Aquaculture Technical, Vocational and Entrepreneurship Training for Improved Private Sector and Smallholder Skills Project

Initial Gap Analysis Report

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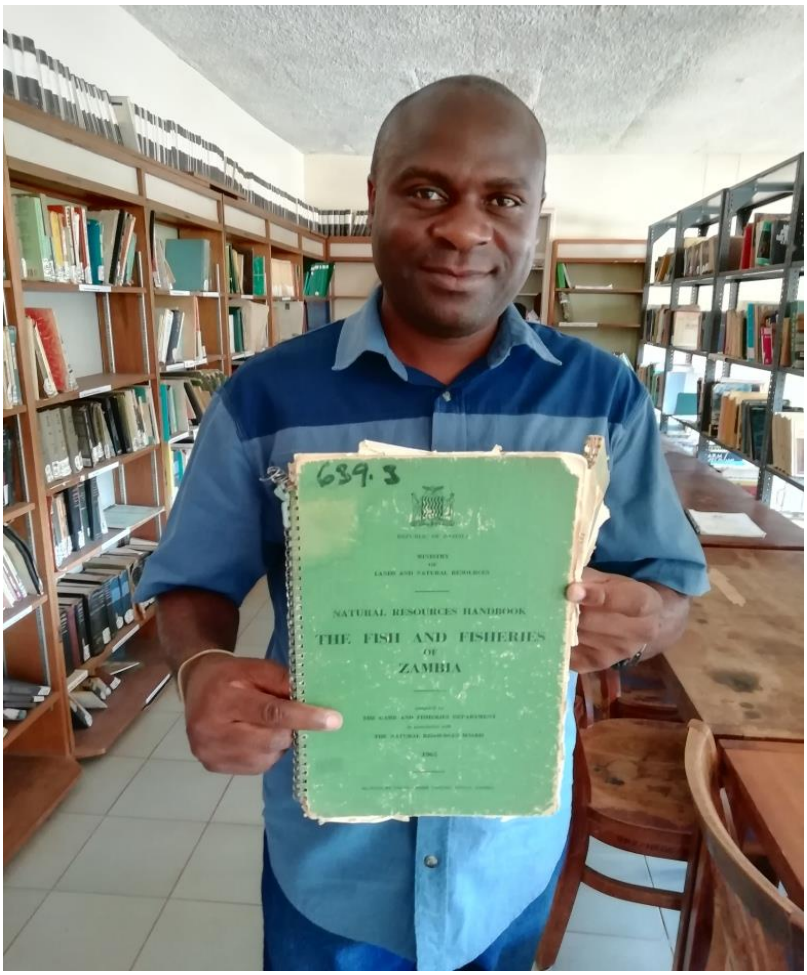

Institute of Aquaculture UNIVERSITY OF STIRLING

Norad BluePlanet MUSIKA Making Agricultural Markets Work for Zambia CGIAR RESEARCH PROGRAM ON Fish WorldFish

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Contents

Tables

Figures

Table 1 Acronyms

AU	African Union
CBU	CopperBelt University
HEA	Higher Education Authority
ID	Imani Development
KMU	Kapasa Makasa University
MU	Mulungushi University
NEPAD	New Partnership for Africa's Development
NORAD	Norwegian Agency for Development Cooperation

NRDC	National Resources Development College
RAS	Recirculation Aquaculture Systems
SANR	School of Agriculture and Natural Resources Mulungushi University
TEVET	Technical Education Vocational and Entrepreneurship Training
UOS	University of Stirling
UOZ	University of Zambia
WFC	WorldFish Center

Introduction and Objectives

In face of the now encouraging, growing commercial aquaculture sector in Zambia and concern about the challenges facing its Fisheries/Aquaculture Science vocational training institutions within its broader Technical Education Vocational and Entrepreneurship Training (TEVET) system, WorldFish Center (WFC) Zambia and partners with financial support from the Norwegian Agency for Development Cooperation (NORAD) is implementing the "Aquaculture Technical, Vocational, and Entrepreneurship Training for Improved Private Sector and Smallholder Skills" project in Zambia. The overall objective of the project is to increase the number of human resources working for the private sector and smallholder commercial fish farmers with enhanced aquaculture knowledge and up-to-date practical skills to help sustainably grow the sector and make it more inclusive.

The project comprises of two components:

1. Upgrading the Fisheries Science curriculum (long and short-term courses), training tools, online training platforms, and internship programs of TEVET institutions in Zambia, namely NRDC and also Kasaka College but with links to other TEVET institutions to scale the upgraded training "package" over the course of the project; and:

2. Enhancing the technical education, vocational, and entrepreneurship skills of rural women, men, and youth smallholder commercial fish farmers and increasing their linkages to input/output markets and entrepreneurship opportunities via private sector extension support and services delivery.

This Gap Analysis Report is one of the initial but key outputs of this project based on addressing major issues in primarily component 1 above. The Terms of Reference for this initial assignment and project deliverable report are listed below as follows:

Overall Objective

- To ascertain and then provide specific guidance on how curriculum revision processes at TEVET institutions, specifically NRDC and Kasaka College, can be carried out in Zambia.

Deliverable Steps within this process

- To understand the synergies between the trainings these institutions provide to students, in particular the focus of the trainings that enable students to obtain a Certificate vs Diploma vs Bachelor's Degree respectively.

- To identify the specific curricula focus and content to enable an upgrade of the curriculum at each institution, with the focus on the consultancy to upgrade the curricula at NRDC and Kasaka.

- Review of current (or recently revised or developed) fisheries science curricula at Kasaka, NRDC, CBU, and Mulungushi University. Carry out a gap analysis and identify the entry points for upgrading the aquaculture and related course content, and especially how each course could incorporate the needs of the private sector.
    - *Deliverable: Gap analysis report and initial recommendations on how to move forward with developing the upgraded curriculum at each institution with relevant stakeholders, with special focus on NRDC and Kasaka.*

- Carry out interviews with relevant Faculty at each institution to acquire their perspectives on best practices to upgrade the fisheries science curriculum (with special attention to aquaculture) at their respective institutions.
    - *Deliverable: Findings to be included in gap analysis report and recommendations on how to move forward with developing the upgraded curriculum and faculty training manuals ("training of trainers") at each institution, with special focus on NRDC and Kasaka.*

- Review tools used to train Fisheries Science students at Kasaka, NRDC, CBU, and Mulungushi University. Carry out a gap analysis and identify training tools (e.g., modules, manuals, references to aquaculture resources, etc.) that are appropriate for students to use at each institution and that will develop their capacities to work specifically with private sector.
    - *Deliverable: Part of the overall gap analysis report. Training tools identified and to be included in the upgraded package for NRDC and Kasaka.*

- Review of the assessment carried out by WorldFish on the staff training needs of the private sector (along the aquaculture value chain) and their perspectives on the course content to be included in vocational training institutions' curricula.
    - *Deliverable: Findings to be included in the gap analysis report and recommendations on how to move forward with developing the upgraded curriculum at each institution.*

- Review of the tracer study carried out by WorldFish (dating back 5 to 10 years) that assessed where students who have attended vocational training institutes are employed (or not employed) and by whom (public versus private sector or otherwise), what were the challenges they faced to find employment (e.g., lack of relevant practical skills training), and how these compare with the needs of the private sector and their perspectives on the course content to be included in fisheries science curricula.
    - *Deliverable: Findings to be included in the gap analysis report and recommendations on how to move forward with developing the upgraded curriculum at each institution.*

Methods and Work Plan

Initially on approval of the contract for this assignment for the University of Stirling (UOS), an experienced team of individual associates were put together with the necessary experience and background in order to cover the range of subject areas and stakeholders involved in any process of upgrading vocational training college curricula and associated resources.

Team members were made up of:

William Leschen (WL)	UOS
Martyn Haines (MH)	Pisces Learning
Jonas Wiza N'gambi (JM)	Private Associate
John Bostock (JB)	UOS
Mike Fuller (MF)	Imani Development (ID)
David Bargh (DB)	Imani Development (ID)

An initial online literature review was carried out of both published papers and grey online literature including relevant websites and media in order to better inform the process ahead.

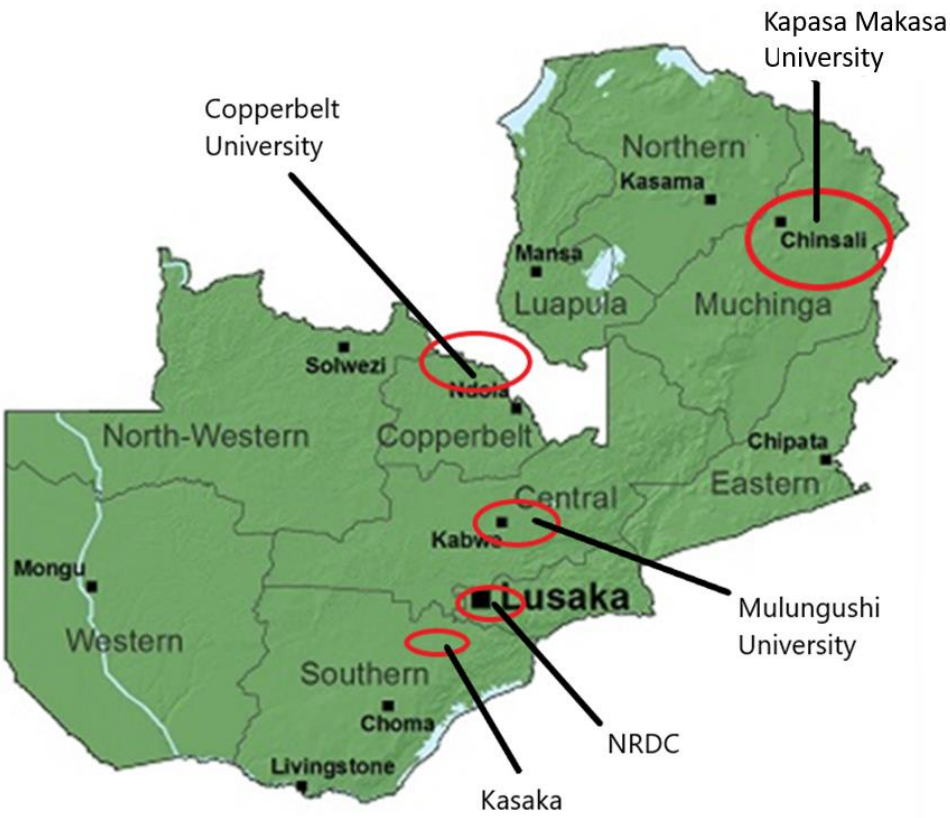

Figure 1: Locations of NRDC, Kasaka College, Mulungushi University, and Kapasa Makasa University (KMU) campus, Copperbelt University (CBU) and other institutions visited by the AQ TEVET team December 2018 – January 2019.

This was then followed by an initial scoping visit to Zambia by William Leschen and Martyn Haines carried out between 3-10th December 2019.

The visit involved initial meetings and discussions between WL MH JM and Steven Cole and colleagues at the WFC office in Lusaka. The key objectives of the overall assignment were discussed and the schedule for the week finalised.

Visits were then carried out to government officer Dr Alexander Kefi (a former graduate of NRDC 1998), the two colleges, NRDC and Kasaka, then Mulungushi University and two commercial stakeholders: a tilapia hatchery operator and a small scale fish processor and retailer, and finally to the fish section of the main Soho market in Lusaka. Meetings with each of the above stakeholders involved discussions based around a key informant/semi structured interview methodology and a previously prepared checklist of key subject area threads which the UOS team used to collect both quantitative and qualitative data. Opportunities were given in each visit and meeting for stakeholders to bring up any of their own concerns or points of view which were not covered within the interviews. These then were developed in the discussions and outcomes noted.

A session was arranged and carried out at NRDC for the UOS team to informally interview and have discussions with 6 former NRDC alumni to gather their different views on their experiences at the college and post-college employment. These discussions centred around what specifically they considered to be positive and also negative about their courses, including areas where they felt the course, the curriculum and the college could improve for future students. The UOS team also talked to current NRDC students in one of the laboratories who were carrying out their practical thesis project work. During the NRDC meetings a range of other teaching staff were also included in the discussions in order to have a better understanding of their backgrounds and experience, as well as collecting their views on the curricula as a whole, and its components. In both colleges NRDC and Kasaka the UOS team were given tours seeing relevant facilities including the college fish ponds and dormitories at Kasaka, and the library, laboratory, IT room and dormitories at NRDC. During the two college visits the up to date curricula overall documents were shared with the UOS team and they were able to ask some initial questions on each and provide some initial feedback.

The UOS team also had a day visit to Mulungushi University (MU) where they had a meeting with different key staff. Although MU doesn't currently run any specific undergraduate or postgraduate courses related to Aquaculture and Fisheries they have expressed an interest in doing so in the near future with the growing interest and commercialisation of aquaculture across the country. Following this initial scoping visit JM also carried out a subsequent similar scoping visit to Kapasa Makasa University (KMU) campus, formerlyCopperbelt University (CBU) with SC from WFC. CBU have been running their own under and postgraduate aquaculture studies and are keen to be involved in the WFC TVET assessment programme in order to get constructive feedback and ideas for their own curricula and students experience, this related to the changing landscape and aquaculture development in Zambia. And also how the current certificate -> diploma -> undergraduate -> postgraduate teaching/training of aquaculture and fisheries can be more structured and mutually compatible with each other.

On return to the UK the UOS team reviewed and collated all their findings and other key documents including the WFC Vocational Students Tracer study and WFC Private Sector Needs Assessment report. Al of these were then used as the basis for this review and Gap Analysis Report which includes identifying the entry points and potential hotspots for upgrading the colleges aquaculture courses' content. It has a strong emphasis for improving these courses and student experience so they are fit for purpose for providing the quality and skillsets that the growing private aquaculture sector in Zambia are now looking for. Also to provide the Zambian government Ministries especially Fisheries and Aquaculture good entry points for well-rounded certificate and diploma level graduates with improved skillsets and experience to better carry out their jobs either in extension or other sectors within the ministry.

Initial Curricula Review: Identifying Gaps and potential areas for improvement

It should be noted that for this report the TOR stated that curriculum review and potential for upgrading and improvement should be concentrating on the two vocational colleges, NRDC and Kasaka which are described in separate sections below. The UOS team (JM) was also involved with a visit and discussions with KMU/CBU over their existing aquaculture and fisheries curricula and a short review from this is also included at the end of this report.

Before going into details on the curricula review for each of NRDC and Kasaka, it is important to state initially that NRDC have been running a 3 year diploma course which is overseen through the University of Zambia (UOS), whilst Kasaka College run a 2 year certificate course overseen through the Ministry of Agriculture. As such the below reviews of each curricula, whilst being bringing forward points and recommendations specific for each curricula and award level, the relationship between the two curricula and their individual contents and levels is also brought out within this report. As we discovered, although not common, there are instances where students had actually gone thorough and completed both courses one after another. Two years at Kasaka gaining a certificate award then a further three years at NRDC achieving a diploma. Therefore five years in total. Whilst it will also be discussed below, for the UOS team it was interesting to see within the two curricula and also hear from the staff for each of the colleges, the overall aim and target levels they saw their graduating students being able to go out and apply for jobs for within the growing aquaculture labour market in Zambia.

NRDC Curriculum Review

Introduction

We were informed by Ms Lizzie Muzungaire the Course Director during our scoping visit that the NRDC Fisheries and Aquaculture Curriculum had undergone an internal review (within NRDC itself) in the last year and as a result had been modified mainly in the areas of changing Module titles as can be seen below - including also some content – in order to better reflect more recent changes in demand from potential commercial sector and government employers. The overall summary module structure is listed out below in Table 2, whilst the rationale for these changes is listed in Table 3.

Lizzie gave some background saying that the college had been established in 1964. It was currently divided into 9 thematic subject areas with their graduates aiming at mid management level employment after leaving this mainly in government ministry positions – extension but now increasingly in commercial aquaculture and also some NGO's. The first year of the curriculum course is considered a bridging one equivalent to A level with basic sciences being taught in the first year. Then into Year 2 specialisation with cutting across the 9 departments including Fisheries and Aquaculture. At the end of Year 2 the students do an 8 week internship mainly in government Fisheries Research stations but also some now on commercial private sector farms of different scales. On the next day after our visit Yalelo were visiting the college to identify and select good potential candidates for up and coming positions on their farms. In 2018 the college had 20 students on the 3 year diploma

course. In the final Year 3 students undergo their research projects. Quality control and overseeing of the courses is through the University of Zambia who certify the diplomas. The college runs a two semester per year system March – June then September – December including: continuous assessment (30%), theory (15%), practical (15%), and final exams (70% respectively). The college also has Distance Learning students for 5 weeks from January each year. Staff are categorised as Senior Training Officers, Training Officers and Help Support Staff for practicals. Currently 5 staff members work on Fisheries Aquaculture course – four of them were originally trained at NRDC themselves! And of the overall operating income for the college less than 50% came from students fees. Currently students have between 20 -30 hours' time per week allocated on the course. Lizzie mentioned that Water Engineering, Food and Nutrition and Animal Sciences were the most popular, whilst Fisheries/Aquaculture and Horticulture courses respectively were the least popular.

