum Development Assessment and Certification Council (TVET-CDACC), and other bodies responsible for the supervision of higher education. This project mapped the current curricula and assessed them against the labour market requirements in order to identify existing gaps, and design a strategic framework for proper development of the aquaculture educational landscape. The analyses done include the required competencies, quality criteria and quality assessment tools for better training of aquaculture professionals in Kenya.

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Abbreviations and acronyms

CAADP	Comprehensive Africa Agriculture Development Programme of the African Union
CBC	Competency Based Curricula
CCSF	Conceptual Change Student Focused
CDACC	Curriculum Development Assessment and Certification Council
CUE	Commission for University Education
EEZ	Exclusive Economic Zone
ESP- FFEPP	Economic Stimulus Project - Fish Farming Enterprise Productivity Programme
FAO	Food and Agriculture Organization
ICT	Information and Communication Technology
IT	Information Transmission
KaRU	Karatina University
KNBS	Kenya National Bureau of Statistics
KUCCPS	Kenya Universities and Colleges Central Placement Service
KWSTI	Kenya Wildlife Service Training Institute
MSU	Maseno University
NARDTC	National Aquaculture Research Development and Training Centre
NEPAD	New Partnership for Africa's Development
NESP	National Education Sector Plan
NGO	Non-Governmental Organizations
RAS	Recirculatory Aquaculture Systems
SDG	Sustainable Development Goals
SEKU	South Eastern University of Kenya
TIMPs	Technological, Innovation and Best Management practices
TLA	Teaching Learning Activities
TVET	Technical-Vocational Education and Training
TVET-A	Technical-Vocational Education and Training Authority
UoE	University of Eldoret
UoN	University of Nairobi
VUB	Vrije Universiteit Brussels

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Introduction

Food and nutrition security is one of the challenges facing developing and middle-income countries globally (Béné *et al*., 2016). Malnutrition and poor diet have been reported as the leading causes of the global burden of disease, with nearly 821 million people suffering from hunger and two billion people suffering from micronutrient deficiencies (IFPRI, 2016; Movilla-Pateiro *et al*., 2020). Fish and seafood plays a crucial role as an essential component of human diets around the world, providing more than 3 billion people with around 20% of the animal-source protein and making greater contribution in many developing countries (Bogard *et al*., 2017). Fisheries and aquaculture development offers a foundation of tackling the UN 2030 Agenda for Sustainable Development in an inter-sectoral manner. Addressing SDG14 (life under water) where fisheries and aquaculture issues are tackled will inadvertently help deliver other SDGs including; poverty alleviation (SDG 1) improved food and nutrition security (SDG 2 and 3); decent work and economic growth (SDG 8); responsible consumption and production (SDG 12); combating climate change and its impacts (SDG 13); conservation and sustainable use of oceans, seas and marine resources for sustainable development (SDG 14); clean environment and maintained biodiversity (SDG 15) as well as the Africa 2063 Agenda on inclusive economic and social development (Hecht *et al*., 2019).

The Food and Agriculture Organization of the United Nations, (FAO) has recognized the critical role played by fisheries and aquaculture in provision of food and nutrition security in the context of climate change in the developing world (FAO, 2018; Hecht *et al*., 2019). World fish production reached 179 million tons in 2018 with a global per capita fish consumption rising from an average of 9.0 kg in the 1960's to 20.5 kg in 2018 mainly due to stable capture fisheries production, reduced wastage and increased aquaculture growth (FAO, 2020). Growth of the global aquaculture industry has doubled over the last 50 years, and capture fisheries production has remained relatively static since the late 1980's (FAO, 2018). This growth has been largely attributed to technological advancements in fish production such as; hybridization, genetic engineering, formulated diets, biofloc technology used in ponds and intensive fish farming in cages, tanks, and recirculation systems (Kumar *et al*., 2018; Oyinlola *et al*., 2018; Maulu *et al*., 2019). However, the rate of growth of global aquaculture has differed across continents. Whereas continental Asia has become the giant in aquaculture production, the pace of growth in Africa has been slow. The continent is yet to report production of significant quantities of aquaculture products on the global scale despite the availability of enormous natural resources (FAO, 2018; Munguti *et al*., 2014). Aquaculture contributes only 17.9% to

total fish production in Africa equivalent to 2.7% of global fish production (Obiero *et al*., 2019; FAO, 2020). This presents a very slow growth, despite having a great potential for fish farming with 37% of its surface area suitable for artisanal fish farming and 43% for commercial fish production (Munguti *et al*., 2014).

In Kenya, fish farming was initiated by the colonialists in 1920's through the introduction of trout in rivers in Mt. Kenya region for sport fishing (Ngugi *et al.*, 2007) and became popular in the 1960's (Ngugi and Manyala, 2004; Nyonje *et al*., 2011). The production stagnated for several decades and started a growth trajectory around 2003 after numerous efforts of "Eat more fish campaigns" by the Kenyan government. The highest production of 24,096 MT was realized in 2014 after the government's intervention to promote fish farming through the Economic Stimulus Project - Fish Farming Enterprise Productivity Programme (ESP-FFEPP) which subsidized fingerlings, feeds and pond construction (Ogello and Munguti, 2016; Opiyo *et al*., 2018). However, the production reduced to 12,356 MT in 2017 due to prolonged drought in 2017, inadequate extension support, poor site selection, and high cost of production (Opiyo *et al*., 2018). In 2019, aquaculture production reached 18,542 MT mainly due to increased adoption of cage farming in Lake Victoria (KNBS, 2020).