Table 2 NRDC "Revised" Fisheries and Aquaculture Diploma Course Plan over 3 Years (Source NRDC Dec 2019) including UOS recommendations/comments.

FIRST YEAR

Semester 1					**Semester 2**				
Code	**Course**	**Hrs/wk**	**CF**	**UOS Comments**	**Code**	**Corse**	**Hrs/wk**	**CF**	**UOS Comments**
ABM 111	Farm Accounts	4	3	*Better in Yr2? to follow Economics inYr 1, prior to entrepreneurship in Yr 3? This makes way for a fish related unit in Yr 1?*	ABM 122	Introductory Economics	6	3	
AG 100	Farm Routine	4			AG 100	Farm Routine	4		
BS 111	Botany	7	5	*Including introductory session on edible aquatic plants*	BS 122	Zoology	7	5	
BS 131	Chemistry	8	5	*Any potential to include water chemistry? Some introduction examples included of standard farm chemicals disinfectants, fertilisers and treatments.*	CS 112	Fundamentals of Soil Science & Crop Production	4	2	*Again some relevant mentions of integrated crop fish systems, rice, aquatic plants*
BS 181	Mathematics	5	2	*To include relevant introductory example calculations from agriculture/aquaculture ?*	FS 162	Marine Mechanics	7	4	*Can this move to later year to make way for fisheries or aquaculture Unit in Yr 1, especially if Farm Accounts cannot move?* *Would be a good Unit in Yr 2 as relevant to Fishing Technology there. Better more relevant to industry title: "**Boat operations and navigation"**, especially for commercial cage farmers*

				To include section on networking and (aquaculture related) information searching on internet.					*Better more meaningful title "**Site surveying: land and water**"* *Can exercises include simple surveys for gradients on pond production sites and depth and rudimentary hydrographical measurements for cage sites?*
ED 111	Communication & Computer Skills	6	2		WE 132	Introduction to Geomatic Engineering	7	3	
		35					35		

SECOND YEAR

	Semester1					**Semester2**			
Code	**Course**	**Hrs/wk**	**UOS Comments**	**CF**	**Code**	**Course**	**Hrs/wk**	**CF**	**UOS Comments**
AS 211	Pig, Poultry & Rabbit Production	7	*Can this be replaced with Unit called **"Integrated livestock production systems"** to include aquaculture integration? As this of interest to all departments. If not should have integrated systems content within.*	4	AG 200	Industrial Attachment			
FS 211	Fisheries of Zambia	4	*Move into Yr 1 & include aquaculture as part of 'fisheries' This Unit not liked by many students we met. It should be a motivating Unit in Yr 1 to make undecided students want to do aquaculture. Content and delivery should be reviewed – also Reading list must be modernised.*	4	AS 212	Ruminant & Pasture Production	7	4	
FS 231	Limnology	7	*Too academic and specialised a title for a Diploma.* *Suggest this replaced with **Aquatic environment and water characteristics?***	4	BS 222	Statistics	7	2	*Must update reading list – several specific aquaculture stats books*
FS 241	Fishing Technology	7	*Some case for moving this to Yr 3 to balance more nos of teaching hours*	4	ED 251	Rural Sociology	5	2	
FS 251	Fish Taxonomy	7	*An ideal Yr 1 Unit to introduce students to fish biology with emphasis on*	4	FS 252	Fish Anatomy & Physiology	7	4	

			external features and identification. Also links well to Fisheries of Zambia and aquaculture moved to Yr1.						
					FS 272	Introduction to Aquaculture	7	4	*This should go into Yr 1 in some format or else many ? students will not wait & decide after Yr1 to take another path in their course not aquaculture.*
					FS 292	Field Trips & Practicals	4	4	
		32					36		

THIRD YEAR

Semester1 **Semester2**

Code	Course	Hrs/wk	CF	UOS Comments	Code	Course	Hrs/wk	CF	UOS Comments
ABM 341	Entrepreneurship	4		*This should include relevant up to date aquaculture case studies of different scales. Visiting guest lecturer?*	ABM 332	Project Management	4	2	
ED 361	Agricultural Extension	4	2	*Guest lecturer for at least some of this course*	BS 302	Environment and Natural Resource Management	4	4	
FS 361	Fish Processing	7	4		FS 312	Fisheries Statistics	4	4	*Is there need for this in year 3 if Statistics course already in Yr 2?*
FS 371	Applied Aquaculture	7	4		FS 332	Aquatic Ecology	7	4	*This could be better in Yr 2?*
FS 381	Fisheries Management	5	4		FS382	Fish Stock Assessment & Population Dynamics	5	4	
FS 390	Research Projects	4			FS 390	Research Projects	4	8	
		27					28		

Table 3 NRDC "Revised" Fisheries and Aquaculture Diploma Course Module changes and status of courses by internal review 2017/2018 (Source NRDC Dec 2018)

Code	Course Name	Status	Reason for Change from internal review not UOS
FS 162	Marine Mechanics (formerly AE 162-Marine Engineering)	Name and code changed and content adjusted; practical sessions to be included	-Name changed to capture the other operational technics that are needful towards operating on water. -Course code changed to FS as the course is more inclined e inclined towards fisheries science and so to be administered by fisheries department.
FS 211	Fisheries of Zambia (formerly Fish and Fisheries of Zambia)	Name changed and content adjusted	-Name changed to drop the fish species component as this is covered in later course (biology).
FS 231	Limnology (formerly Hydrobiology)	Name changed and content adjusted	- the course to focus mainly on the hydro-dynamics of lakes and other fresh water systems; leaving out the biology which is already covered in first year under Zoology and Botany
FS 241	Fishing Technology (formerly Fishing Gear Technology)	Name changed and content adjusted	- Course focuses on various technologies as they apply to fishing; not only gear.
FS 251	Fish Taxonomy (formerly Fish Biology1)	Name changed and content adjusted	- Focus at this stage is mainly classification, identification and naming of fish.
FS 252	Fish Anatomy and Physiology (formerly Fish Biology2-FS 351)	Name and code changed and content adjusted	- **F**ocuses on not merely general biology but detailed physiology. Recoding since to be offered in second year.
FS 272	Introduction to Aquaculture (formerly Aquaculture-FS 271—to be offered in two semesters)	Name and code changed and content adjusted	- Aquaculture is a specialized branch of fisheries and there is need to broaden the training base to cover as many aspects of aquaculture as necessary. Likewise, more relevant content has been fused in; with a lot of emphasis on practical training.
FS 290	Field Trips and Practicals	New course	- fisheries training is challenging owing to difficulties in accessing practical training facilities such as seamanship/boat handling, safety on water; river/lake ecology; in-situ observations - training will require field excursions to meet the training needs (hours to a week). - exposing students to current trends in the industry through organized seminars at which scientific presentations would be made
FS 301	Introduction to Fish farming and Apiculture (formerly Fundamentals of Fish Farming)	Name and code changed and content adjusted	-Just like FS 302 but rather shallower in terms of content (to be taught to all **agriculture groups including Food and Nutrition and Horticulture students**). -will not include intensive practicals and so allocated 5 hours per week.
FS 302	Fundamentals of Fish Farming and Apiculture (formerly Fundamentals of Fish Farming)	Name changed and content adjusted (**to be taught to Agric Education students**)	-content reinforced by adding a lot more topics as required by Ministry of Education for a teacher to be. -apiculture seen as a necessary component -to have intensive practicals and so allocated 7 hours per week from 4 hours.
FS 311	Fisheries Statistics	Not much change apart from reinforcing content to meet current practices	
FS 361	Fish Processing (formerly FS 261)		-Recoded since moved from second to third year
FS 371	Applied Aquaculture (formerly Aquaculture-FS 271—to be offered in two semesters)	Name and code changed and content adjusted	
FS 381	Fisheries Management	Name and code remains same	- Content has been reorganized and shuffled around; with a lot of inclusions and eliminations to meet training needs.
FS 332	Aquatic Ecology	Not much change apart from reinforcing content to meet current needs	- Practicals have been included since the earlier curriculum did not have any
FS 382	Fish Stock Assessment & Population Dynamics (formerly	Name Changed and content adjusted	- Content has been reorganized and shuffled around; with a lot of inclusions and eliminations to meet training needs

	Fish Stock Assessment)		
FS 390	Research Projects (formerly Practicals and Projects)	Name changed and content adjusted	Content reinforced to appeal to needs of research execution

We now go on to give more feedback on the specific courses content and structure. Whilst these are in some cases quite detailed we think it is important to include within the report at this stage as these go on to inform the Curriculum Design Workshops which follow this Gap Analysis Report. Note the format is selected sections from the curricula are included and then below in bullet points the UOS team add their comments and recommendations. These should be read in conjunction with the Curriculum document:

FS 162: MARINE? Freshwater ? MECHANICS Target group: First Year Fisheries Students
Contact hours: 4 Lecture Hours/week

- Recommend change in course title: **Boat operations and navigation** –Also why is this titled as Marine? If the existing course content is mainly related to freshwater then this should be represented in the title.
- Title and content must reflect growing commercial cage culture sector
- Also if not the capacity to teach this side of the course within NRDC then guest lecturer from industry to come in?

Aim: To enable Leaner acquire knowledge and skills towards approach to marine mechanics and dealing with water transport in general.

- This aim should include mention of cage culture daily procedures as well as government fishery officer type wild fisheries related boat operations.

Objectives

- These need to be rewritten so that they better reflect new title and cage culture content
- Noting as we will say again below Objectives should be clearly measurable and achievable and should be towards the basis for assessment – throughout the curriculum for each module

Course outlines

- These require addition of cage culture section

Practicals

- Would recommend over time % of practical time increased. But this as with all other practicals throughout course depends on financial resources available.

Reading List

- Existing book list relatively up to date. But are they each available in college library? If not then they can't be recommended? Would be good here to ask industry the larger cage producing companies Yalelo, Lake Harvest to simply share their staff cage culture operating manuals. If they are willing to do so ?
- Recommend Cage Culture by Malcolm Beveridge But this will need to be purchased https://www.amazon.co.uk/Cage-Aquaculture-Malcolm-Beveridge/dp/1405108428
- Recommend following this report and then overall review towards upgrading the two curricula that a new book list to be acquired is drawn up with two categories: 1.Essential books which should be purchased /acquired 2. Other useful books which should be acquired one by one in future - Both categories should include costs for individual books and then total costs.

FS 211: FISHERIES OF ZAMBIA Target group: All Second Year Fisheries Students
Contact hours: 4 Lecture Hours/week

Aim: To enable Leaner acquire knowledge about the Zambian Fisheries with respect to their biological, physical and chemical conditions.

- Recommend this module needs to make explicit reference to aquaculture, in order to act as an introduction and attraction to first year students, so as they know where fish farming is being conducted in Zambia, and in basic terms why. It also needs to link to the governance and statute impacting on the sector (positively and negatively).
- Should be in Year 1
- Recommend/ Suggest new title **"Introduction to Fisheries and Aquaculture in Zambia"**

Objectives

- These objectives are short and broad- and in many cases non-measurable, therefore of limited use to guiding assessment as in Marine Mechanics before. As across all courses objectives these need to be elaborated to become directly functional within students assessment development and also overall course Quality Assurance process
-

Course Outline

- Unlike Marine Mechanics module, this course outline is very skeletal. Does it reflect everything that is delivered? Needs to be more developed content so as the NDRC management have more QA control over it.
- For instance no reference to fishing methods used in Zambia to provide some overview.
- This module was criticised by some students we met, which is surprising as it would be popular in the UK... Perhaps it has emphasis on legislation as opposed to the broader content that inspires students?
- Would expect reference to basic concepts such as sustainably yield, in relation to fishing method.

- Also module would benefit from simple focussed case studies
- Unit would benefit from full review and modification with lead tutor

Reading List

- What is the difference – not clear - between prescribed and recommended books? Perhaps first is essential to the course and latter good for students if they can read?
- Needs to be clearly monitored and evaluated by individual tutors in each course that student has at least opened and read something from each prescribed book – should be built into students assignments. There is obvious trade off between more conventional books in library as a resource and online learning and accessing of course texts.
- UOS recommend healthy balance of both, noting that there are still very much some essential key written book publications which are not and never will be available on the internet.
- Needs here if course content to include as prescribed introduction to aquaculture several standard books
- M Landau Introduction to Aquaculture https://www.amazon.com/Introduction-Aquaculture-Matthew-Landau/dp/0471611468
- M Huet Text book of Fish Culture https://www.amazon.co.uk/Textbook-Fish-Culture-Breeding-Cultivation/dp/0852381409
- Bhujel Ram 2014 Manual for Tilapia Business Management CABI Publishers https://www.amazon.co.uk/Manual-Tilapia-Business-Management-Bhujel/dp/1780641362
- Then also recommended:
- W Howarth Law of Aquaculture https://onlinelibrary.wiley.com/doi/abs/10.1002/rrr.3450070210
- Stickney, R. R. 1979. Principles of Warmwater Aquaculture. John Wiley & Sons, Inc. New York. 375 pp. https://www.amazon.com/Principles-Warmwater-Aquaculture-Robert-Stickney/dp/047103388X

FS 231: Limnology

Target group: All Second Year Fisheries Students **Contact hours:** 4 Lecture Hours/week
Practical: 3 Hours/week ***Pre-requisite:*** *FS 211*

Introduction

Lakes, rivers, swamps and streams cover approximately 20% of Zambia's surface area and affect human life. Proper management of the water resources depends on understanding of the types of water bodies and how physical and chemical parameters influence life in aquatic ecosystems. This course is intended to provide students an understanding as to how diverse life forms are organized in aquatic ecosystems and affected by the physical and chemical factors.

Aim: To enable students describe and characterize aquatic ecosystems using limnological techniques.

- This description fits well with UOS proposed recommended new course title: "**Aquatic Environment and Water Characteristics"**
- Needs care and some review perhaps to avoid duplication and repetition with Aquatic Ecology in Year 3
- Would suggest if needed to rationalise and reduce number of overall courses these two as an option could be merged - but should stay in Year 2.

Objectives

- Course objectives are well written, and can directly be used to derive a quality assured assessment strategy and instruments of assessment- except for number v. which is using incorrect "immunological " term and should be re-written.

Course Outline

- Well-structured course outline and the content looks strong and complete. A good module. It just needs a better, less academic title to appeal more to both the students and the aquaculture industry.

Reading List

- Ok - but must include one book here with pond fertilisation as core part.
- Recommend - Hilary Egnah Claude Boyd Pond Dynamics https://www.crcpress.com/Dynamics-of-Pond-Aquaculture/Egna-Boyd/p/book/9781566702744 This a must for the students anywhere round the world
- On recommended list - Boyd, C.E. 1979. *Water Quality in Warmwater Fish Ponds.* Agriculture Experiment Station, Auburn, Alabama. 359 pp.

FS 241: Fishing Technology Target group: All Second Years Fisheries Students
Contact hours: 4 Lecture Hours/week **Practical:** 3 Hours/week

Aim: To enable Students get an insight on the various fishing techniques/operations as used in Zambia while making reference to those applied in other parts of the world.

Introduction

This course gives an insight of the classification of various fishing gear (more especially those used in Zambia), their design, mending and principles of operation. It also includes fundamentals of net making aimed at providing the student sound understanding of both practical and theoretical components. Generally, it is meant to provide a solid ground for future skills in fishing methods. It is divided into six (6) units to make it easy for you to follow the content.

- Introduction can have slight rewrite to make it non-personalised

Objectives

- Good objectives and appropriate. There is an obvious link to the Boat Operations Unit (objective vi), which justifies its movement from first to second year (as proposed).

Course Outline

- Generally good categories but clear overlap here with 6. Seamanship which should be in the Boat handling course

Reading List

- Seems ok but rather old publications - Can at least one be updated to more up to date books?

Practicals and Assessment

- Surprised in a practical based course like this only 10% assessment for practical component?

FS 251: Fish Taxonomy Target group: All Second Year Fisheries Students
Contact hours: 4 Lecture Hours/week 3 Practical Hours/week

Aim: To enable Students to have basic knowledge and skills as related to classification through distinction of external features.

Introduction

Fish identification is no doubt the first step towards resource conservation. It aids the Fish Biologist/Manager to be able to follow fish populations per various classes. The course is therefore deals with the classification of fishes, naming of fishes, their external features and their basic internal anatomy.

Objectives

Identify the external features of a fish

Describe the internal anatomy of a fish

- The Fish Anatomy module is proposed to be moved to Year 1. Therefore these 2 above objectives are revision and consolidation, which planned in the right way, can fit well in the overall course in terms of follow on, and preparing the students for the more scientific aspects of taxonomy.