The primary freshwater-farmed fish species in Kenya are Nile tilapia (*Oreochromis niloticus)* (75%) and African catfish (*Clarias gariepinus*) and other fish species (25%) (Ngugi and Manyala, 2004). Mariculture involves the farming of finfish such as milkfish (*Chanos chanos*) and grey mullets (*Mugil cephalus*); shellfish such as mud crab (*Scylla serrata*), oysters (*Saccostrea cucullata*), shrimp (*Penaeus monodon* and *P. indicus*) (Munguti *et al*., 2014). The farming of the brine shrimp (*Artemia*), seaweed (mainly *Eucheuma denticulatum* (*spinosum*) and *Kappaphycus alvarezi (cottonii*) has been introduced with positive performance and potential for development of mariculture along the Kenyan coastline (Hecht *et al*., 2019). Mariculture is still underdeveloped due to lack of marine hatcheries, accessibility problems, conflicts over land ownership, inadequate technologies (amongst others to produce and apply live food in the larviculture phase) and lack of clear policies (Opiyo *et al*., 2018). Kenya has a great potential for aquaculture production since the country is endowed with several inland natural water resources such as Lakes Victoria, Turkana, Baringo, Naivasha, Chala, Kanyaboli and Jipe, among others. Major rivers include the Tana, Athi, Nyando, Nzoia, Sondu-Miriu, Kuja, Migori, Yala, and Mara. In addition to artificial water bodies from dams, which are spread across the landscape, Kenya has approximately 600 km of coastal shoreline with an Exclusive Economic Zone (EEZ) of 200 nautical miles, which can still be harnessed

to enhance aquaculture production.

Although most parts of the country are suitable for aquaculture, only 0.014% of the 1.4 million ha of potential aquaculture sites are used for aquaculture and about 95% of fish farming is practiced in small-scale culture systems characterized by low levels of production (Opiyo *et al*., 2018). The low production from aquaculture in Kenya has been attributed to a number of problems including lack of adequate training of personnel in the sector who can tackle fast-evolving production systems like recirculatory aquaculture systems (RAS), innovation to increase value addition and reduction of post-harvest losses, market linkages, feed production technologies and diagnosis of fish diseases (Veverica *et al*., 2015). Provision of adequate skills through training fall within the activities to be achieved within the development agenda concerning fisheries and aquaculture sector under (Comprehensive Africa Agriculture Development Programme (CAADP) of the African Union/New Partnership for Africa's Development (NEPAD). The programme was key in helping achieve the 6% annual agriculture growth target in Kenya among other countries in Africa in order to foster growth and combat poverty and hunger in rural areas (Brüntrup, 2011).

Education is considered a key determinant for better employment opportunities. Kenya has made progress in recent years with enrollment numbers for primary and secondary education due to the 100% transition government policy (NESP, 2015). However, with only 3.3% of women and 4.7% of men enrolled in tertiary education, Kenya is falling behind many other African nations and the graduates often have inadequate skills and knowledge required for the job market. Efforts have been made to enhance capacity development in the fisheries and aquaculture sector through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) by development of Competency Based Curricula (CBC) and implementation of the curricula in the various TVET institutions including the ones teaching aquaculture (CAADP, 2016). Such interventions have gone a long way in ensuring that the TVET institutions offer credible and relevant courses to the industry. At the universities, many aquaculture-related programmes have been launched, especially at undergraduate level, over recent years. However, the general aquaculture training landscape in Kenya and curricula are still fragmented, do not meet labour market needs and are partially duplicative and sometimes designed on an *ad hoc* basis (Veverica *et al*., 2015). Furthermore, the existing curricula do not sufficiently address specific training skills needs in an in-depth manner, leading to a general lack of proficiency of graduates in the aquaculture industry. Whereas career success of individuals in relation with the organization they are employed have been investigated in previous studies in

other sectors (Moen and Han, 2001), the relationship between students' satisfaction with their training and career satisfaction in the aquaculture industry has not been adequately examined.

The success of a new technology relies strongly on mechanisms of its dissemination from its source of invention to a wide range of potential end-users (Kumar *et al*., 2018). It is widely recognized that a well-functioning extension system is crucial for disseminating information and promoting the adoption of new farming technologies among farmers who otherwise may lack the knowledge and avenues to new farming technologies on their own (Suvedi *et al.*, 2017). Skilled extension personnel are involved in the development of effective extension programmes that identify key problems and who then design appropriate combinations of activities that provide the necessary information, including results of on-farm trials that demonstrate feasibility and are essential for the timely transfer of technologies to farmers (Engle, 2017). Therefore, the education received by the extension service providers is very important in promoting sustainable growth of aquaculture in Kenya.

The goal of the TEAM project was to develop a strategic framework for aquaculture education in Kenya, to sketch a strategic vision on the type of aquaculture education Kenya needs while defining its quality criteria. The project focused on putting in place aquaculture education policy framework for the recognition of academic and vocational aquaculture programmes in Kenya under the authority of the Commission for University Education (CUE), Technical and Vocational Training Authority (TVET-A), TVET Curriculum Development Assessment and Certification Council (TVET-CDACC), and other agencies responsible for the supervision of higher education.