Course Outline

4. Poison, electricity, light and sound production in fishes
5. Colouration in Fishes

- The first three sub sections are good, but then the module seems to run out of logical flow? Points 4 and 5 above are strange and rather out on limb? Worth reviewing and redefining.

Practicals

- Hopefully these done with both tilapia and Clarias to show comparative physiology.
- Also important here these done with no more than 2 students per fish? Hands on learning
- Not effective if just one dissection done at front of class by lecturer
- This has obvious resource implications for dissecting kits boards etc.

Reading List

- Is ok

Time allocation and Assessment:

- No comment

FS 252: Fish Anatomy and Physiology Target group: All Second Year Fisheries Students
Contact hours: 4 Lecture Hours/week 3 Practical Hours/week *Pre-requisite:* *FS 251*

Aim: The course is aimed at orienting Students with aspects of the biological make-up of the various fish species; concentrating on the life supporting systems.

Introduction

Cardinal to the life sustenance of any living organism is the life supporting systems. The understanding of the said systems helps a Biologist in fisheries management aspects such as the multiplication of numbers through enhanced reproductive capacity. The Course gives an introduction to the various systems found in fish, with an emphasis on the anatomy and physiological adaptations to varying aquatic habitats. The following themes are covered: muscular system, sensory system, skeletal system and reproduction.

Objectives

i. Describe the anatomy and physiological adaptations of fish in relation to their environment.

ii. Analyse the internal organs of a fish
    - Very underdeveloped objectives. Need to be elaborated. No mention of the important practical competences of fish dissection and removal of identified organs for example.

- "Analyse" seems to have the wrong emphasis or needs further definition. Some reference to identification of the organs would be expected.
- Also, no reference to recognition of organs in their normal healthy state. This is an important point providing preparation for fish health studies, from an aquaculture perspective. Needs elaboration
- These key points and skills learnt that commercial farms mid to larger scale will be happy to see in the curricula – Many Department of Fisheries staff and also some university graduates don't know how to do this.

Course Outline

- The introduction refers to an emphasis on adaptions to various habitat. This is not reflected in the course outline which is pure physiology... Is there something missing?

Practicals

- It would be useful to have more definition & specifics for each practical – also no mention of species?

Reading List

- Some replication from before but worth looking for and updating for more tilapia and Clarias related books with clear line drawings and/or photos – these can be found in opening sections of a number of fish health books.

Assessment:

- Again very low (10%) for practical assessment
- Also not clear what is meant here by practical assessment paper – exam?

FS 272: Introduction to Aquaculture *Pre-requisites:* *FS 231 & FS 211* **Practicals (3 Hours/week)**
Target group: All Second Year Fisheries Students Contact hours: Lectures (4 hours/week)

- As this is such a key course for the whole diploma we have developed a proposed revision of the entire unit which we wish to present and then discuss at the curricula design workshops.

Aim: The Course is aimed at equipping Students with basic preparatory principles in aquaculture; more specifically fish farming.

- This should be reworded

Introduction

With the ever-dwindling fish stocks experienced from the natural waters, Aquaculture is a sure initiative designed to complement the much needed fish resource. The Course therefore highlights basic tips in fish farming such as introductory concepts and definitions, set-up of a fish farming facility as well as other key preparatory aspects in order that one may attain a successful fish farming enterprise.

- This does not sound introductory, but more advanced. We would expect this module to start with overview of extensive, to intensive and monocultures to polycultures and into integration to appear here.

Objectives

Describe the various Aquaculture Systems and facilities as employed in Zambia.

- "Outline" better than "Describe" - this is introductory level

Illustrate the key preparatory activities to undertake before setting up a fish farm.

- This also sounds beyond introductory?

Determine the main characteristics of fish species suitable for aquaculture in Zambia.

- This objective more in line with what should be in an introductory course

Course Outline

- As above we feel for the first introduction to aquaculture course there is almost too much moving into advanced here
- We would take out planning new fish farming site and enterprise site selection etc. – this to go in next module or at least minimise it in this one.
- This introduction course should give students overview of aquaculture itself – general principals and categorisation of different systems species - with Zambian focus but history can include brief introductions to other key aquaculture systems species including non-fish section shrimp, seaweeds and freshwater aquatic plants.
- No mention of Recirculation Aquaculture Systems (RAS) here?
- Also must be simple but short introductory section on market chain also feed inputs supply.

Practicals and Assessment

- Survey land and test soils for a pond construction and possibly build pond
  Build tanks with breeze blocks and mortar Mock raceways with inlets outlets etc.?
  Plumbing and filters?

Reading List

- Ok – see common books recommended also from Fisheries of Zambia above.

FS 292: Field Practicals and Seminars Target group: All Second Year Fisheries Students
Contact hours: 4 Lecture Hours/week

Aim: To enable Students acquire practical orientation and general know-how on various principles/field activities in the fisheries industry.

Introduction

The fisheries training programme is relatively challenging considering the fact that training facilities (water bodies and aquacultural activities) are not always available at the training institution. It is in this vain that students would need to be taken to the points of operation for them to learn and appreciate the fisheries field. Such field visits are meant to consolidate the various fisheries aspects as would be covered through the training programme. Students would then have to undertake intensive practical experience of a minimum of one week at fisheries stations (one capture and one aquaculture) during the training duration. This course is meant to prepare fisheries second Year Students towards undertaking research projects; an activity which is summed up in the Third Year of study. It is meant to provide a solid foundation for their future skills in planning and conducting scientific research. It is for this reason that this course will offer the much needed tools in the designing, setting up research experiments, field surveys, and data collection techniques. They will then be expected to produce and submit a concrete Research Proposal in readiness for execution.

- Important point that the necessary training facilities not available at the college - the curriculum and practicals must fit in with the current facilities and planned future ones
- Hope also through new intern scheme building new links with commercial sector some of these private sector farms and other can be used for on farm practicals.
- Recommend existing policy of conducting scientific research within this diploma course should be reviewed. Students having to pay for their own thesis laboratory and other equipment costs is not sustainable
- We recommend ok to teach the principals of scientific research within the curriculum and perhaps use one or two case studies for the students – ie a simple feed trial to demonstrate principles in taught course. But to ask the students to carry out their own research projects at their own expense is a step too far for this course in our view.
- Also will any of the target employers want their students to have these types of skills?
- Better to allocate resources and time in the course to other areas.
- Writing and submitting a proposal for research funding should be for under or even postgraduate not diploma level. However within Entrepreneurship? or other aquaculture module writing and submitting a business plan/model for outside investment or funding should very much be included. This far more relevant.

Objectives

- Poorly expressed objectives, that are not really objectives at all as most are activities... What are the objectives of these activities is the question that needs to be answered?

- These practicals are important skills development and experiential learning opportunities. Can they not be better defined here, even if only indicative? Will they include hatchery, on-growing and fisheries, or are they entirely opportunistic? Can improving links with industry including internships make them a more routine and predictable part of the curriculum that can be better defined?

Course Outline

1.0 Seminars and presentations.

- From who to who and for what purpose? More definition needed.

2.0 Short term practical undertaking at various aquaculture facilities.

3.0 Intensive field practicals.

3.1 Capture fisheries station such as Sinazongwe, Ithezhi-tezhi, Kariba or any other.
3.2 Aquaculture facility like NARDC, Palabana, Misamfu or any other.

- What's the difference between short term and intensive? Not clear…… And what purpose for each?

Reading List

- Needs some revision. These mainly water and chemical based publications. Addition of different field work manuals looking towards informing student of field skills and best management practices when they are out in the field or also in the labs in college.

S 311: Fisheries Statistics *Pre-requisite:* *FS 290* Target group: All Third Year Fisheries Science Students Contact hours: 4 Lecture Hours/week

Aim: The Course is designed to equip Learners with general concepts and tools as applied in Fisheries data collection strategies and analysis.

- To question ? shouldn't this module also include aquaculture component – Could through one of private sector partners include proprietory on farm software package? This linked into Blue Planet online material. And to be included 50/ 50 alongside Fisheries statistics?

Introduction

The fisheries industry strives to achieve sustainable stock levels and therefore data collection is vital in assessing levels so as to administer appropriate and timely management measures. It highlights key surveys as undertaken by the Department of Fisheries in an attempt to take inventory of the fishing industry (Fishing community and their fishing methods) as well as the diversity and abundance of the fish stocks.

Course Objectives

i. Explain the "concept" of fisheries statistics;

- Better to explain the “purpose”
- Objectives should also include one related to aquaculture on farm records and managers weekly/monthly reporting in relation to statistics ?
- Again fish farming private sector would like to see this in.

Course Outline

- Other than above comments about aquaculture statistics/records keeping outline is good and comprehensive for Fisheries.

Assessment:

- OK

Reading List

- Needs to reviewed
- But would include these two below:
- Choosing and using Statistics: A Biologists Guide. 2011 Calvin Dytham. Department of Biology, University of York Third Edition A John Wiley & Sons, Ltd., Publication Wiley Blackwell 316pp https://www.amazon.co.uk/Choosing-Using-Statistics-Biologists-Guide/dp/1405198397
- Statistics for Aquaculture Bhujel R 2009 Wiley https://www.wiley.com/en-us/Statistics+for+Aquaculture-p-9780813815879

FS 332: Aquatic Ecology Target group: All Third Year Fisheries Science Students
Contact hours: 4 Lecture Hours/week 3 Practical Hours/week *Pre-requisite:* *FS 231*

Aim: To enable students describe and characterize and identify aquatic organisms.

- This does not seem complete as an aim for ecology. Should go beyond mentioning the organism level, to refer to communities and habitats

Introduction

Lakes, rivers, swamps and streams cover approximately 20% of Zambia's surface area and many people depend on water resources for income generation. Good management of aquatic resources depends on understanding of organisms that are found in water bodies and how they are affected by physical and chemical parameters. This course is intended to provide students an understanding of the structure and dynamics of life forms and how they are organized in aquatic ecosystems.

Objectives

Describe physical and chemical characteristics of water bodies in relation to aquatic productivity;

- Big overlap with Limnology objective. Intentional? Same tutor or different?

Describe conventional hydrobiological techniques used in aquatic studies

- Aquatic ecological studies... Why is the objective to "Describe" and no objective to conduct field work and gain field skills? This is a great unit for applied experiential learning and it can be conducted on a wide range of local waters at relatively low resource cost.

Apply basic principles and concepts for the protection and conservation of aquatic organisms;

- Conversely, this objective goes too far. How can students apply basic principles? Is this by forming a conservation policy and plan perhaps? If so, the objective should refer to this output.

Course Outline

- Well-articulated

Practicals

- OK and specific enough

Assessment:

- Practical reports 10% should be increased. This module lends itself to this.

Reading List

- OK but again could benefit with more up to date publications
- A number of good online resources for this topic – again to include as links in Blue Planet? e.g. **http://www.ramp-alberta.org/river/ecology/aquatic+ecology.aspx**

FS 361: Fish Processing Target group: All Third Year Fisheries Science Students
Contact hours: 4 Lecture Hours/week **3 Practical Hours/week**

Aim: To enable Students acquire knowledge and skills as pertaining to fish processing Approaches aimed at enhancing life span of the already scarce fisheries resource; and to further process fish in such a manner that value addition is attained.

Introduction

Dealing with the fish after harvesting is a cardinal exercise in the fishing industry. Therefore fish processing is a discipline that endeavours to retain the fish quantities as were harvested by devising strategies that will ensure minimal losses are incurred. Thereafter, value addition techniques are also applied to enhance consumer appreciation; thereby profit maximization. In this vain, fish processors promote good handling practices, understanding of fish spoilage agents, improved processing methods and ultimately, fish quality control mechanisms.

- Long language and writing style of Aim /Introduction detracts from main message. Needs simple rewrite.

Course Objectives

- From our meeting with students and the instructor it is clear this module is very practical in nature and also enjoyed by the students. There is no objective here to indicate this. Should there not be? However, the content below does make the practical nature clear.

Define fish processing

- This should not be Define – Rather actually doing it - again the practical nature of this module

Identify the external features of a fish and their functions in the fish life.

Application of morphometric and meristic measurements in fish identification.

Describe the internal anatomy of a fish.

- These 3 objectives useful overlaps with Fish Taxonomy but beware of repetition

Course Outline

- Good, well-structured with logical progression. We heard from student feedback a popular course.

Practicals

- Good !! All of these -

Reading List

- OK but again might need some more modern updates
- Here access to online videos through likes of Blue Planet or other sources would be very valuable.

S 372: Applied Aquaculture Target group: All Third Year Fisheries Students
Contact hours: 4 Lecture Hours/week 3 Practical Hours/week *Pre-requisites:* *FS 272*

Aim: The Course is aimed at equipping Students with advanced application principles in aquaculture; more specifically fish farming.

- "Advanced application principles"? Aim could do with rewrite.

Introduction

The Course is aimed at equipping Students with general principles in aquaculture; more specifically fish farming. It is meant to highlight application concepts in fish farming as relate to management techniques which are appropriate towards attaining a viable/profitable fish farming venture. The Course further introduces the practice of integrated farming which leads to maximum utilization and resources to further hike profitability of farming as a business.

- Good, but need to watch the overlap with the **Integrated livestock production** module proposed.

Objectives

Apply the various water quality management approaches

- Good, but how will they apply this? Or is this really about knowing how to apply? In the future when the NRDC have a fish holding facility, yes.

Evaluate the significance of nutrition in aquaculture

- Poorly worded objective. Nutrition is highly significant in aquaculture! Needs rewriting.

Formulate an appropriate diet per given growing stages of fish

- Appropriate to which species?

Explain the feeding rationale in aquaculture

- Isn't this just different feeding strategies?

Describe types of diseases in aquaculture

- This needs to be in its own unit/module. From commercial sector feedback this is one of the main ones they want to see taught well in the curriculum. Would also ask for NRDC to review if they have necessary staff expertise in this – if not then should take necessary action. Guest lecturer?

Justify the significance of Environmental Health in fish farming activities.

- Needs rewording. Is this about environmental impact? Or actually as it sounds?

Course Outline

- *Note here in italics we have shown proposed draft restructure*
- *Add hatchery outcome? Site selection design, construction, or create Hatchery Unit (take out 1.0 and 2.0) Include Catfish*
-

1.0 Aquaculture production
- 1.1 Fish seed production
- 1.2 Natural production and Artificial production

2.0 Broodstock selection and management.
- 2.1 Fry management
- 2.2 Mono-sex production
  - 2.2.1 Physical
  - 2.2.2 Hybridization
  - 2.2.3 Hormonal
    - 2.2.3.1 Sex reversal
    - 2.2.3.2 Super male technology
- *2.3* Management practices *(Change to 3.0)*

2.3.1 Water quality and quantity

2.3.1.1 Dissolved Oxygen, Temperature, pH, Turbidity, Liming and water levels

2.3.2 Weeds in aquaculture *Aquatic vegetation benefits and control, including plankton*

2.3.3 Pond fertilization. Fertilising and liming (could go under 3.1.4)

- Note add reference to lined structures, including wood to intro to Aquaculture
- Pond fertilisation very important part of course and must have practical inclusion

3.0 Fish nutrition and aquaculture

3.1 Energy requirements and sources (revise title)

3.1.1 Carbohydrates, Proteins and amino acids, Lipids and essential fatty acids, Vitamins and Minerals

Supplementary feeding

3.1.2 Feed formulation and preparation

3.1.3 Live food production *(move)*

3.1.4 Feed storage

3.2 *Methods of feeding fish*

Intensive feeding regimes

3.2.1 Fish stock record keeping

3.2.2 Feed distribution,

3.2.3 Growth and FCR calculations

4.0 Health and diseases in aquaculture

- Should this be a Unit or major part of one? Yes….! Industry feedback strong on this
-

1.1 Factors that affect fish health

1.1.1 Host susceptibility, Pathogen and Environment

1.1.2 Major diseases in aquaculture and their management

1.1.3 Viral diseases, Bacterial diseases, Fungal diseases

1.1.4

- Suggested other content for new unit/module
- Biosecurity?
- Parasitology? It was not included….
- Parasite practical?
- There also must be section here on how to treat fish
- The calculations of doses and then the methods step by step
- Bath and flush treatments in tanks
- In ponds

- In cages
- In feed treatments? Calculations of dosages.
- All of these very important for the industry - they will be very happy to see in curriculum
- In future treatment must be a practical - this very important

2.0 Integrated Aquaculture

2.1 Rationale and *history* for integrated farming

2.2 Forms on integrated aquaculture

2.2.1 Fish cum livestock

2.2.2 Fish cum crop

2.3 Fish-livestock-crop integration

2.4 Economics of integrated aquaculture

- Would take this 2.0 out to go into earlier module to give more time on fish health
-

3.0 Aquaculture and the Environment/Public Health

3.1 Impact of aquaculture on the environment

3.2 Environmental impact assessments relevant for aquaculture projects in Zambia Case studies and how to do one

3.3 Zoonotic risks of aquaculture

3.4 Occupational health for those working on fish farms

Practicals

i. Live fish handling, transportation and stocking

ii. Feed formulation, preparation and feeding *(Include pond fertilization practical) and assessment of growth food and FCR*

iii. Natural and artificial fish seed production

iv. Fish health and treatment practicals

v. Taking samples for fish health analysis and diagnosis

vi. Then fish treatments practical in different holding facilities with different treatments

vii. Field visits (Integrated farming, Cage farming, Seed production facility). ***Annual field visit to Aquaculture Research Station!***

Reading List

1. Silva, S.S. & Anderson T.A. 1995. *Fish Nutrition in aquaculture,* London New Yolk: Chapman and Hall. ISBN- 13:978-0412550300.
2. Pillay, T. (1993). Aquaculture: principles and practices. Oxford Cambridge, MA, USA: Fishing News Books. ISBN-10: 0852382022, ISBN-13: 978-0852382028.