2.0 Study design

The study consisted of a survey of a representative set of aquaculture-related educational programmes and of a number of surveys, related to analysis of the existing and future labour market. The surveys were conducted using semi-structured questionnaires, site visits and a multi-stakeholder engagement.

The **labour market surveys** targeted various stakeholders in the aquaculture value chain including fish farmers (grow-out and hatcheries), input supplier (feeds and aquaculture equipment), fish traders, fish farmers' associations, community based organizations, research institutions, fisheries departments, extension service providers at the County and National government level and tertiary institutions offering aquaculture programmes. The overall purpose was to identify the types of aquaculture workers, knowledge and skills that are present and what Kenya's

aquaculture industry needed. It included three parallel and mutually complementary surveys: firstly, a survey of a representative and nationwide set of aquaculture stakeholders, mapping their present situation in terms of human resources and inquiring for their future needs in this respect; secondly a survey among aquaculture alumni, inquiring about their job satisfaction and preparedness in light of their training at the institute where they had their schooling; and thirdly a survey among fish farmers and fish extension service providers, investigating the preparedness of the latter in providing aquaculture technical support, also within the light of their previous training.

The **education programme surveys** covered 7 institutions (5 universities and 2 TVET institutions) offering aquaculture training at different levels (PhD, MSc, BSc, Diploma, Certificate and Vocational training) including University of Eldoret (UoE); University of Nairobi (UoN); Maseno University (MSU); South Eastern Kenya University (SEKU); Karatina University (KaRU); Kenya Wildlife Service Training Institute (KWSTI) and the National Aquaculture Research Development and Training Centre (NARDTC). Primary information was collected through extensive and detailed questionnaires followed by site visits to all the seven participating institutions by a survey team, non-affiliated to any of the institutions. Additional information was obtained from the various institutions' websites, through various documents (in soft or hardcopy) on the respective programmes provided by the institutions. The type of information collected was two-fold. A first focus was on the institutes themselves and the contents of the programmes offered, on student numbers, enrolment and success rates, quality assurance procedures, qualifications of teaching personnel (practicals and theory), availability of facilities and infrastructure, embeddedness of education in research and collaborations (international and national). A second focus of the surveys was on how the educational process is organized in terms of educational and evaluation tools; use of innovative methods like use of information and communication technology (ICT) in the educational process and in the way examinations and assessments are organized. Data collected from the various participating institutions were compiled and analyzed, to identify trends, similarities, differences, hiatus, and in general elements whatsoever that stood out with regard to the quality of education.

3.0 Key findings

3.1. Labour market situation

3.1.1. General labour market survey

Nation and sector-wide information about the **general aquaculture labour market** in Kenya and its needs was collected among different aquaculture stakeholders through personal visits by enumerators, who had received specific training for the assignment. Information was thus obtained from 130 respondents: 77 of these were from the private sector (i.e. finfish/shellfish farmers of any type; fish feed producers; finfish/shellfish processors; suppliers of aquaculture materials), and 53 from the non-private sector (i.e. NGO's, universities, research institutes, governmental bodies at different levels of governmental organization, henceforth called the 'public sector').

Information was collected on the personal data of the respondent; entity (company/ farm/ institution/authority) represented by the respondent; current employment of aquaculture staff (numbers; gender distribution; educational level; knowledge and skills; staff retention); future human resources policy of the entity in relation to aquaculture staff (current vacancies; future changes in staff composition; desired educational levels and skills; recruitment policy in general); on-site schooling provided by the entity to aquaculture staff (organization of intake training; type and frequency of recurrent training; bottlenecks to organize trainings).

The survey allowed for the following conclusions; As for the respondents, 59% were from the private sector (finfish/shellfish farmers, feed producers, processors) and 41% public (government bodies, research institutes, and NGOs). The respondents were mainly male (72%), comprising of people between 40-59 years, thus having generally several years of experience in the aquaculture sector, and this applied to the respondents from the entire aquaculture sector (private farms and companies; NGO's and government institutions). In the private sector the biggest group of respondents (42%) worked in grow-out aquaculture, followed by the hatchery sector (24%), broodstock breeding, (16%), fish feed producers (8%), input suppliers (6%) and fish processors (4%). In the public sector, the majority of respondents (55%) worked in extension services, (18%) policy and regulation, (16%) research, and (11%) tertiary education. The bulk of aquaculture production was from pond-based semi-intensive culture systems followed by recirculatory systems. Nevertheless, pond production was not perceived as the most profitable while fish processing and hatchery operations were regarded as the most economically viable activities in

aquaculture.

The gender of staff employed by the respondents, especially at higher functions in the private sector (grow-out farms, hatcheries) were male-dominated; other functions in the private sector and positions within the public sector showed better gender balance. As for the educational level of staff employed, the public and private sector showed a different pattern: in the public sector staff of all levels (certificate, diploma, BSc, MSc, PhD) were employed, depending on the position. In the private sector, there was a domination of staff with certificate holders, and to a lesser extent diploma holders, except for managerial functions where people employed had higher qualifications (although it was not uncommon to have staff with certificate level also at these higher positions), especially for male staff members in this position. Across the labour market landscape, the responding employers from both public and private sector were moderately to highly satisfied with the skills and the knowledge of their employees. Moreover, at least 2/3 of respondents from the private sector declared not to have problems in retaining staff of any category at their company or farm. In the public sector, though, lecturers and extension service providers seem slightly more difficult to retain, although not all respondents from this sector appreciated this.