- Jauncey K Tilapia Feeds and Feeding 1998 Pisces Press - https://www.amazon.co.uk/Tilapia-Feeds-Feeding-Kim-Jauncey/dp/0952119846
- Haylor G and Muir J Fish Hatchery Manual for Africa Pisces Press

- Steffens Werner 1985 Principles of Fish Nutrition Ellis Horwood Publications https://www.amazon.com/Principles-Nutrition-Horwood-aquaculture-fisheries/dp/0745805558
- Halver John 1972 Fish Nutrition Academic Press Elsiever https://www.elsevier.com/books/fish-nutrition/halver/978-0-12-319650-7

- Recommend at least two fish health texts:
- ie Textbook of Fish Health George Post https://www.amazon.com/Textbook-Fish-Health-George-1987-01-30/dp/B01JXQN3PK
- Aquaculture for Veterinarians: Fish Husbandry and Medicine Lydia Brown (Pergamon Veterinary Handbook S.) Paperback – 1 May 1993 https://www.amazon.co.uk/Aquaculture-Veterinarians-Husbandry-Medicine-Veterinary/dp/0080408362
- Recommend at this level much increased content within one module 50% for fish health to do it properly and get the buy in of the commercial sector.

S 381: FISHERIES MANAGEMENT

Target group: All Fisheries Science Students Contact hours: 4 Lecture Hours/week, 1 Hour Tutorial/week

Aim: The Course is designed to equip Learners with general concepts and tools as applied in Fisheries Management.

Introduction

A Fisheries Manager is mandated with the task of initiating and nurturing various strategies and techniques that will bear sustainable resource utilization. Specifically, the Course highlights various management approaches or strategies that one needs to put in place as a Fishery Manager. The main idea is to get a better understanding on how we could conserve the fast diminishing aquatic resources, particularly fish.

- Introduction needs rewrite

Course Objectives

i. Explain terms, facts, fundamental principles and concepts used in Fisheries Management.

- Take out “facts and terms” here – Rewrite to be clearer

ii. Explain and apply the basic fisheries management strategies and systems.

- Too much in one objective to be measurable and assessed. Needs to be divided up.

iii. Analyze the Fisheries Legal Framework as applied in Zambia and how it relates to effective resource utilization.

- Better “explain” than “analyse”

Course Outline

- Good well-structured content but be aware of replication with Fisheries of Zambia

Reading List

- Ok but maybe need for more legal policy level publication
- Zambian government 5 year? Fisheries Strategy/Plans? These documents similarly useful for 5? 10? Year National Aquaculture Strategy if they are available?

Assessment

- OK

S 382: FISH STOCK ASSESSMENT AND POPULATION DYNAMICS *Pre-requisite:* *FS 381*
Target group: All Third Year Fisheries Science Students Contact hours: 4 Lecture Hours/week 1 Hour Tutorial/week

Aim: The Course is designed to equip Learners with general concepts and tools as applied in the critical analysis of the fishery resources.

Introduction

The Course deals with fisheries techniques that are useful in determining levels of our fish stocks. Such techniques include mathematical models that help in giving precise estimates of stocks and hence ensuring that harvesting is only done at sustainable levels. Emphasis is made on adopting measures for the long-term conservation and sustainable use of fisheries resources. Conservation and management measures, whether at local, national, sub regional or regional levels should be based on the best scientific evidence available and be designed to ensure the long-term sustainability of fishery resources at levels which promote the objective of their optimum utilization and maintain their availability for present and future generations; short term considerations should not compromise these Course Objectives.

- Aims and Introduction ok but slight rewrite to shorter sentences.

Course Objectives

Discuss population dynamics and the various models applied in fish population estimation.

- To discuss is not a suitable objective, it is a teaching and learning approach, and has no linkage to assessment strategy

Course Outline

- Content and structure looks fine and specific individual parts

Assessment:

- No comments

Reading List

- No further comments

S 300: RESEARCH PROJECTS Target group: All Third Year Fisheries Science Students
Contact: 4 Lecture Hours/week *Pre-requisites:* *FS 290*

Aim: This course is meant to provide a solid foundation of Research Application skills; more so scientific writing skills.

Introduction

Research projects conducted are meant to enhance and promote innovation. It is therefore, mandatory for all Fisheries students in their third year and final year of study to undertake research projects. Due to lack of proper and adequate facilities for research at the college, students are encouraged to utilize the facilities at the institutions where they are placed, for industrial or vocational attachment. At the end of their second year of study, students undertake an eight weeks (2-3 months) vocational or industrial attachment at any government or private institutions. During this placement they are expected to participate in all the ongoing activities and also carry out appropriate research with the help of available research officers. Towards the end of the course, the students prepare report on their findings of the Research project. However, a separate report for all the attachment activities carried out during the vacation is also compiled.

- The role of scientific research is very questionable at Diploma level in UOS team opinion. Case studies/group trials that may or may not be supported by field work may be a better concept.
- As a side issue, the students are also at a major disadvantage when they have to pay for the resources to undertake research themselves.
- Recommend/suggest firstly teach principles of scientific (research) writing and then use a simple longer term practical activity or two i.e. an on farm or on station feed trial or two on separate farms for whole class as a case study and activity they all have to contribute to. Divide them into two groups and give each student clear role they are responsible for for each trial This should very much be seen as a group activity of them working together as two teams – Framing original hypothesis that trial will answer, setting up methods, running trial, collecting and recording data, then data analyses, results and conclusions.
- UOS recommend more team working activities to be included in the curriculum, both as out of class practicals, but also in class powerpoint presentations and role playing.
- Then at the end of trial(s) award prize for best team producing the best results and final report and powerpoint presentation.

- Within this 2 group structure have to also build in mechanism for monitoring and evaluating individual students
- Course should provide more incentives (not necessarily financial) for students throughout its duration

Course Objectives

Have a sound knowledge of the process of writing scientific papers.

- Vague – But recommend diploma students should not be doing this.
- Recommend rewriting objectives to fit in with above proposed group trials/activities.

Course Outline

1.0 Definition and explanation of facts and terms as used in scientific research.
2.0 Basic principles in scientific writing skills.
3.0 Components of a Scientific Report and detailed description of each element.
4.0 Results and Data Analysis.
1.1. Data Exploration.
1.2. Hypothesis testing.
1.3 Interpretation and conclusion.

- Recommend rewriting course outline to fit activities /group trials but keeping in basis of 1-4 above

Practicals

- As above

Reading List

- This needs to be discussed and arranged
- The two aquaculture statistics books recommended in Fisheries Statistics should be included here

FS322: Fish Farming Target group: Third year Education students

Contact hours: **Lectures 4 hours per Practical 3 hours per week**

Aim

The Course is aimed at equipping Students with basic preparatory and application principles in fish farming.

Introduction

With the ever dwindling fish stocks experienced from the natural waters, Aquaculture is a sure initiative designed to complement the much needed fish resource. The Course therefore highlights basic tips in fish farming such as introductory concepts and definitions, set-up of a fish farming facility

as well as other key preparatory aspects in order that one may attain a successful fish farming enterprise.
The module will also to highlight application concepts in fish farming as relate to management techniques which are appropriate towards attaining a viable/profitable fish farming venture. The Course further introduces the practice of integrated farming which leads to maximum utilization and resources to further hike profitability of farming as a business.

- This course/module is for the other non-fishery aquaculture students? Perhaps the change proposed to Integrated livestock production will negate the need for this Unit
- Could be reviewed

Objectives and Course outline

- As above – This is a general course aimed at covering what is necessary for other non-aquaculture students within NRDC

Reading List

- OK but needs 1-2 more general aquaculture texts other than Pillay.

FS302: Basic Fish Farming and Epiculture
Target group: Third year ABM, ASM, CSM, HORT, NUT Students
Contact hours: Lectures 4 hours per week

Aim
The Course is aimed at equipping Students with basic preparatory and application principles in fish farming and bee keeping.

Introduction
With the ever dwindling fish stocks experienced from the natural waters, Aquaculture is a sure initiative designed to complement the much needed fish resource. The Course therefore highlights basic tips in fish farming such as introductory concepts and definitions, set-up of a fish farming facility as well as other key preparatory aspects in order that one may attain a successful fish farming enterprise.
The module will also to highlight application concepts in fish farming as relate to management techniques which are appropriate towards attaining a viable/profitable fish farming venture. The Course further introduces the practice of integrated farming which leads to maximum utilization and resources to further hike profitability of farming as a business.

- This course/module also as previous one is for other non-aquaculture students
- Not sure of joint aquaculture epiculture module? Shouldn't epiculture be on its own or elsewhere?
- Putting both together and looking at Course Content it makes it a huge module and not realistic to teach to that level of detail for both aquaculture and bee keeping within timeframe.

- Is it not possible for the whole college curriculum to have just one standard Introduction to Aquaculture module rather than these separate ones? This would help to rationalise the modules and stop replication and reduce administration issues.

Overall Summary of gaps and proposed changes to the NRDC Aquaculture /Fisheries Related Curricula

- Recommend Year 1 students have at least one specialised aquaculture module
- This could be also be alongside a revised Fisheries of Zambia module
- Then aquaculture module(s) that follow in Year 2 and 3 specialise in more detail
- Industry want specific content/modules on Fish Diseases/Fish Health, Cage culture, better Hatchery, boat and other related operational skills
- Recommend college should review staff capacity to teach these new modules.
- And if necessary aim to take in guest lecturers from private sector? Resource? Financial implications?
- Or other alternative, seek funding to take carefully chosen existing staff member on refresher course(s)?
- Recommend firm revision of "research" based student's projects - away from research per se into more practical specialised longer term activity/ group trials. Diploma courses shouldn't be involved in research in our opinion.
- Other key gaps in the existing curriculum content would include: Market and value chains, RAS systems, pond fertilisation.

Proposed Changes to NRDC Curriculum

- We have produced draft outlines for three new aquaculture units/modules (with a more commercial basis) derived from the current NRDC curriculum.
- We also have produced a revised Year 1- Year 3 modules framework see below including the 3 new modules replacing two of the originals which we will present for further discussion at the Curriculum development workshops.
- These new more commercial aquaculture based units will move we believe the course more positively towards fish farm manager and hubandryman/woman target employment for leaving students and prospective employers. However as noted below we express caution in Diploma course aims for students to go straight into management positions.
- Taking the Introduction to Aquaculture and Applied Aquaculture modules, we have extracted their content and objectives, placing these within three new Module Titles:

- Aquaculture Systems and Facilities (Replacing Introduction to Aquaculture)
- Fish Hatchery Management (Taking content from both of the previous Modules)

- Fish Production Management (Mostly derived from Applied Aquaculture, but some from the Intro Module)

- Fish Health and Feeds and Feeding we propose will be incorporated as major content in the second and third modules above.
- Any introductory content left uncovered we propose would be in the Zambia Fisheries and Introduction to Aquaculture Year 1 module.

Table 4 Proposed Revised NRDC Diploma

FIRST YEAR

Semester1				**Semester2**			
Code	**Course**	**Hrs/wk**	**CF**	**Code**	**Course**	**Hrs/wk**	**CF**
FS 211	Fisheries of Zambia	4	4	ABM 122	Introductory Economics	6	3
AG 100	Farm Routine	4		AG 100	Farm Routine	4	
BS 111	Botany	7	5	BS 122	Zoology	7	5
BS 131	Chemistry	8	5	CS 112	Fundamentals of Soil Science, Hydrology & Crop Production	4	2
BS 181	Mathematics	5	2	FS 251	Fish Taxonomy	7	4
ED 111	Communication & Computer Skills	6	2	WE 132	Introduction to Geomatic Engineering	7	3
		35				35	

SECOND YEAR

Semester1 **Semester2**

Code	**Course**	**Hrs/wk**	**CF**	**Code**	**Course**	**Hrs/wk**	**CF**
AS 211	Integrated Livestock Production Systems	7	4	AG 200	Industrial Attachment		
ABM 111	Farm Accounts	4	3		Ruminant & Pasture Production	7	4
FS 231	Aquatic environment and water characteristics	7	4	BS 222	Statistics	7	2
FS 241	Fishing Technology	7	4	ED 251	Rural Sociology	5	2
FS 252	Fish Anatomy & Physiology	7	4	FS 162	Boat Operations and Navigation	7	4
				FS 272	Aquaculture systems and facilities	7	4
				FS 292	Field Trips and Practicals	4	4
		32				36	

THIRD YEAR

Semester1 **Semester2**

Code	**Course**	**Hrs/wk**	**CF**	**Code**	**Course**	**Hrs/wk**	**CF**

ABM 341	Entrepreneurship	4		ABM 332	Project Management	4	2
ED 361	Agricultural Extension	4	2	BS 302	Environment and Natural Resource Management	4	4
FS 361	Fish Processing	7	4	FS 312	Fisheries Statistics	4	4
	Fish Hatchery Management	4	2	FS 332	Aquatic Ecology	7	4
FS 381	Fisheries Management	5	4	FS382	Fish Stock Assessment & Population Dynamics	5	4
	Fish Production Management	4	2				
FS 390	Research Projects	4		FS 390	Research Projects	4	8

Review and initial recommendations for Kasaka College curriculum

Introduction

Again to note a copy of this curricula was given to UOS on the day of our scoping trip visit to the college by Mr Libanga Octiola who was responsible for overseeing the Fisheries and Aquaculture certificate course at Kasaka. He had worked as an aquaculturalist for 10 years, and previously for 17 years within the government ministries in capture fisheries extension and research. He explained that there had been no official curriculum review for the course since 2002 but some revisions and modifications had been made since then internally and by visiting lecturers. The certificate course is for 2 years and is supported financially through the ministries but Mr Octiola stated finances were a very challenging issue in maintaining the Fisheries and Aquaculture course. There was currently no library and also on site internet for the students or staff.

The teaching staff are drawn from different subject areas, and presently compose of 5 integral Training Officers (workload average 6 hours per week) and 3 Practical Instructors (3-4 hours per week). Continuous assessment was practiced – weighted 60% practicals/assignments and 40% exams). Mr Octiola said few of the students actually came originally to the college to do Fisheries and Aquaculture but ended up on the course after one year. Ten years previously there were up to 60 students in one year stream but more recently this had reduced to around 30. In terms of facilities as we saw on the day of our visit these included several earthponds (one stocked) with a pumped water supply from the adjacent river. Mr Octiola welcomed the review and up and coming project and was very open and communicative to all questions.

Review and initial recommendations for Kasaka College curriculum

Similarly to the previous review of the NRDC curriculum the same format and approach is taken with Kasaka curriculum below. With specific comments and recommendations at module level being then used as the basis for discussion at the subsequent curriculum design workshops. Please read in conjunction with the curricula document.

KASAKA COLLEGE OVERALL PROGRAMME PURPOSE

The purpose of this programme is to provide a competent workforce for the fisheries sub-sector and associated industries. The graduates will be able to work as Fisheries assistants, Fish farm managers or be self-employed; providing extension services for fish farmers/fisher folk and managing the vital fishery areas in our country.

- We would question that a certificate course would be able to produce managers for mid to larger scale fish farmsor elsewhere in the value chain, and would advise caution in making such claims in any course publicity materials or in fact in the curriculum document. Important to manage expectations.

PROGRAMME OBJECTIVES

Manage aquaculture farms

- This objective we would question

Establish and manage enterprises

- Interesting to see this in the objectives as this is basically saying graduate students will be able to go out into the world and set up their own aquaculture related businesses? Is this realistic?

Write Project proposals

- This objective rather vague - but again we would recommend this not included – instead talk about business plans? In terms of looking for finance for starting up a farm.

Course Outline - 2 semesters per year

Module Title	Module Code	No. of hours
SEMESTER I		
Fish Biology I	FB 101	100
Aquaculture I	AQ 101	120
Hydrobiology I	HB 101	80
Fisheries Management I	FM 101	80
Fish Processing I	FP 101	120
Fishing Gear I	FG 101	60
River and Lakemanship I	RL 101	110
Marine Mechanics I	MM 101	80
Basic Mathematics	BM 101	60
Communication Skills I	CS 101	60
Computer I		40
SEMESTER II		
Fish Biology II	FB 102	100
Aquaculture II	AQ 102	120
Hydrobiology II	HB 102	80
Fisheries Management II	FM 102	80
Fish Processing II	FP 102	120
Fishing Gear II	FG 102	120
River and Lakemanship II	RL 102	120
Marine Mechanics II	MM 102	80
Fisheries Statistics I	FS 102	80
Extension Methods I	EM 102	80
Computer II		40
SEMESTER III		
Fish Biology III	FB 201	120
Aquaculture III	AQ 201	100
Hydrobiology III	HB 201	80
Fisheries Management III	FM 201	60
Fish Processing III	FP 201	120
Fishing Gear III	FG 201	100

Fisheries Statistics II	FS 201	100
Extension Methods II	EM 201	60
Fisheries Economics I	FE 201	80

SEMESTER IV

Fish Biology IV	FB 202	100
Aquaculture IV	AQ 202	80
Hydrobiology IV	HB 202	60
Fisheries management IV	FM 202	60
Fish Processing IV	FP 202	120
Fishing Gear IV	FG 202	120
Entrepreneurship		
Fisheries Economics II	FE 202	80
Attachment/projects		320

- Overall first comment on this structure layout and content is very favourable.
- Having series of follow on modules on one topic makes sense ie Aquaculture 1 Aquaculture II etc.
- Semester 1 has a good blend as an introduction.
- Whilst we would commend the college and authors for the comprehensive nature and content of this curriculum we would question whether within the obvious limited resources and finances the college has, whether all of this curriculum can be adequately taught within the two year course duration?
- If not then within the subsequent process following this report the course curriculum can be modified to produce a more realistic and accurate reflection as to what actually can be taught.

STUDENT ASSESSMENT

Assessment shall comprise the following:-

(i) Theory component subjects

CA (30%)		***EXAM (70%)***
Tests	*Assignments*	*THEORY*
20%	*10%*	*70%*

(ii) Theory and Practical component subjects

CA 30%			***Final Exam 70%***	
Tests	*Practicals*	*Assignments*	*Practical*	*Theory*
10%	*14%*	*6%*	*30%*	*40%*

- Assessment clearly articulated
- Perhaps some discussion to lower final exam % to 60 or even 50%?

CERTIFICATION

Upon successful completion of the programme, students are awarded with a Certificate in Fisheries Science.

- Recommend course title changed to Fisheries Science and Aquaculture
- This to attract more private sector approval and interest, even sponsorship?
- Course title very important in next few years for advertising and income generation.
- Would also ask does college have a simple working mechanism for an alumni network? If not then should consider under this project starting one up. But must be able to run itself under minimal resources eg to start simple Facebook group ? Joint alumni network with NRDC?

MODULE: AQUACULTURE. AQ 101 DURATION: 120 hours

MODULE PURPOSE: To equip trainees with knowledge, skill and change attitude aquaculture facilities and systems.

- Not sure what change attitude means? Rewrite this. This same wording goes through the whole curriculum document. Would remove.

OBJECTIVES: On completion of the module trainees will be able to

1. Know the general overview of Aquaculture.
2. Know different levels and types of Aquaculture Production Systems.
3. Know and practice the selection of suitable sites for construction of aquaculture facilities.
4. Know and practice how to plan, design and construct aquaculture facilities

- These objectives clear but not sure if too much/ambitious in first aquaculture course?

Course outline – units

UNIT 1.0. GENERAL OVERVIEW OF AQUACULTURE

1.1. Introduction to Aquaculture
1.2. History of Aquaculture.
1.3. Goals and objectives of fish farming
1.4. The status of fish farming in Zambia.
1.5. Methods of fish Farming system
1.6. Advantages of fish farming over capture Fisheries
1.7. Importance of fish farming
1.8. Comparison of fish farming with Agriculture

- These all clear and well structured
- But to reduce complexity and even content would remove 1.6 -1.8 and make into one "Aquaculture in a wider context "

- Again we are aware throughout this curriculum there is a lot of detail and content. More realistically for certificate level and resource and finances may be better to cut down content.

UNIT 2.0. AQUACULTURE PRODUCTION LEVELS AND SYSTEMS

- Comprehensive and ok

UNIT 3.0. SITE SELECTION FOR AQUACULTURE FACILITIES

- Again looks good but could this unit go into later course to give this one more specificity?

UNIT 4.0. DESIGN AND CONSTRUCTION OF AQUACULTURE FACILITIES

- Recommend this especially construction should go into later advanced module

REFERENCES

- Ok but would recommend also:
- M Landau Introduction to Aquaculture https://www.amazon.com/Introduction-Aquaculture-Matthew-Landau/dp/0471611468
- M Huet Textbook of Fish Culture https://www.amazon.co.uk/Textbook-Fish-Culture-Breeding-Cultivation/dp/0852381409
- Stickney, R. R. 1979. Principles of Warmwater Aquaculture. John Wiley & Sons, Inc. New York. 375 pp. https://www.amazon.com/Principles-Warmwater-Aquaculture-Robert-Stickney/dp/047103388X
- Bhujel Ram 2014 Manual for Tilapia Business Management CABI Publishers https://www.amazon.co.uk/Manual-Tilapia-Business-Management-Bhujel/dp/1780641362

MODULE: AQUACULTURE. AQ 102 DURATION: 120 HOURS

MODULE PURPOSE: To equip trainees with knowledge, skill and change attitude in the management of Aquaculture systems and their operations.

OBJECTIVES:

1. Identify, name and select fish species for culturing**.**
2. Know the aquatic environment by studying the biology of a fish pond.
3. Identify and name flora and fauna found in or closely associated with Fish ponds.
4. Know and practice good fish husbandry and fish pond/farm management practices.

- These objective clear and good to see terms like Identify and name, Know and practice – These can be directly used towards assessment and quality assurance

UNIT 1.0 SPECIES SELECTION AND IDENTIFICATION

- Straightforward

UNIT 2.0 FISH POND BIOLOGY

UNIT 3.0 AQUATIC FLORA AND FAUNA

UNIT 4.0. FISH POND MANAGEMENT

- Pond fertilization covered here in correct place Very important component in the whole course.

REFERENCES

- Can use previous unit books but needs some updating
- Recommend Hilary Egnah Claude Boyd Pond Dynamics https://www.crcpress.com/Dynamics-of-Pond-Aquaculture/Egna-Boyd/p/book/9781566702744 This a must for the students anywhere round the world
- Boyd, C.E. 1979. *Water Quality in Warmwater Fish Ponds.* Agriculture Experiment Station, Auburn, Alabama. 359 pp.

MODULE: AQUACULTURE. AQ 201 DURATION: 100 HOURS

MODULE PURPOSE: To equip trainees with knowledge, skill and change attitude in the management of Aquaculture facilities and their operations.

OBJECTIVES:

1. Be acquainted with the practices of integrating fish farming with other agricultural activities
2. Know and practice techniques of making available fertilized eggs, fry, fingerlings, or juvenile fish species for stocking culture enclosures
3. Know and practice different transportation methods of live fish
4. Know nutritional requirements of cultured fish and practice how to formulate and produce feed for fish.

- Ok but again ambitious - a lot of content and learning in this unit?
- Recommend putting integrated aquaculture in another module if possible then concentrate on **Hatchery Fingerlings and Feed** – Better module more descriptive title will attract more students and also be liked by industry.

UNIT 1.0. INTEGRATED FISH FARMING

- Recommend moving this unit elsewhere

UNIT 2.0. FISH SEED PRODUCTION

- Suggest change of name Fish hatchery production
- No species mentioned here?
- Should concentrate on tilapias and catfish
- A bit too much concentration on wild fish seed
- Better to have more content on siteing and building new hatcheries
- Different types and scales of small scale hatcheries
- Breeding in hapas

UNIT 3.0. TRANSPORTATION OF LIVE FISH

- OK here but should look to move this unit to another module so as to concentrate on Hatchery and Feeds
- Good to see in. Will please commercial sector

UNIT 4.0 FISH FEED, FORMULATION AND PRODUCTION

- Standalone unit – well written
- Digestibility of Feeds and Feed Quality make into one
- Feeding should be Feeding Methods and Calculations to remove 3.7 Feed quality and frequency of feeding and 3.9 Feeding Techniques
- Nutritional diseases in another module concentrating on Fish Health?
- Not sure what Impacts of Feeding is?
- Feed formulation should also include comparison of commercial formulated feeds against on farm feeds – pros and cons?
- Also need to show simple Feed calculations Feed tables – In Feeding Methods and Calculations
- This alongside Hatchery and Fingerlings is one of the key units in this curricula and these two along with Fish health most valued by private sector
- Therefore need to get it correct!
- Recommend basing unit content on Jauncey's Tilapia Feeds and Feeding book below

REFERENCES

- These carefully need revising but recommend basing this important unit on just these two very good books:
- Jauncey K Tilapia Feeds and Feeding 1998 Pisces Press - https://www.amazon.co.uk/Tilapia-Feeds-Feeding-Kim-Jauncey/dp/0952119846
- Haylor G and Muir J Fish Hatchery Manual for Africa Pisces Press https://www.amazon.co.uk/Fish-Hatchery-Manual-Africa-Practical/dp/0952119838
- Also good: Steffens Werner 1989 Principles of Fish Nutrition John Wiley and sons

MODULE: AQUACULTURE. AQ 202 DURATION: 80 HOURS

MODULE PURPOSE: To equip trainees with knowledge, skill and attitude in the management of Aquaculture facilities and operations of facilities.

- Needs more up front mention of fish health fish diseases and treatments.

- Is it possible to give each of these module titles more descriptive titles? Since private sector will like this much more? This one Fish Farm Economic Management, Planning and Fish Health
- If these have to be together in one module recommend Economic management and planning go first before Fish Health

OBJECTIVES:

- Objectives should also include primary recognition of specific fish diseases and also have basic understanding in relevant hands on treatments in water and feed.
- In terms of management and Economics – to be able to write standard business plan and simple cost benefit profit and loss for farm? Or is this in Entrepreneurship module – Must be included as content at some place in course.

UNIT 1.0. FISH POND SANITATION AND HEALTH

- OK but needs some revision
- To include in water and in feed treatments. This must be incorporated into hands on practicals
- At least mention of vaccination for bacterial diseases
- College should review its own staff capability in this area of fish health and if necessary arrange new staff or guest lecturer. Or send own member of staff for good refresher course elsewhere – Stirling? Would be good use of project funds but must make sure correct staff member chosen – This could be done along with staff member from NRDC – Good regional fish health capacity to teach staff Univ of Zimbawe Harare Dr Maxwell Barson - or get in Dr David Huckermeyer specialised Fish Vet from South African - often in Zambia working with larger companies.

UNIT 2.0. FISH FARM ECONOMICS AND MANAGEMENT

UNIT 3.0 PLANNING IN AQUACULTURE

- These two as standard. Should base content on Ram Bhujels publication below
- But must include cost benefit profit and loss FCR feed farm productivity and other key economic management tools

UNIT 4.0 GUEST SPEAKER

- Good to see this in curriculum! And would recommend if resources allow there can be guest speaker in each module – Industry led - Plenty of good candidates in Zambia alone
- Recommend in curriculum design workshops discussions then list drawn up of key guest speakers - Plenty to ask and chose from - Fergus Flynn, Emmanuel Cawthon, Wiza !, Mike Fuller, Patience, Kasazi Nywenda, Adam Taylor plus plus

REFERENCES

- Haylor G and Muir J Fish Hatchery Manual for Africa Pisces Press https://www.amazon.co.uk/Fish-Hatchery-Manual-Africa-Practical/dp/0952119838
- Bhujel R 2014 Manual for Tilapia Business Management Hardcover – 18 Jun 2014 https://www.amazon.co.uk/Manual-Tilapia-Business-Management-Bhujel/dp/1780641362
- These two books are must for this course !!

FISHERIES MANAGEMENT MODULE FM 101: FISHERIES MANAGEMENT & CONSERVATION
DURATION: 80 HRS

MODULE PURPOSE: To equip students with basic knowledge and skills and, change attitude in Fisheries Management and Conservation.

OBJECTIVES:

- Some need to rewrite slightly – "Knowing" is not so measurable? Knowing and being able to practice?
- Make it clear here these are freshwater fisheries.

UNIT 1.0 INTRODUCTION TO FISHERIES MANAGEMENT

UNIT 2.0 CONSERVATION

UNIT 3.0 FISHERIES OF ZAMBIA

- These all good

UNIT 4.0: FISHES OF ZAMBIA

- Would put this higher up earlier in this module before the Fisheries
- Biology of Fish rather general. Biology and Physiology?

UNIT 5.0 METHODS OF CAPTURING FISH FOR INVESTIGATIVE PURPOSES

UNIT 6.0 COLLECTION AND PRESERVATION OF SPECIMENS

- These two need more detail and clear sub division
- Recommend 5.0 and 6.0 to be joined into one.

REFERENCES

- OK but needs more modern up to date publications

MODULE: FISHERIES MANAGEMENT AND CONSERVATION – FM 102
DURATION: 80 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude in Fisheries Management and Conservation

OBJECTIVES:

- Again slight rewriting to address "Know"

UNIT 1.0. BREEDING

UNIT 2.0. FISH MIGRATION

UNIT 3.0. FECUNDITY

- With these especially 1.0 and 3.0 they need to have linkages with Hatchery and broodstock – Estimation of egg numbers and small fry very relevant here. How it's done in the hatchery?

UNIT 4.0. RECRUITMENT

3.1. Factors affecting hatching
3.2. Factors affecting survival of Larvae

- Again similar here with 3.1 and 3.2 with cross over to hatchery section – Students understanding one helps them to understand the other
- Understanding different types of cichlid mouth brooders and next builders, and with the 4-5 farmed tilapia species in Zambia how this affects trying to produce fingerlings in hatcheries or modified ponds and or hapas

UNIT 5.0. FIELD EXAMINATION OF GONADS

- Same This should be linked in to Hatchery unit/section also Fish biology for dissections especially for Clarias

REFERENCES

- These need revising but these two books should be core to the course:
- Recommend Pullin Lowe McConnel 1982 The Biology and Culture of Tilapias ICLARM Proceedings – also for wider course https://www.amazon.com/biology-culture-tilapias-Proceedings-International/dp/9710400045
- Recommend Balarin J D, Hatton J P 1979. Tilapia : a guide to their biology & culture in Africa https://trove.nla.gov.au/work/10097308?selectedversion=NBD1830997

MODULE: FISHERIES MANAGEMENT AND CONSERVATION – FM 201
DURATION: 60 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude in Fisheries Management and Conservation

OBJECTIVES:

- OK but stronger measurable objective related to students getting core understanding of aquatic produce value chains and being able to identify main stakeholders and their linkages throughout different value chains
- Note understanding value chains – much wider than just fish marketing

UNIT 1.0. FISH GROWTH

UNIT 2.0. CONDITION FACTORS

UNIT 3.0. MARKING FISH

1.1. Purpose of marking fish
1.2. Types of marking fish
1.3. Methodology of marking fish

- Is this not about Fish tagging? Change title
- Does college have necessary equipment to demonstrate – Pan Jet? Microtags?

UNIT 4.0. MORTALITY

- Again some cross overs here to aquaculture and potential effect form aquaculture and wild fish in a water catchment area, and vice versa

REFEFERENCES

- No added comment

MODULE: FISHERIES MANAGEMENT AND CONSERVATION – FM 202
DURATION: 60 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude to enable them understand the Fisheries Law and Regulations of Zambia

OBJECTIVES:

1 Know Fisheries Law and Regulations of Zambia and other approaches to Fisheries management and conservation

- To be able to know and also apply
- This type of legal module can be quite dry and uninteresting for students
- Review it to discuss ways of making it more attractive
- Actual legal case – case study examples – in Zambia or neighbouring countries
- Here the niloticus story in Zambia could be taught and the legal aspects behind it
- With also reference to niloticus and indigenous tilapias in neighbouring Malawi
- Another good legal case study currently very relevant - Frozen Chinese tilapia imports into Zambia – also bring out legal developments in other African countries Ghana where they have been banned

UNIT 1.0. THE FISHERIES ACT AND ITS REGULATION

UNIT 2.0. GUEST SPEAKER

3.1. Give an overview of the Fisheries management and conservation

- Same comments mentioned as above about Guest speaker(s)

REFERENCES

- Review to include any more up to date legislation and National Fisheries/Aquaculture Planning strategy documents – also on non-indigenous species introductions.