Whereas the respondents did not report any major problems related to their present pool of employees, they expressed specific requirements for staff recruitment in future. For almost any type of position, at least half of the respondents from the private sector declared to have vacancies, except for the highest positions such as director and general manager, for which the market seems saturated. In the fish feed and hatchery sectors a growth potential was generally recognized. Similarly, in the public sector a variety of functions were very much in demand (through present vacancies) or were expected to be so in the near future. This applied especially to lecturers and teaching assistants. In terms of educational level needed, there was a clear distinction between both sectors: for most of its positions, the private sector recruited staff having vocational education (diploma or certificate), except for the highest managerial functions, where also university degrees were appreciated. In the public sector, on the contrary, employers primarily recruited staff with a university degree, except for the position of fisheries assistant, where vocational education was perceived as the most suitable.

The respondents also provided a detailed account of the general and specific skills they saw as important for the staff at different positions that they employ or would want to recruit. In the private sector, the employers linked a specific set of skills to a certain position (although some skills, such as communication were considered

essential for many functions). However, in the public sector, the linkage between a certain position and specific skills was less clear, and many skills were regarded as equally important across all positions.

The respondents also expressed their opinion on tools in place for training on-site or so-called 'lifelong learning' (e.g. induction training upon recruitment; periodical on-job training provided by employer; opportunity of staff to attend short specialization and/or updating courses outside the company/institute: especially in the field of hands-on skills and experience), a need for basic, refresher and/or specialization courses was felt necessary. Although several opportunities do exist or are at least theoretically available, they were generally felt as being poorly accessible and having little impact in practice, mainly because of low funding from the organizations, preventing potential trainees to attend them.

Although in a fast evolving field such as aquaculture lifelong learning is important, the practical constraints of organizing for training puts more emphasis on the need for the educational institutions to deliver graduates having qualifications, knowledge and skills tailored to the needs of the labour market. This comprehensive labour market study provides detailed information on the requirements for the variety of job positions, operating in the aquaculture sector in Kenya.

3.1.2. Aquaculture alumni survey

To complement the labour market survey, addressed from the point of view of the employers, the **alumni survey** aimed at obtaining information from the point of view of the employees. It assessed the impact of satisfaction with academic training on the job satisfaction and performance of aquaculture training institutions' alumni in the aquaculture sector market. Specifically, the study aimed at determining the socio-demographic characteristics of the alumni, the level of alumni satisfaction with academic training, alumni job satisfaction and performance, and how satisfaction with training affects job satisfaction and performance. Using a cross-sectional study design, data was collected from a total of 162 respondents, having graduated from nine different aquaculture training institutions in Kenya (including those participating in this project), using an online survey platform.

The study found that most (75%) of the aquaculture training institutions' alumni were male; aged between 20 and 29 years, and the employment rate among these alumni was 71%. Of all the employed alumni, most of them worked in the aquaculture sector, 35% worked in private companies and fish farms, 20% in government agencies, 17% in research institutions, while the rest were self-employed, or working in NGOs and other sectors. They generally had a working experience of more than five years. The

study found that the alumni were satisfied with their academic training and with their job, and that they were satisfied with how they performed in their job. The study further established that satisfaction with academic training had a significant effect on both job satisfaction and job performance. The study concluded that the more satisfied the alumni were with their academic training, the more satisfied they were with their jobs and their performance.

3.1.3. Extension service survey

During the general aquaculture labour market survey, it was realized that there is a skill gap with regard to aquaculture extension service in Kenya. Therefore, an **additional extension service survey** examined the factors affecting farmers' participation in extension programmes, adoption of improved aquaculture technologies in Kenya, and the skills required by extension service providers to deliver services to the sector. This survey was organized, inspired by the view that there is a link between the education received by the extension service providers during their vocational and university training, skills and knowledge they disseminate to farmers, in order to promote uptake of new Technological, Innovations and Best Management practices (TIMPs).

The extension service survey was conducted on two levels, one involving fish farmers and another one involving the extension service providers, to complement the labour market and alumni surveys. The farmers' survey aimed at identifying the extent to which farmers were satisfied with the services received from extension service providers and to identify determinant factors for farmers' satisfaction. The extension survey, on the other hand, sought to determine how extension service providers were equipped in terms of training and skills in the delivery of extension services, the challenges they face while discharging their duties, and to evaluate areas of need in extension service providers training and capacity building.

A cross-sectional survey design was employed and a total of 292 fish farmers and 56 extension service providers were interviewed in 17 counties throughout Kenya. A semi-structured questionnaire was used as the primary research instrument. The farmers' survey focused on farmers' demographics, awareness of extension services, perceptions of the extension service providers, preference of delivery system, and benefits derived from extension services. The extension survey, on the other hand, focused on extension service providers ' demographics, frequency of farmers' contact, extension approaches used, skill enhancements, challenges, and impact of extension service delivery. Secondary data from published and unpublished records were also used to complement these primary data.

Findings from the ***fish farmers' survey*** indicated that the majority (81%) of the respondents were male, with a mean age of 51 years. Most farmers (76%) had attained secondary education and beyond. The majority of farmers (91%) reported that they were aware of the extension service provider within their area, and the frequency of extension service provider 's visits to farms was mainly monthly.