MODULE: HYDROBIOLOGY – HB 101 DURATION: 80 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude to enable them understand different physical parameters of lentic environment.

OBJECTIVES:

- Know and apply for objectives

UNIT 1.0 INTRODUCTION TO HYDROBIOLOGY

UNIT 2.0. CLASSIFICATION OF FRESH WATER ENVIRONMENTS

UNIT 3.0. TEMPERATURE

UNIT 4.0: DENSITY AND PRESSURE

UNIT 5.0. BUOYANCY

UNIT 6.0. WATER MOVEMENT

UNIT 7.0 VISCOSITY

UNIT 8.0 WATER SURFACE TENSION

UNIT 9.0. LIGHT AND COLOUR OF WATER

UNIT 10.0 WATER TRANSPARENCY

- These all good but this module has lot of content?
- Is possible to amalgamate some of these subheadings? Properties of water?
- Also no inclusion of water pollution? Waste water? Would be welcomed by private sector

REFERENCES

- No comments

MODULE: HYDROBIOLOGY – HB 102 DURATION: 80 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude to enable them understand different physical parameters of lentic environment.

OBJECTIVES:

- Ok but again rewrite to not just use the word know – remembering objectives should be linked in to assessment and quality control

UNIT 1.0 DISSOLVED GASES

- Again there are linkages here to aquaculture to be brought out
- Nitrogen
- Ammonia
- Supersaturation - boreholes other - gas bubble conditions/disease hatcheries.
- Also linked into aeration in aquaculture?
- Different methods pros and cons of each

UNIT 2.0 DISSOLVED SOLIDS

- Links into inorganic fertilizers and ponds

UNIT 3.0: DISSOLVED ORGANIC MATTER

- Same here with livestock agricultural wastes towards pond fertilization.

REFERENCES

- No comments

MODULE: HYDROBIOLOGY – HB 201 DURATION: 80 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude to enable them understand the aquatic Flora and Fauna of freshwater environments.

OBJECTIVES:

- Rewrite not using Know

UNIT 1.0 ORGANISMS

UNIT 2.0 PRIMARY PRODUCTION

UNIT 3.0: GUEST SPEAKER

1.1. Give an overview on the aspects of Limnology and the types of research taking place in the country

- OK as above

REFERENCES

- Seems to be same list as for other modules

MODULE: HYDROBIOLOGY – HB 202 DURATION: 60HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change their attitude to enable them understand different physical parameters of running waters and how human activities affect freshwater environment

- Good title but could be cut down wordwise

OBJECTIVES:

UNIT 1.0: FEATURES OF RUNNING WATER

UNIT 2.0: FRESH WATER AND MAN

- This module on running waters – is there case for joining last two modules together to make one? Locustrine and running waters

REFERENCES

- As above

MODULE: FISH HANDLING AND PROCESSING FP 101
DURATION: 120 HOURS

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes to enable them handle and process fresh fish successfully.

OBJECTIVES:

4. Know and practice the selection of quality ice for use to preserve fish

- Take out 4. Too specific

UNIT 1.0 GENERAL OVERVIEW OF FISH HANDLING AND PROCESSING

UNIT 2.0 HANDLING OF RAW FISH

- Better fresh than raw

UNIT 3.0. HYGIENE AND SANITATION IN A FISH PROCESSING PLANT

- Good to see building design and construction – again private sector will like to see this

UNIT 4.0 MANUFACTURING, CHILLING AND USE OF ICE

UNIT 5.0 FREEZING OF FISH

- Good content and well written

REFERENCES

- Good - Comprehensive reading list
- Again here online videos and access to them for students v important – through Blue Planet?

MODULE: FISH PROCESSING TECHNIQUES FP 102
DURATION: 120 HOURS

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes to enable them handle and process fresh fish successfully.

OBJECTIVES:

- Better written objectives

UNIT 1.0 DRYING TECHNIQUES OF FISH

UNIT 2.0 SMOKING OF FISH

UNIT 3.0 SALTING OF FISH

UNIT 4.0 CANNING

- All of these units good content well structured
- But making this module a very full one in content

REFERENCES

- Ok

MODULE: FISH HANDLING AND PROCESSING (FISH AND FISH BY-PRODUCTS) FP 201

DURATION: 120 HOURS

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes to enable them handle and process fresh fish successfully.

- Exactly same purpose as module before – Needs rewriting

OBJECTIVES:

- All good and specific
- But we would question if the college has necessary equipment resources and finances to achieve all of these? Or if practically the students can learn all of this hands on with an outside person/organisation?
- Recommend Kasazi Nywenda as outside resource person and guest lecturer /speaker for this course.

UNIT 1.0 EXTRACTION OF FISH OIL

UNIT 2.0 FILLET PRODUCTION

UNIT 3.0 FISH DELICATESSEN PRODUCTION

UNIT 4.0 ANIMAL FEED PRODUCTION

4.1. Introduction to fish meal and silage
4.2. Pellet production
4.3. Chemical composition of fish meal
4.4. Laboratory water contents analysis in fish meal and silage

- Not very clear why this unit is here? And what it actually is?

REFERENCES

- No further comment

MODULE: FISH HANDLING AND PROCESSING FP 202 DURATION: 120 HOURS

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes to enable them handle and process fresh fish successfully.

- Exactly same purpose written for all of these modules – Needs rewriting

OBJECTIVES:

- Needs to be clear here you are referring to foodborne human zoonotics? Parasites? Bacteria and not to confuse with fish pathogens

UNIT 1.0 FISH QUALITY ASSESSMENT

UNIT 2.0. QUALITY CONTROL OF FISH PRODUCTS

UNIT 3.0 PARASITES AND CONTAMINATION

UNIT 4.0 PATHOGENS (BACTERIA CAUSING DISEASE)

UNIT 5.0 FOOD MICROBIOLOGY AND MYCOLOGY

- Think terms Zoonoses and also Contaminants should be used more often in descriptors
- Seems to be some replication in 4.0 and 5.0? Join these together under Microbiology?

UNIT 6.0 PRACTICAL TRAINING

6.1. Orientation visit to fish processing industries, fishing camps and villages

- Yes all good but concern here would be that individual students don't get enough one to one practical time carrying out number of these activities. They cant learn by just watching

- If you don't already – and shes willing to contribute would recommend Kasazi to take part in this module in number of ways – also to do practical work at Lotuno Enterprises her business premises.

UNIT 7.0 GUEST SPEAKER

- As above recommend Kasazi

REFERENCES

- No comment

MODULE 1: INTRODUCTION TO FISH BIOLOGY - FB 101 DURATION: **100 HOURS**

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes in fish biology

- These Purposes are all tending to read the same type of format
- Recommend review each and rewrite so they come across more attractive to students

OBJECTIVES:

- Again too much "Know" in the objectives. Would benefit from rewrite so that each objective can be part of assessment process – They need to be measurable for this

UNIT 1.0 INTRODUCTION TO BIOLOGY

UNIT 2.0 GENERAL CHARACTERISTICS OF A BONY FISH

UNIT 3.0 EXTERNAL MORPHOLOGY OF FISH

- Again units all well written and structured - Sometimes for this certificate course they are almost too detailed and we think would benefit from taking some of the content out

REFERENCES

- Ok

MODULE 2: FISH TAXONOMY-FB102 DURATION: **100 HOURS**

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes in fish Taxonomy.

- Rewrite these as above

OBJECTIVES:

- All clear and good

UNIT 1.0 CLASSIFICATION OF FISH

- This requires a bit more detail in the subtitles

UNIT 2.0 BODY MEASUREMENTS

- Condition factors?
- Dress out weights?
- Body mass indexes

UNIT 3.0 FIN RAY FORMULA AND FINS

UNIT 4.0. FISH IDENTIFICATION (systematics)

UNIT 5.0 BINOMIAL SYSTEM OF NOMENCLATURE

- All straightforward

REFERENCES

- Ok

MODULE: FISH ANATOMY AND ADAPTATION - FB 201 DURATION: 120 HOURS

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes in fish anatomy and adaptation

- As above rewrite.

OBJECTIVES:

- Some rewriting again to get away from "Knowing everything"
- Are poison glands in fish in Zambia a serious enough issue to include in this certificate course?

UNIT 1.0 INTERNAL ANATOMY

UNIT 2.0 POISON IN FISH

- Is this actually necessary as a unit? Relevance to Zambia? If not recommend taking out.

UNIT 3.0 LOCOMOTION

UNIT 4.0 NUTRITION OF FISHES

UNIT 5.0 FEEDING HABITS AND ADAPTATIONS

UNIT 6.0 GROWTH

UNIT 7.0. MUSCLES STRUCTURE AND FUNCTION

REFERENCES

- Needs more to cover total content of this module

MODULE 4: FISH PHYSIOLOGY-FB 202 DURATION: 100 HOURS

MODULE PURPOSE: To equip students with knowledge and skill and, change their attitudes in fish Physiology

- Rewrite

OBJECTIVES:

- Again some rewrite to replace "Know"

UNIT 1.0 NERVOUS SYSTEMS OF FISH

UNIT 2.0 ENDOCRINE SYSTEM (HORMONES)

UNIT 3.0. DIGESTIVE SYSTEM

UNIT 4.0. RESPIRATION

UNIT 5.0. REPRODUCTION IN FISH

UNIT 6.0 IONIC BALANCE (OSMOREGULATION) IN FISH

- All ok again

UNIT 7.0 HEREDITY

- Some links in this one to hatchery and broodstock? Simple selection programmes

REFERENCES

- Ok

MODULE. INTRODUCTION TO FISHING GEAR TECHNOLOGY. FG 101 DURATION: 60 HOURS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in fishing gear technology.

OBJECTIVES: On completion of the module, students will be able to

1. Know and explain fishing, its development, the level of mechanization and fishing levels in general**.**

- Its development? Rewrite to make clear
- Know and apply?

UNIT 1. DEVELOPMENT OF FISHERIES

UNIT 2.0 CLASSIFICATION OF FISHING GEAR

- Nets used in aquaculture - seine nets dip nets

UNIT 3.0 FISHING GEAR NETTING MATERIALS

REFERENCES

- Ok

MODULE: FISHING GEAR TECHNOLOGY FG 102 DURATION: 120 HOURS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in fishing gear technology.

- Same comments as above

OBJECTIVES:

- Know and in some cases use?

UNIT 1.0 CLASSIFICATION OF FISHING METHODS

UNIT 2.0 NET CONSTRUCTION

- Hapas also would be useful

UNIT 3.0 NET MENDING (TRIMMING A TEAR).

REFERENCE

- Same as module before

MODULE: FISHING GEAR TECHNOLOGY FG 201
DURATION: 100 HOURS
PURPOSE OF MODULE: To equip trainees with knowledge and skills and, change attitude in fishing gear technology**.**

- Would question whether this certificate course needs to have 3 separate modules on this subject? Rather set resources and time aside instead to concentrate more on key aquaculture subject areas like Fish Disease and Treatments which the commercial sector would much more likely wish to see in this course
- Would ask the question how many or what % of the graduating students will be working or looking for employment in this area of fishing gear technology

OBJECTIVES:

- To try to get away from just “knowing”

UNIT 1.0. COLOUR OF FISHING NETS

UNIT 2.0. RELATIONSHIP BETWEEN MESH SIZE AND FISH SHAPE

UNIT 3.0 RELATIONSHIPS BETWEEN FISHING GROUND AND FISH BEHAVIOUR

UNIT 4.0 BUOYANCY AND SINKING FORCES

REFERENCES

- As above

MODULE 3: PRACTICAL FISHING - FG 202 DURATION: 120 HOURS

PURPOSE OF MODULE: To equip trainees with knowledge and skills and, change attitude in fishing technology**.**

- As above
- This seems to be a summary type module
- How much of this will the students actually be able to conduct themselves on a boat?
- Again relating to how comprehensive the associated practicals are /will be for this and other associated modules.

OBJECTIVES:

- Ok but point 4 above is very relevant.

UNIT 4.0 PRACTICAL FISHING

- Also basket fish traps? Different types

UNIT 2.0 GUEST SPEAKER

- As above

REFERENCES

- Light on reading material. Review

MODULE: FISHERIES STATISTICS FS 102 DURATION: 80 HOURS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in fisheries statistical data presentation.

- Rewrite as before

OBJECTIVES:

- All fine but rewrite from just “Know”

UNIT 1.0 GENERAL OVER VIEW OF FISHERIES STATISTICS

UNIT 2.0 TABULAR PRESENTATION OF STATISTICAL DATA

UNIT3.0 GRAPHIC PRESENTATION OF STATISTICAL DATA

UNIT 4.0 .0 MEASURE OF QUANTITATIVE DATA

UNIT 5.0 PROBABILITY

REFERENCE

- Good list but would also recommend these two
- Choosing and using Statistics: A Biologists Guide. 2011 Calvin Dytham. Department of Biology, University of York Third Edition A John Wiley & Sons, Ltd., Publication Wiley Blackwell 316pp https://www.amazon.co.uk/Choosing-Using-Statistics-Biologists-Guide/dp/1405198397
- Statistics for Aquaculture Bhujel R 2009 Wiley https://www.wiley.com/en-us/Statistics+for+Aquaculture-p-9780813815879

MODULE: FISHERIES STATISTICS FS 201 DURATION: 100 HOURS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in Fisheries Statistics.

OBJECTIVES:

- Know and apply

UNIT 1.0 GENERAL OVER VIEW OF FISHERIES STATISTICS (SURVEY SYSTEMS)

- Ok different types of quantitative surveys
- Some inclusion here of Piloting? Also methods of Triangulating data from surveys
- Designing surveys with ease of implementation for data entry and data analysis

REFERENCE BOOKS

- Including two above

MODULE: RIVER AND LAKEMANSHIP - RL 101 DURATION: 110 hours

MODULE PURPOSE: To equip trainees with knowledge and skills and change attitude in River and Lakemanship.

- As above
- Some point here in changing the module title to incorporate boat handing and also importantly for growing employment market for commercial cage culture jobs
- Industry would like to see this clearly represented in your curriculum

OBJECTIVES:

- Recommend inclusion of cage culture operations objectives and content

- College should review staff capacity to do this and if not within college to look for guest lecturer to cover this – important part of course for the future – Person teaching must have practical hands on commercial experience in this.

UNIT 1.0. INTRODUCTION.

UNIT. 2.0. BOATS

UNIT 3.0. WATER WISDOM AND REGULATIONS

UNIT 4.0. SWIMMING

UNIT 5.0. SEAMANSHIP SAFETY

- Change title?

UNIT 6.0. GENERAL SAFETY IN FISHING OPERATIONS

UNIT 7.0. THE RULE OF THE ROAD

- Again do these relate to the sea? Or freshwater lakes?

UNIT 8.0. LIGHT RECOGNITION OF MARINE VESSELS

- Do we need to include marine related content in this course?

UNIT 9.0. CARE AND MAINTAINANCE OF HULLS AND OTHER ACCESSORIES.

UNIT 10.0. HANDLING PASSENGER AND CARGO VESSELS

UNIT 11.0. HANDLING SMALL VESSELS IN ROUGH WEATHER

- Comprehensive and systematic content. Again this module is full of content and a lot in there to get over to students – also through strong practical component – if that's available
- For whole module to include section day to day cage culture operations using boats and other equipment

REFERENCES

- Try to get cage operations manual from company like Yalelo or Lake Harvest - Im sure they would share if asked.

MODULE: RIVER AND LAKEMANSHIP II – RL 102 DURATION: 120 hours

MODULE PURPOSE: To equip trainees with knowledge, skills and change attitude in River and Lakemanship.

- Perhaps this is historic for this Kasaka course? but we would question the need to have so many modules in this subject area for the modern employment market
- It seems 4-6 modules on the same subject area
- Recommend cutting these down by at least two modules to then develop at least two more specialised modules – Fish health?

OBJECTIVES:

UNIT 1.0. NAVIGATION I
UNIT 3.0. NAVIGATION II
UNIT 4.0. THE COMPASS
UNIT 5.0. SOUNDINGS
UNIT 6.0. BUOYAGE
UNIT 7.0. WIND AND WAVES
UNIT 8.0. ANCHORS AND ANCHORING
UNIT 9.0. COMMUNICATION
UNIT 10.0. LIFE SAVING AND DIVING
UNIT 11.0. FIRST AID ON THE WATER
UNIT 12.0. LIFE SAVING AND FIRE FIGHTING

- Very comprehensive in this and previous modules. But we would question if this course in 2019 with current employment market needs this amount of content in this area?

REFERENCES

- Ok

MODULE: MARINE MECHANICS I – MM 101 DURATION: 80 Hours

MODULE PURPOSE: To equip trainees with knowledge, skill and change attitude in Marine Mechanics.

- Rewrite as before
- Change title? As this is not Marine? And it is specifically about boat engines

OBJECTIVES:

- More know and practice or apply

UNIT 1.0. INTRODUCTION TO MARINE MECHANICS

UNIT 2.0. GENERAL COMPONENTS OF AN ENGINE

UNIT 3.0. TYPES OF ENGINES

UNIT 4.0. MAJOR COMPONENTS OF AN OUTBOARD MARINE ENGINE

UNIT 5.0. THE STARTING PROCEDURE OF A MARINE ENGINE.

- All ok but to ask what practical facilities available to do this hands on? In college? or outside ?

REFERENCES

- Ok

MODULE: MARINE MECHANICS II – MM 102 DURATION: 80 Hours

MODULE PURPOSE: To equip trainees with knowledge and skills and attitude in Marine Mechanics.

- Rewrite to be specific to the module

OBJECTIVES:

UNIT 1.0. THE FUEL SYSTEM

UNIT: 2.0. THE COOLING SYSTEM

UNIT: 3.0. THE IGNITION SYSTEM

UNIT 4.0. THE LUBRICATION SYSTEM

UNIT 5 .0. TROUBLE SHOOTING

UNIT 6.0. ENGINE MAINTENANCE

- All good systematic content again but for total hours on course can this module not just be incorporated into the one before to make one on boat engines

REFERENCES

- Ok

MODULE: FISHERIES ECONOMICS I – FE 201 DURATION: 80 hours

MODULE PURPOSE: To equip trainees with knowledge and skills and, attitude in Fisheries Economics.

OBJECTIVES:

- Again all ok but should also include about economics of different scales of private sector aquaculture as rather fishing biased,

UNIT 1.0. INTRODUCTION TO ECONOMICS

UNIT 2.0. PRINCIPALS OF PRODUCTION

UNIT 3.0 GENERAL PRODUCTION AND CONSUMPTION OF FISH.

- No mention of value chains here? Also markets chains – These link the above two in the title

UNIT 4.0. MARKET FORCES

- Perhaps better to include value chains here

UNIT 5.0. INCOME AND MEASURES OF PERFORMANCE

Measures of performance: Catch rate, Fishing effort and Utilization

- Again this should also include the equivalent income and performance and productivity indicators in aquaculture

UNIT 6.0. FISHERS' ACCOUNTING

- These aren't just Fishers? Recommend change title
- Also cost benefit analyses?
- Other concepts Return on investment Cashflows etc.

REFERENCES

- Ok

MODULE: FISHERIES ECONOMICS II – FE 202 DURATION: 80 Hours

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in production, marketing and distribution of aquatic products.

OBJECTIVES:

- Again not sure for this total number of hours if this module can be incorporated into one before ?

UNIT 1.0. MARKETING SYSTEMS

UNIT 2.0. MARKETING STRATEGIES

UNIT 3.0. QUALITY CONTROL AND FISH PRICING

UNIT 4.0. FINANCIAL MANAGEMENT IN FISHING AND FISH FARMING.

- Lacking definition and content onvalue chains market chains wholesale retail middlemen also perhaps something on certification ? Import Export? Some relevant case studies? Chinese tilapia in Zambia?

REFERENCES

- **Ok**

MODULE: COMMUNICATION SKILLS. CS 101 DURATION: 60 HOURS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in communication skills.

- Like the idea and concept of this module as can be so important to develop skills in these areas for the graduating students

OBJECTIVES:

UNIT 1.0 INTRODUCTION TO COMMUNICATION SKILLS

- Recommend inclusion in here of online communication methods, effective networking , social networks, whatsapp groups, linked in etc. and their pros and cons
- Through Blue Planet on this project online distance learning will also be key – but all of this depends on regular good internet connectivity at the college. Presently and in the past this has been a big issue in this college.

UNIT 2.0 LISTENING SKILLS

UNIT 3.0. READING

UNIT 4.0. NOTE TAKING

UNIT 5.0 STUDYING

UNIT 6.0 WRITING

UNIT 7.0 KEY WORDS USED IN ESSAY AND EXAMINATION QUESTION

UNIT 8.0 EXAMINATIONS

- All of the above useful – This module to be taken in Year 1?

MODULE: EXTENSION METHODS; EM 201 DURATION: 80 hours

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in Fisheries Extension.

OBJECTIVES:

Explain what is involved in fisheries Extension.

- Is this module just about Fisheries Extension? Or aquaculture extension too?
- Should differentiate
- Recommend change title to reflect course content

UNIT 1.0 GENERAL OVERVIEW OF EXTENSION METHODS

UNIT 2.0 EXTENSION PHILOSOPHY

UNIT 3.0 FEATURES OF EXTENSION

1.1

REFERENCE BOOKS / MATERIALS

- Recommend also Kumar D 1999 FAO Trickle Down System (TDS) of Aquaculture Extension for Rural Development http://www.fao.org/3/a-x6946e.pdf
- And Townley R 1996 Rapid rural appraisal, participatory rural appraisal and aquaculture FAO Technical Paper http://www.fao.org/3/w2352e/W2352E00.htm

MODULE: EXTENSION METHODS; EM 102 DURATION: 60 hours

MODULE PURPOSE: To equip student with knowledge skills and change attitude in extension methods

OBJECTIVES:

- Again comprehensive but would benefit from mentions and objectives related with aquaculture not just fishers / wild fisheries
- Also this is about Field skills and working with communities, private sector businesses, government, NGOs
- This important module to get across to students will benefit them whichever type of employment they go into

UNIT 1.0 MASS MEDIA

- This now must be including online?

UNIT 2.0 AUDIO VISUAL AIDS

UNIT 3.0 PUBLIC SPEAKING

UNIT 4.0 WORKING WITH PEOPLE

UNIT 5.0 DEMONSTRATIONS

UNIT 6.0 MEETINGS AND DISCUSSION GROUPS

UNIT 7.0 LEADERSHIP

UNIT 8.0. FACT (INFORMATION) COLLECTION
UNIT 9.0 LEVELS OF LEARNING

UNIT 10.0 HIV/AIDS

REFERENCE BOOKS / MATERIALS

- Seems to be good list of materials

MODULE: BASIC MATHEMATICS BM 101 DURATION: 60 HRS

MODULE PURPOSE: To equip trainees with knowledge and skills and, change attitude in mathematical computations.

- Mathematical computations? Maybe needs a rewrite

OBJECTIVES: On completion of the module, students will be able to

1. Know how to compute mathematical figures
2. Know how to compute mathematical expressions.

- These two not in clear English?

3. Know how to measure different parameters of different shapes and how to convert them.

4. Know the tools used in statistical data presentation.

- And apply

5. Know how to calculate vectors and bearings and the use of maps

6. Know the definitions of statistical terms

UNIT 1.0 GENERAL OVER VIEW OF BASIC MATHEMATICS

UNIT 2.0. ALGEBRAIC EXPRESSIONS

UNIT 3.0. MEASUREMENTS AND CONVERSION OF UNITS

- In here using some fisheries and aquaculture examples

UNIT 4.0. RATIOS AND PROPORTIONS

UNIT 5.0. VECTORS AND EARTH GEOMETRY

UNIT 6.0. PERCENTAGE AND INTEREST

UNIT 7.0. DIAGRAMS AND GRAPHS

- Using Excel? Other?

UNIT 8.0 STATISTICS

REFERENCE BOOKS

- Also include Choosing and using Statistics: A Biologists Guide. 2011 Calvin Dytham. Department of Biology, University of York Third Edition A John Wiley & Sons, Ltd., Publication Wiley Blackwell 316pp https://www.amazon.co.uk/Choosing-Using-Statistics-Biologists-Guide/dp/1405198397
- Statistics for Aquaculture Bhujel R 2009 Wiley https://www.wiley.com/en-us/Statistics+for+Aquaculture-p-9780813815879

Overall Summary including gaps and proposed changes to the Kasaka College Fisheries/Aquaculture Curricula

- Overall we found the curriculum document in its content, layout and organization of modules to be of a very good quality for a 2 year certificate Fisheries Aquaculture course.
- Individual module outlines and structures were general clearly articulated and followed a common flow towards completion of each module.

- For aquaculture and several other of the key modules we found the Aquaculture I, II, III, IIII, follow on structure of gradually specialising modules to be logical, and in the main part well planned out and again a logical progression for the students taking them.
- These aquaculture modules in general contained most of the key subject areas for a "certificate course".
- However noticeably missing were Aquatic produce value chains (inputs through to outputs and to the final consumer). Identification of and description of linkages between key value chain actors would improve the course and also be welcomed by the private sector.
- Also missing increasingly important cage culture procedures and practices including boat operations in this area.
- Fish Health/Fish Diseases content needed to be improved with clear content on fish treatments.
- And to teach these three above key discipline areas we would recommend Kasaka review their existing staff capacity, with possibility of bringing in relevant and experienced guest lecturer(s) to cover them properly. Or alternatively seek funding to take carefully chosen existing staff member on refresher course(s) or even work experience to cover them.
- These three are key areas the private sector will value in the coming years in the changing landscape of Zambian aquaculture and fisheries.
- In terms of the overall Fisheries/Aquaculture balance in course content we believe this still to be stacked in favour of wild fisheries which quite understandably is a legacy of the history of the college and why it was originally set up.
- However we believe that for some series of modules i.e. Fisheries Management, Fisheries Gear, Seamanship I II III etc there is too much content, considering the actual target employment the students now have available to them.
- We would also question with the dedicated teaching hours for the 5 full time lecturing staff and 3 part time there are actually enough hours per week per month to effectively cover all of these modules contents- most of which are listed at 100 hours each per module?
- Many of the objectives across most of the modules we recommend are slightly rewritten so that they can be worded to at least be also used in the appraisal and quality assurance procedures for the overall course.
- The references/reading lists for some of the modules are good, but there are some obvious omissions for which we have included new more up to date texts.
- However from our visit to the college we have quite serious concerns about the lack of a library or it seems any texts available to the students?
- Similarly hearing about lack of regular internet access on the campus and students having to use their own smart phones (if they have them) to access texts and information. This obviously has significant effects on the learning experience they have over the two years
- Finally practicals were not covered in this curriculum document and how they fitted in with each of the modules in terms of hands on learning.
- Again other than the one stocked fish pond we saw on the day of our visit we would have significant concern of whether or not practical based learning at the college across all the modules has been effective in terms of the facilities and resources available.
- This of course also depends on the extent to which practical are effectively carried out outside the college at other private or government sector facilities. And the financial and resource implications of doing so.

Proposed Changes to the Kasaka Curriculum

- We conclude “on paper” this curriculum is generally good, well written and comprehensive for a 2 year certificate course and as such would not recommend major revisions.
- However we feel almost the opposite that the curriculum as such is almost too detailed and too much content for a two year certificate course to be effectively taught and resourced by the staff available and also with the finance and funds available for doing so.
- We therefore recommend firstly in particular areas actually cutting down the overall content either within modules or joining two modules together into one.
- We feel obviously due to historical perspective the course is still wild fisheries top heavy. But with the changing economic and available jobs market in Zambia , redressing this balance towards aquaculture would in the next years increase the attractiveness of the course both to students and also to the growing commercial aquaculture sector
- We see a case for rationalising some of these fisheries based modules, to reduce their content and numbers down to allow then for introduction at least two new specialised aquaculture related modules to come in – Fish health - Aquatic animal value chains, and somewhat of a strengthening of the fish hatchery and fish feed components.
- We would also question the course aim and target areas for students to be employed at fish farm managerial level following this course. Only realistically if they have had had some hands on experience prior to the course working on fish farms.

Mulungushi and Copperbelt Universities: Reviews for new aquaculture graduate/post graduate courses and revision of existing ones respectively.

Introduction

Mulungushi (MU) and Copperbelt (CBU) Universities were both visited as part of the TOR for this assignment. And although the emphasis of our work and this document is towards curriculum upgrades for the two vocational training colleges, we were also asked in the TOR to include much shorter reviews of: 1. MU and their recent wish to start some form of under or post graduate course on aquaculture; and 2. CBU's existing under and postgraduate courses in aquaculture. And whilst these two are by definition short reviews, they are also in the much wider context of looking towards an effective and fit for purpose national strategy for Certificate-> Diploma-> Undergraduate->Postgraduate training and education for the changing fisheries and aquaculture sectors across Zambia and their associated future employment needs.

Mulungushi University Visit

The UOS team visited MU on Friday 7th December 2018 being also accompanied by Steve Cole (WFC) and Lizzie Muzungaire (NRDC). The objective of our visit was through a meeting with a range of MU staff to obtain a background of the university itself, and then to move on and discuss their expressed wish since 2013 ? to develop some form of aquaculture based under or postgraduate course(s), future associated research and suitable hands-on aquaculture facilities to make this possible.

The meeting was attended by 7 MU staff members from the School of Agriculture and Natural Resources (SANR) including: Mr Jameson Tambo the Assistant Dean, Mr Moses Daura the Head of the Department for Agriculture, Mr Joseph Mwale Lecturer Department of Agriculture, and other lecturers Mr Adrian Pirie, Mr Paul Simulon, Dr Charisa Chamba and Paul S…

Moses Daura explained that the university had originally had discussions with the government Department of Fisheries (DOF) in 2013 related to research into genetic diversity of cichlid fish stocks in Zambia, an important and contentious issue! From these discussions and also a growing realisation that development of commercial aquaculture in Zambia and its associated future employment requirements for suitably trained scientists and technical staff was only likely to increase over the next years, the university, and more particularly its SANR began to look into the potential for setting up a new aquaculture/fisheries related course and associated research to follow. At the time of our visit they had still not decided at which level(s) they wished to enter, but were interested to have open discussions with the visiting team from UOS, WFC and NRDC, to get their opinions on the way forward.

The university itself is centrally located in a key crop and livestock belt which has future potential for aquaculture development, and in terms of catchment area for students is ideally suited for other surrounding provinces. On the advice of the DOF the university had acquired suitable? nearby land which it has earmarked for future development of aquaculture facilities – ponds? a hatchery? other.

The School runs the following below MSc and BSc courses:

- Master of Transformative Community Development
- Master in Disaster Studies

- Master of Science in Agribusiness
- Master of Science in Agricultural Risk Management
- Master of Climate Change and Sustainable Development

- Bachelor of Agriculture
- Bachelor of Land and Water Resources Management
- Bachelor of Agricultural and Rural Innovation
- Bachelor of Climatology
- Bachelor of Environmental Studies
- Bachelor of Agricultural Business Management

Most these courses originally starting in 2008. The MSc's are two and the BSc are four year courses respectively, with the students paying fees and other costs for themselves or from their own sources. Most of their students come for their BSc courses directly from the final levels of secondary schools, however some have passed through a 3 year NRDC diploma before. The MU staff all agreed that the mature students with more life experience tended to perform significantly better than those straight out of school, both in terms of assessment within the university and also afterwards in the jobs or future research markets. More recently in the agriculture related BSc's aquaculture is now taught in the 4th year as a separate module, and they explained they have three modes of course delivery: full time, research only, taught only, and also by distance learning. They are currently also developing a graduate level apprenticeship programme, which has some similarities to the development of a working sustainable internship scheme proposed within the WFC project for the two vocational training colleges.

Details of the University as a whole and the above courses can be found at http://www.mu.ac.zm/

And the School of Agriculture and Natural Resources http://www.mu.ac.zm/index.php/school-of-agriculture-and-natural-resources

After these discussions related to the background of the university and school we then went on to discuss possibilities and a way forward towards starting up new aquaculture/fisheries related course(s) and associated research. Below are the key points from our discussions:

Mulungushi University: Towards a new aquaculture teaching, training and research programme

- MU staff explained it was 2013 when the university first seriously considered setting up a new programme for aquaculture.
- They added this was due to involvement at the time with DOF with a genetics research topic
- And that they perceived in the future there would be a demand (and a financially viable market for the university) for under and postgraduates in this field due to the now growing commercial aquaculture sector in Zambia
- The UOS team concurred with this but also added that the university should not just look at this potential new student target market as only within Zambia.
- They stated that initially this should be the aim but surrounding countries and regionally – Malawi, Zimbabwe, Mozambique, even Botswana and South Africa – were all potential future target markets that the university should look towards as they planned their new programme.