Generally, farmers perceived extension service providers as being important because they offer advice on fish farming, transfer technology and disseminate information. A positive correlation was found between the frequency of extension service provider 's visits to the farm and the knowledge of extension service providers in the area, and a negative correlation between the farmers' education and age on the frequency of visits. Farmers' primary mode of contact with extension service providers was through farm visits (67.5%) and through visiting the extension service providers' office when they needed help (27.1%). The main training topics from extension service providers to farmers included fish seed production, stocking, feeding, and harvesting (64%); pond/production system construction and design (63.4%); water quality management (58.2%), pond fertilization and liming (55.8%); record-keeping and financial management (45.2%); fish feed formulation, storage and administration (40.4%). Extension service providers tackled less of cooperative group formation and management, during training. Majority of fish farmers reported that the quality of the extension service provision was at least "good". Farmers rated officers possessing practical skills highly. Cumulatively, fish farmers preferred a mixed method of extension information delivery, with preference especially for individual farm visits (71.6%), extension farmers-meetings (53.4%), and agricultural shows/ trade fairs (28.4%). Print media, mass media, social media and ICT channels were less preferred.

However, a minority of the farmers reported that the impacts of the new knowledge and skills acquired from extension services resulted in improved productivity/ yield. To improve training and extension service delivery, the top suggestion was the facilitation of extension service providers in terms of transport and equipment, improved training materials and tools, and (of lower priority) more regular/frequent farm visits to farmers and more extension service providers in general.

Results from the ***extension service providers' survey*** showed that the extension service sector is male dominated (82%). All extension service providers had attained secondary education and beyond, with 41.1% possessing diploma certificate, but with only half of extension service providers having a background education in fisheries and aquaculture and half of them having weekly contact with farmers. The other half were trained on agriculture, zoology, animal production and natural

resource management. There were significant relationships between some factors linked to extension service providers' performance. For instance, there was a positive correlation between adoption of aquaculture technologies by farmers and the extension service providers' highest level of education; adoption of aquaculture technologies by farmers and frequency of contact with farmers; and a positive correlation was found between skills and knowledge enhancement programmes and on-job trainings attendance. However, there was a negative correlation between on-job training attendance and the extension service provider's highest level of education.

The main extension approaches used were training and visits (85.7%), which corroborates with what farmers preferred. Among the extension service providers who reported attending some skills and knowledge enhancement programmes, both paid and non-paid study leave granted. Although about half of the extension service providers acknowledged awareness of continuous professional development courses in fisheries and aquaculture, only a minority (range 20-40%) reported following some sort of the in-service/job training or refresher courses. Insufficient facilitation in terms of transport and equipment was reported as the main challenge faced by extension service providers though also the need for more adequate training and for more staff were highlighted as important aspects that needs improvement, showing the need for development of programmes for skill enhancement, for induction and refresher courses in relevant topics and for continuous professional development courses, allowing the extension service providers to deliver current knowledge with regard to the changing technologies in aquaculture.

3.2. Status of aquaculture education programmes

3.2.1. Educational programme contents and facilities

3.2.1.1. Overview of academic programmes surveyed

The survey covered one certificate programme, two diploma programmes, seven bachelors, two masters and two PhD programmes. Given the many bachelor programmes among the project partners, the information below focuses on this level of education but much of it (e.g. available infrastructure; human resources deployed) is also applicable and relevant for the non-bachelor programmes surveyed. Except for the certificate in Aquaculture programme, none of the programmes addressed aquaculture exclusively, but aquaculture was always combined with a related domain such as fisheries, aquatic science and aquatic resources management amongst other courses. The academic programmes offered at degree, diploma and

certificate level were on Fisheries and Aquaculture, Aquatic Resources Conservation and Development, Fisheries and Aquatic Sciences, Fisheries and Aquaculture Management, Fisheries Management and Aquaculture Technology and Aquaculture and Fisheries Management.

3.2.1.2. Course composition of the academic programmes

The academic calendar and curricula were very similar/identical among all institutions, having semester-specific courses of a certain 'weight', which is expressed according to a common set of parameters. Nevertheless, different terminologies were used to describe the weight of a course such as; credit hours, units and contact hours, complicating comparison across programmes and hindering possible student transfers among the different institutions.

Irrespective of the academic programme, many similarities were found when comparing the course guide of the respective universities for the programmes concerned. All programmes shared substantial focus on supporting disciplines such as biology, chemistry and mathematics. Aquaculture-related courses such as fish health management, feed processing, seed production, fish selection and genetics were common among programmes, as is the focus on freshwater fish. Only limited time was allocated to mariculture and shellfish species. Courses such as field attachment and special project were common among programs, as well as courses related to management (in the broad sense). With the exception of field attachment and special project, nearly all courses had the same weight.

Despite the similarities among the academic programmes, each of them distinguished itself by offering specific unique courses e.g. biology of shellfish, live food production and mariculture. However, programmes differed in the number of courses offered, specifically on aquaculture-related topics (as opposed to courses related to both aquaculture and fisheries; aquatic resources in general). They also differed in the number of courses related to computer and IT skills, economics and management, and in the number of courses in which practicals and/or field trips were offered.

In conclusion, it can be stated that the present BSc programmes do not offer specific specialization in the field of aquaculture but rather differentiate themselves by having different programmes names and intonations, which are reflected in the programme's objectives and outcomes and in the descriptions on the institutional websites and study guides.

3.2.1.3. Profile of teaching staff

As for the aquaculture-related courses taught in the programmes, lecturers were 40-45 years of age on average, predominantly male. Generally, lecturers taught full-time but in some programmes, part-time lecturers had an important contribution; in those cases, they came from other departments within the same institution, from other institutions or from a related government institution. Reliance on external part-timers was because of not having adequately qualified teaching personnel available in the hosting department or institution. Inadequacy of teaching staff (in terms of number of staff available and/or their qualifications) was commonly reported as an important problem.

The teaching load was very variable, with substantial differences among universities. Based on the available data, relatively few courses were taught per lecturer, but peaks occurred. Since this aspect of the survey covered only strictly aquaculture-related courses, and data collected were partial, this could probably be an underestimation of the real workload. The number of technical staff in the institutions were few. Most of the lecturers also had weak links with research such as research projects and supervision of Masters and PhD research work. They also had few collaborations with national and international organizations: Time constraints, limited research funding prevented the lecturers from being involved in meaningful research. The academic programmes were therefore not sufficiently embedded in research. Only few PhD studies were being conducted in the institutions. Lecturers occasionally had opportunities to attend capacity-building initiatives in aquaculture but those opportunities were rare and erratic. As a result of the foregoing, educational institutions risked being isolated from ongoing state-of-the-art scientific and technological developments in the field of aquaculture. As undergraduates are seldom exposed to ongoing research, there is limited focus on transferring appropriate research skills to them, or to motivate them to do scientific research, for example through PhD studies, thus contributing to a negative circle of conditions.

3.2.1.4. Teaching infrastructure and materials

In addition to human resources, there were inadequate classrooms and poorly equipped laboratories and aquaculture facilities for both indoors and outdoors teaching activities. This situation was related to an overall inadequate funding for proper higher education, to not only buy, construct and/or install certain aquaculture facilities, but also to maintain and to operate such facilities. The latter is important because some institutions were more privileged in terms of facilities available, but this did not necessarily mean that they were optimally utilized and that the

educational/learning process is taking maximum advantage of them. For educational tools different from conventional classroom teaching (e.g. practicals, excursions and fieldwork) the acute shortage of facilities could often result in cancelation of such activities, or conducting them in a reduced/minimal format with low impact to the student.

3.2.1.5. Quality assurance

Examination systems (scoring and grading) are very similar among universities, with generally most of the total score assigned to the end-of-semester exams and similar systems to score for research projects and field practical training. Oral examinations for the core courses were non-existent but were only done for special projects' proposal and dissertation. All institutions surveyed had a more or less elaborate system of quality assurance in place, generally with quality assurance monitored with both internal examiners and external evaluators. Systems were generally in place for students to evaluate lecturers and the courses, and for overall periodical revision of courses and programmes. External quality assurance in universities is governed by CUE and in vocational institutes by TVET-A.

In general, academic programme accreditation and recognition process at the universities followed the same steps from departmental board, to school/faculty/ directorate /college/academic boards to University Senate for consideration and approval, and to CUE for accreditation and recognition. For the TVET institutions, Academic programmes accreditation and recognition process was based on standards from section to academic boards for approval and to TVET-A. In terms of overall quality assurance, there is thus not much difference among the institutions surveyed. However, the requirements and criteria for appointment of internal and external examiners and the procedures to be followed in case of conflicting opinions of evaluators were always clear. On the other hand, these aspects were not surveyed in depth. Additionally, anonymous evaluations of the courses and programmes by students were lacking in some of the institutions and the process was not effective to provide reliable data for feedback as a quality assurance mechanism in most of the institutions.

3.2.1.6. Student numbers and success rate

Admission requirements were similar across programmes, as they were governed by the same standards. Across the educational landscape, the dropout rate was low; conversely success rate was high in completing the programme in all institutions. For the programmes which had been existing long enough to see evolution over several years, typically 10-30 students would annually enroll (although exceptions

did occur). Based on recent data however, there was a decreasing trend in student enrolment and intake across the universities. In the academic year 2018-2019, some universities did not admit any students in aquaculture-related courses due to low number of students qualifying in science subjects that form entry subject cluster requirements for aquaculture academic programmes. This was linked to mass failures in science subjects such as biology, physics and chemistry at secondary school level as reported by CUE. The self-selection options linked to the Kenya University and Colleges Central Placement Service (KUCCPS) contributed to this problem since most students selected programmes perceived to be marketable in the job market, and an aquaculture career did not have a strong profile in this respect. The student enrolment was affected by the location of the institution as students preferred institutions in urban areas compared to those in rural areas.

Attracting sufficient numbers of students in Aquaculture related courses in the years 2018 and 2019 was a challenge for most institutions, and self-supporting students were in high demand. Some universities were actively advertising their programmes, but they mainly highlighted the intake modalities and requirements, rather than by emphasizing the value of the courses and programme offered for the graduate's future career and position on the labour market.

A minority of institutions has an alumni office in place. However, even in this case, formal follow-up of alumni was virtually non-existent and only erratic and informal follow-up through social networks took place. There were thus no formal channels to evaluate the impact of education on the graduates' career progression in the end.

3.2.2. Educational tools

3.2.2.1. Respondents

For this part of the study, questionnaires were issued to both lecturers and students of six partner institutions, of which five universities and one TVET institution (KWSTI). In total, 21 lecturers responded and provided information on 49 aquaculture courses in these six institutions. In view of the instructions provided while issuing the survey, these lecturers were considered representative for the core aquaculture faculty of the different institutions. Students completed 288 surveys on 72 courses of 8 programmes. About half of students were male (53.8%) and in the 2nd year of their study (46.5%), with an average age of 21.6 years.

3.2.2.2. Lecturer profiles

About half (52.4%) of the lecturers were PhD holders, the remaining had Masters degrees (47.6%). Cumulatively only a minority (28.6%) of the lecturers had education degrees. Considerable differences between the different institutions were observed: seven of the surveyed PhD holders came from one institution, whereas the other institutions had zero (2), one (3) or two (1) PhD holder(s). Only 4 of the 6 institutions had 1 or 2 lecturers with an education degree. Lecturers were predominantly male (62%) with age ranging from 40-49 years. They had 10.6 years of teaching experience on average, of which 7.3 years was in their current institution.

3.2.2.3. Learning outcomes and teaching/learning activities (TLAs) per course (Lecturers)

Firstly, information was collected on how courses fitted within a programme. Therefore, the lecturers were asked to provide both the programme and course learning outcomes, and make the connection between them. Programme learning outcomes were provided for 31 (63.3%) of the 49 courses, and course learning outcomes for 41 (83.7%) courses. In most courses, the highest level at which the course learning outcomes were formulated was at the understanding level of Bloom's taxonomy, only 18 courses reached the level of applying and in only one course, evaluating. Although these findings raised some questions, they did not necessarily imply that a significant part of the lecturers did not know how their course(s) fitted(s) within the programme, they teach. It could also be that they did not have adequate information on how to formulate course learning outcomes. It is noted that lecturers with education degree should be able to do this well, but this correlation was not made.

Lecturers were also asked to provide in-depth information on the TLAs they undertook during their course(s). Five types of TLAs were discerned: lecturing, demonstration, self-study, lab work and group work. Lecturing occurred in all but two courses; lab work in 41 courses. Lecturers had different teaching approaches for the courses for example, demonstration (in 28 courses), self-study (31 courses) and group work (26 courses). These latter activities also showed that teaching approaches differed over the different institutions: self-study and group work were not reported in two institutions, while demonstrations was not reported in one institution. Finally, in two institutions, all surveyed courses made use of the same TLAs: either lectures, lab work and group work; or lectures, demonstration, self-study and lab work.

3.2.2.4. Assessment

Students were asked whether the evaluation criteria of their courses were clear. For 82.3% these were clear; 13.2% indicated that the evaluation criteria were unclear, whereas 4.5% were not sure. The lecturers provided types of assessment. Summative evaluation occurred in all courses, Continuous Assessment Tests (CAT) and end of semester exams in more than 85% of the courses. Formative evaluation was used in only 42.9% of the courses spread over five institutions; one institution did not use formative assessment; in three institutions, formative evaluation was used in all courses. As most courses foresee 30% for CAT and 70% for the end-exam, the biggest gain would be to train lecturers in using formative assessment such that learners could get more insight into their learning progress before the end of semester exams.

3.2.2.5. Digital learning environment, blended learning and e-portfolio

In the majority of the courses (67.3%), lecturers/students used some kind of digital tool/technology; and in two institutions, all courses had a digital component. This did not mean that all lecturers were been trained on using technology since only three lecturers received formal training and five lecturers trained themselves through self-study. About 30% of the courses involved some kind of e-learning or blended learning or use of an (e-) portfolio. It is important to provide training to lecturers on how to use digital tools/technologies for online lecturing or online evaluation and follow-up, and/or on how to integrate these tools in the face-to-face courses.

3.2.2.6. Self-efficacy, teaching and learning approach

Teacher self-efficacy, to measure lecturers' self-confidence in teaching their course(s) was assessed through the scale developed by (Lindblom□Ylänne *et al*., 2006). We found that lecturers were confident in teaching their course(s), M=4.57 (range 3.50-5.00); lecturers with education degree were significantly more confident than those without a teaching degree. To assess how lecturers in aquaculture education teach, we used the approaches to teaching inventory (Prosser & Trigwell, 2006), that consists of two approaches holding each two subscales: the *conceptual change / student-focused* (CCSF) approach and the *information transmission / teacher-focused* (ITTF) approach. Lecturers in aquaculture education generally preferred a CCSF approach that led to conceptual change among students and was student-focused. The ITTF approach was adopted less frequently with information transmission happening more frequently than the teacher-centered approach. There were no significant differences between lecturers based on teaching degree, but differences between the partner institutions were observed in teaching approaches. In three institutions, information

transmission was the most frequent teaching approach, and there was one institution in which the teacher-centered approach was used more frequently than the student-centered approach.

To assess how students preferred to learn, we used the revised two-factor study process questionnaire (Biggs *et al*., 2001). Items had to be rated on a scale ranging from '*never or only rarely' to '(almost) always'*. The 20 items were grouped into two subscales: *Deep Learning* (DL) (studying for a profound personal satisfaction) and *Surface Learning* (SL) approach (studying to pass the courses). Most students preferred the DL approach significantly over the SL approach, and this difference was consistent over the different years of the programme. There were, however, differences between institutions. We observed that students preferred the DL approach much less (compared to the scores in the other institutions) in the institution in which the lecturers used the information transmission approach most during their courses.

3.2.2.7. General assessment of educational tools

In order for lecturers to disclose their knowledge to their students, lecturers needed to have pedagogical knowledge to enhance transfer of their content knowledge to students, and through which means (= technological knowledge). Assuming that lecturers in the field of aquaculture are experts in this field, our survey showed that there is a need for supplementary training of lecturers, both on pedagogical aspects (formulating learning outcomes; designing teaching activities; why using portfolios) and on technological aspects (digital/electronic tools).

Moreover, lecturers reported that they could teach their courses in different modes, when it comes to integrating a digital component. There is a continuum between face-to-face education in which all teaching happens in a classical setting, and e-learning in which all teaching happens online (in a context in which students and lecturers were separated in place and often also time). Blended learning is any form of teaching that combines face-to-face education with an online component. In some institutions, first steps were set towards integrating e-learning in aquaculture programmes, but most lecturers lacked knowledge of what e-learning or blended learning is, and how it could be effectively integrated into their teaching. Moreover, many lecturers reported that they taught in different institutions because of their expertise. To decrease the teaching load of these lecturers, blended learning should be adopted.

As for student assessment, the survey showed that there is room for the lecturers to be empowered to practice better-targeted and timely feedback as well as formative assessment. Formative assessments are low-stake assessments that aim to help the students to cumulatively grow through their learning paths. They do not contribute much to the final grades of the students but rather allow them to gain better insights into the current gaps in their learning gains. The study revealed that most lecturers mainly used the high-stakes summative assessments in their courses (exams account for 70%). Existing non-graded assessment (including CATS) could be reinforced as formative assessment. Timely unbiased feedback on the students' learning process should also be more normalized in the institutions, as it contributes to the continuing growth of the student on the cognitive path. Besides, if more formative feedback would be provided, and more weight would be given to the CAT's, the threshold for passing a course (now generally 40%) could also be raised. Finally, Community Service Learning could be integrated in the programmes, as a powerful pedagogy in which lecturers, students and partner stakeholders learn with and from each other while working on authentic cases provided by the partner organization. This is a way for institutions to connect with the future work field of their students.

4.0 Conclusions and recommendations

Conclusions

i). Aquaculture is a fast evolving field and lifelong learning is key to deliver graduates having qualifications, knowledge and skills tailored to the needs of the labour market.

ii). The present undergraduate programmes do not offer specific specialization in the field of aquaculture but rather differentiate themselves by having different programmes names, and sometimes by putting different intonations. These are reflected in the program's objectives and outcomes and in the descriptions on the institutional websites and study guides.

iii). Lecturers occasionally had opportunities to attend capacity-building initiatives in aquaculture but those opportunities were rare and erratic. Consequently, educational institutions risked being isolated from ongoing state-of-the-art scientific and technological developments in the field of aquaculture.

iv). E-learning and blended learning appeared to be the least optimistic of all the sections studied in this analysis. Kenyan higher aquaculture programmes do not appear to give any much attention to digital learning and blended classrooms.

v). Satisfaction with academic training has a significant effect on both job satisfaction and job performance.

vi). A minority of institutions had an alumni office in place. But even in this case, formal follow-up of alumni was virtually non-existent and only erratic and informal follow-up through social networks took place. There were thus no formal channels to evaluate the impact of education on the graduates' career progression in the long run.

vii). Fish farmers preferred a mixed method of extension information delivery, with preference especially to, individual farm visits, extension farmers-meetings and agricultural shows/trade fairs.

viii). Extension service providers have relevant practical skills and knowledge to deliver services and provide useful information that help fish farmers in improving fish production. However, farmers have concerns regarding extension service providers having the right training materials for extension service delivery thereby necessitating the need for setting up strategies for improvement of extension services.

Recommendations

i). Learning institutions should improve their partnerships with the industry to have the students exposed more to on-site learning experiences and as such, ensure similarity of learning and workplace contexts.

ii). There is need to review, strengthen and improve aquaculture training in order to have programmes that are more suitable for the labour market especially at vocational training level in order to have well-trained vocational graduates for the aquaculture industry and enhanced alumni job satisfaction and job performance in Kenya.

iii). More infrastructure and resources are needed in aquaculture training institutions to enhance the quality of education received by the students especially in gaining of practical skills.

iv). The learning institutions to merge some of the aquaculture related courses, which are either duplicated in different programmes to have specific programmes beneficial to the students.

v). Studies should focus on the use of ICTs in science-based programmes in Kenyan higher education. A change in organizational culture is proposed to help improve the research documentation as well as the adoption of learning management systems, e-portfolios and other ICT-based learning environments in Kenyan higher education.

vi). Kenyan Higher Education institutions and CUE should prioritize teacher professional development among the lecturers. Such continuous professional development efforts will ensure that institutional management does not leave the teaching in these institutions to chance and individual lecturer compassions.

vii). Provision of training for lecturers on modern teaching methodology (pedagogical and technological training) will be appropriate combination to ensure the students in these highly scientifically oriented programmes learn profoundly and with enough focus on higher cognitive and metacognitive levels. Teacher involvement by the faculties in the construction of course and programme outcomes should also be encouraged to make the teachers insiders in the entire learning process.

viii). To improve training and extension service delivery, extension service providers should be facilitated in terms of transport and equipment, improved training materials and tools, and regular/frequent farm visits to farmers.

ix). Recruitment strategies will need to consider employing more extension service

providers to ease the burden of the limited staff who are facing the challenge of reaching out to many farmers.

x). Facilitating extension service providers, providing opportunities for extension service providers' skill and knowledge advancement, and increased female workforce in extension service is necessary for the service to have impact to fish farmers.

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