- Bunda College University of Lilongwe Malawi was mentioned as an existing regional hub for university training and education in aquaculture with good facilities and with associated funding through the NEPAD node and associated African Union.
- The UOS team acknowledged this, but pointed out that Malawi, currently and in the past, had little or no commercial aquaculture (due to a range of reasons). And as such firstly it had limited potential private sector employment opportunities within the country outside the conventional government ministries) for their graduates in this area. Also Bunda College did not within Malawi have the available network of private sector stakeholders across the value chain, from feed suppliers, commercial producers through to Wholesale/Retail market chain through which it could provide its students with the necessary practical and hands-on experience to complement their degree courses, as well as carry out their postgraduate research. Whilst MU very much does have all of these and as such in UOS's view had a competitive advantage.
- As the UOS team also pointed out outside country students also tended to open doors into new funding streams and also potential other opportunities for the university and its alumni.
- The discussions then went on to the entry point for a new course or courses. Which level of course to start with? And why?
- The MU team stated firstly that ultimately the final decision on this would be taken by the overall Higher Education Authority (HEA). However it was up to the School and the university to make the best case model and application for the new course or associated programme.
- MU staff expressed their initial preference for entry point to be an MSc by Research, and then broaden this out to into a full taught programme at Masters level.
- The UOS team tended to agree with this, pointing out the evidence base elsewhere historically /internationally was that MSc Aquaculture by learning courses were set up and run for a number of years before/if the institution then got involved in a specialist BSc level.
- UOS also pointed out that currently the differentiation in Zambia between existing aquaculture diploma courses (3 years) and potential new 4 year bachelor level aquaculture courses was more blurred and might not lead to the necessary numbers of enrolling students required in the first years of a BSc to make it a financially viable business model for the university.
- However it was brought up by both MU and UOS that one of the key issues/challenges to firstly planning and then implementing a new MSc Aquaculture curriculum and course was the current staffing capacity and expertise within the university in order to carry this out.
- UOS would recommend that moving forward the university should set up a review on staff capacity in order to identify firstly the required specific areas of expertise they did not have, then calculate how many new staff members they would require to set up a new Masters and then run in the first few years.
- This obviously has implication in terms of finances and in relation to a draft business model being written for the new course.
- UOS pointed out that already within Zambia there were certain good candidates for these types of positions, who had academic, research and also commercial experience. This blend they suggested would or could differentiate a new MSc course at MU with its competitors.
- The subject of guest lecturers was also brought up. And other examples from US and Europe were described where key individuals from primarily the private but also research sectors were taken on as guest lecturers at Master level to teach specific topic areas such as Aquatic Animal Health /Fish Diseases, fish feeds and nutrition, and hatchery broodstock.

- But again the financial and logistical implications of doing this had to be well examined and understood firstly to work into a financial viable and also quality assured course business model.
- Following later analyses the UOS team would also recommend that there should be a very careful selection process for the position of Overall Course Director for this new MSc course.
- This person is crucial to the success or failure of setting up any such new course. UOS would recommend that there should be an open (internal and external) recruitment process for this individual starting in the near future so that the person can be involved at very early stage in designing and working on the first draft curriculum for the course. Before then going on to implement it in its first year.
- This led the discussion on to whether the new course(s) should be as before in Zambia Fisheries/Aquaculture content related ie an approximate 50/50 balance between the two; or more specialised in being mostly all aquaculture content?
- There were different views expressed with pros and cons for both but the consensus seemed to be that MU should aim for a more specialised course but retaining some fisheries based content, and particularly from a UOS viewpoint, we would recommend a module or at least significant content on the Fisheries-Aquaculture interface.
- Otherwise there were some other further discussions related to one year duration Masters in other countries, but it was considered unlikely in Zambian context due to overseeing regulations of the Higher Education Authority.
- Some time was also spent discussing about other non-staff related resources required necessary to put in place prior to any new course starting.
- Although MU informed the meeting an area of land had been acquired nearby? on campus? to set up dedicated aquaculture facilities through the DOF, UOS recommended the university selected very carefully at this early stage the location of the land and its associated characteristics before they started designing or constructed anything. UOS cited several examples from Kenya, Ghana, Tanzania, and Malawi of universities who had spent considerable amounts of (overseas) funds setting up aquaculture facilities (earthponds, tanks, hatcheries, even feed mills) on land located nearby which turned out to be totally inappropriate – (especially related to water sources) for any sort of sustainable working fish farm.
- UOS advised proper, independent (of Ministry) site inspections of a number of locations nearby and then if appropriate and available to be developed, the best of the option selected.
- Another lessons learning from all of these above universities endeavouring to set up aquaculture facilities for their teaching and research, was that most also had no plan or means within to make each of their sites income generating so that through sales of fingerlings, broodstock?, grow out fish, or rental of ponds or tanks for commercial trials, each site could at least cover its own costs and also if well run make profit which could be reinvested back in to develop further facilities. UOS recommends this is carefully looked into for the MU facilities.
- The importance of a well-equipped up to date aquaculture section in the university library was also mentioned. As was the increasing role of internet and online learning resources and tools at Masters level.
- Finally gender balance between existing students in the School and also future students on aquaculture courses was also discussed. It was agreed that facilities within the School and also newly constructed university aquaculture facilities /fish farm /fish hatchery would have to be set up for both male and female students. Anecdotally it was mentioned that across other SS African countries eg Ghana, Kenya, Uganda, and Nigeria where aquaculture was now really

beginning to develop commercially, it was mainly (younger) female graduates who were doing well and in charge of the commercial company hatcheries at mid to larger scale.

Visit and review Kapasa Makasa campus Copperbelt University

Introduction

Copperbelt University is a Public University located in Kitwe, Zambia established through the Act of Parliament No. 19 of 1987. Prior to 1987, the University existed as a campus of the University of Zambia Federal System with two schools; namely: School of Business and Industrial Studies (SBIS) and School of Environmental Studies (SES). The campus was referred to as the University of Zambia at Ndola (UNZANDO) until 1st December 1987. It currently in 2019 operates from four campuses: Jambo Drive Main Campus, Parklands Campus, Ndola Campus and Kapasa Makasa Campus in Chinsali.

Construction of the university was completed in 2016 at a cost of ZMW 107 million (10 million USD). In June 2016 Government transformed the newly constructed Kapasa Makasa into a faculty of the Copperbelt University. This was to help operationalize the University without necessary incurring the full costs of establishing a new University. At this time some programs: Aquaculture, Livestock, Forestry and Information Technology were moved from CBU to the Kapasa Makasa campus.

Objectives of visit

To introduce the AQ TEVET project to the staff at Kapasa Makasa University, seek an understanding of the current status of the aquaculture/fisheries programs at the university so as to identify areas of possible collaboration within the framework of the project.

Participants

Professor Jacob Mwitwa (University Director)
Mr Jerous Nguluwe (Deputy Registrar)
Mr Bright Nyimbili (Lecturer/Standing in for the Head of Department)
Mr Kunda (Maintenance Officer)
Dr Steve Cole (Senior Scientist/ WorldFish/ AQ TEVET Project Leader)
Ms Lizzy Muzungaire (Training Officer NRDC/ AQ TEVET Project Manager)
Dr Jonas Wiza Ng'ambi (Aquaculture Consultant /AQ TEVET/WorldFish)

Introductory remarks (Prof. Jacob Mwitwa)

- Copperbelt University (CBU) was given a 3 year mandate to run Kapasa Makasa University (KMU) which will end this year, after which the delinking process will commence.
- Kapasa Makasa campus currently has 4 degree programs: BSc ICT Education, BSc Animal Science, BSc Agroforestry and BSc Fisheries and Aquaculture. The institution enrolls students from all over Zambia. Over 95% of the students are on government loan scholarship and only about 2% are self-sponsored. The most popular course is ICT with education.
- The site has 20 lecture rooms, 2 lecture theatres and a fully functional computer room with 50 PC's (the team were shown round the facilities in the afternoon). It has capacity for 2500

students but only 740 students are currently enrolled due to inadequate accommodation. The university has 43 staff, out of which 13 are academic and 30 are Administrative and support.

- The university can recruit up to 55 full time academic staff, however the current strategy is to recruit some part-time so as to reduce operational costs.
- Students sit in class for 4 days, from Monday to Thursday, with Friday reserved for practical, tutorials, etc.
- The university currently runs a more traditional form of training but aims to move to a more entrepreneurial model involving livestock and fish production.
- Currently there are no laboratory facilities for research and basic sciences, with construction of laboratory facilities recently underway.
- There are plans to develop a virtual library. The institution subscribes to ASTRIA based in UK to access e-books. This plan will cut down on the need to recruit library staff and thereby reduce operational costs.
- The University hosts some projects such as IIED UK: Social and Environmental *Trade-offs* in African *Agriculture project and the* Improving Governance and Economics of Protected Areas project funded by NORAD

Fisheries and Aquaculture programs summary (Mr. Bright Nyimbili)

- The BSc Fisheries and Aquaculture program has 3 classes each holding about 40 students, with plan to scale down to 35 per class.
- Females account for just 12% of the student population. Most female students do not fare well at basic sciences courses in year 1 and tend to drop out by year 2.
- Continuous assessment carries 40% and exams 60% with pass rate ~ 50%. Students failing continuous assessment by end of year 1 cannot enter year 2.
- The university migrated from the Copperbelt University with the current programs.
- Deficiencies were identified in curriculum and therefore three new programs were proposed as follows:
    - BSc Fisheries and Aquaculture (current)
    - BSc Fisheries and Aquaculture (Proposed new version)
    - BSc Fisheries Science (proposed new)
    - BSc Aquaculture (Proposed new)

➢ The detailed course content of each of these programs is presented below

BSc Fisheries and Aquaculture (Current)

#	Yr 1 Courses	Yr 2 Courses	Yr 3 Courses	Yr 4 Courses
1	(B100) Biology	(AF 201) Genetics	(FA 300) Fish ecology	(FA 450) Fishing Gears and technology
2	(CH 130) Chemistry	(FA 210) Fish Biology & systematics	(FA 310) Aquaculture systems &Engineering	(FA 420) Fish post-harvest technology
3	(PH 110) Physics	(FA 230) Limnology	(FA 320) Fish pathology and parasitology	(FA 410) Fisheries Economics and entrepreneurship

4	(M110) Maths	(FO 210) Biometry	(FA 330) Fish Nutrition and feed formulation	(FA 430) Fisheries management and extension
5	(LA 111) Communication & computer skills	(FA 240) Biology of Aquatic Fauna & Flora	(FO 330) Research Methods & seminar	(FA 440) Fish stock assessment and population dynamics
6		(FO 260) Soil Science	(FO 370) Operations Research & project management	(FA 461) Industrial attachment
7			(FA 340) Aquaculture production and Management systems	(FA 461) Research project

BSc Fisheries and Aquaculture (Proposed new)

#	Yr 1 Courses	Yr 2 Courses	Yr 3 Courses	Yr 4 Courses
1	(B100) Biology	(AF 270/FA370) Genetics & Fish breeding	(FA 300) Aquatic ecology & environment	(FA 400) Aquaculture production & Management
2	(CH 130) Chemistry	(FA 210) Ichthyology	(FA 310) Aquaculture systems &Engineering	(FA 420) Post-harvest Fish technology
3	(PH 110) Physics	(FA 230) Limnology	(FA 320/FA 470) Fish health and Diseases	(FA 410) Fisheries Economics and entrepreneurship
4	(M110) Maths	(FO 210) Biometry	(FA 330) Fish Nutrition and feed formulation	(FA 450) Fisheries management, rural sociology and extension
5	(LA 111) Communication & skills	(FA 220) Principles of Biochemistry	(AA 330) Research Methods & ethics	(FA 440) Fish stock assessment and population dynamics
6	(ICT 110) Introduction to computers	(AA 220) GIS & remote sensing	(FA 360) Fishing Gears and technology	(FA 461) Industrial attachment
7				(FA 461) Research project

BSc Fisheries Science (Proposed New)

#	Yr 1 Courses	Yr 2 Courses	Yr 3 Courses	Yr 4 Courses
1	(B100) Biology	(AA 200) Biometry	(FA 300) Aquatic ecology & environment	(FA 420) Post-harvest Fish technology
2	(CH 130) Chemistry	(FA 210) Ichthyology	(AA 310/AA 410) Rural sociology and extension	(FA 410) Fisheries Economics and entrepreneurship

3	(PH 110) Physics	(FA 230) Limnology	(AA 370) Project Management	(FA 430)Fisheries management
4	(M110) Mathematics	(FA 240) Biology of Aquatic Fauna & Flora	(FA 360) Fishing gears and technology	(FA 440) Fish stock assessment and population dynamics
5	(LA 111) Communication & skills	(AA 220) GIS & remote sensing	(AA 300) Research Methods & ethics	(AA 461) Industrial attachment
6	(ICT 110) Introduction to computers			(AA 400) Research project

BSc Aquaculture (Proposed new)

#	**Yr 1 Courses**	**Yr 2 Courses**	**Yr 3 Courses**	**Yr 4 Courses**
1	(B100) Biology	(AA 200) Biometry	(AA 370) Project management	(FA 400) Aquaculture production and management
2	(CH 130) Chemistry	(FA 210) Ichthyology	(AA 350) Aquaculture Engineering	(FA 420) Fish Post-harvest technology
3	(PH 110) Physics	(FA 250) Soil and water quality management	(AA 310/AA410) Rural sociology & extension	(FA 410) Fisheries economics and entrepreneurship
4	(M110) Mathematics	(FA 220) Principles of biochemistry	(FA 330) Fish Nutrition and feed formulation	(FA 470) Fish health and diseases
5	(LA 111) Communication & skills	(FA 200) Principles of Aquaculture	(AA 300) Research Methods & ethics	(AA 461) Industrial attachment
6	(ICT 110) Introduction to computers	(FA 220) GIS & remote sensing	(FA 370) Genetics & fish breeding	(AA 400) Research project

UOS Initial Comments/Feedback

- As with all these BSc courses the majority of Year 1 is taken up with sciences refresher/update modules? Obviously this is for a reason but UOS would wish to understand why. Effectively this just adds an extra year onto these courses which UOS would question the necessity for doing this.
- It seems the university with its new proposed courses wish to run separate Fisheries and Aquaculture BSc's to attract more specific targeted students for each, then also to keep its joint Fisheries and Aquaculture course too.
- Both the current Fisheries and Aquaculture course and the new proposed Aquaculture course have no specific aquaculture content until Year 3 and Year 2 respectively? We find this unusual and not in the best interest for recruiting and keeping students following Years 1 and 2.
- We would recommend for the new Aquaculture course one aquaculture module in Year 1, i.e. preferably (FA 200) Principles of Aquaculture then follow into years 2, 3 and 4 with the more specialised aquaculture modules. And move (LA 111) Communication & skills (title needs rewording?) to Year 2.

- Good to see a separate specialised module for fish health. We would hope that the School has the lab facilities and staff technical expertise to give this module the proper hands on practical infrastructure it needs.
- Since we do not see it there we would recommend adding Aquatic Animal Value Chains (including marketing) to (FA 420) Fish Post-harvest technology.
- And also adding to Field skills to (AA 310/AA410) Rural sociology & extension
- We would recommend 50% change in title and associated content from (FA 410) Fisheries economics and entrepreneurship to Fisheries/Aquaculture economics and entrepreneurship
- Finally although not vital we would recommend moving (FA 400) Aquaculture production and management from Year 4 to Year 3. And then vice versa (AA 370) Project management from Year 3 into Year 4
- In spite of this the general balance of the new proposed Aquaculture course in our view is better and much improved from the current one. We also think the coupling of subject areas and disciplines within the modular titles is well done.
- The UOS team also received a copy of the existing Aquaculture Curriculum. And whilst not within the remit of this report to carry out a detailed analyses of it, below are some key points we wish to make from reading through it (should be read in conjunction with copy of Aquaculture curriculum:

C2.2.2 Level of Qualification and Articulation in the Zambia Qualifications Framework - ZQF Level 7: Bachelor's Degree (p4)

At this level, it is expected that the graduate shall:

"Have knowledge and skills needed for independently operating as an expert in fish nutrition, fish healthy, fish production and management of fish farms. "

- We would question whether all graduates coming out of this course would have the necessary hands on and also previous work experience to walk into a fish farm managers position; particularly in a mid to larger scale commercial company
- Also we would recommend not using terms like "expert" as again this is raising expectations about individual graduates who prior to the course may never have worked on a commercial farm and certainly in research terms will not be "experts" in fish nutrition and a number of the other taught disciplines.
-

Have adequate knowledge in aquaculture to critically evaluate the appropriateness of different approaches to solving problems faced by the fish farmers.
Demonstrate originality and creativity in formulating, evaluating and applying evidence-based solutions and arguments within the field of aquaculture .
Apply a range of established techniques to initiate and undertake critical analysis of information, and to propose solutions to problems in the field of aquaculture.
Understand the limits of their knowledge, and how this influences analyses and interpretations based on that knowledge.
Present information and transfer knowledge, skills and values to others through delegation and practice.
Acquire skills needed to study further with a high level of autonomy.

Systematically establish and address personal learning needs.
Develop existing skills and acquire new competencies to enable assumption of significant responsibility within organizations.
Exercise personal responsibility, initiative and decision-making in complex and unpredictable contexts.
Exhibit autonomy, well developed judgment, adaptability and responsibility as a practitioner or learner.

- UOS would congratulate authors of the curriculum in including all of these above learning outcomes and personal qualities – Each very important in terms of expectations of new potential commercial employers - and well-articulated in the text.

C2.4.1 Staff Qualifications (p9)

The Department of Agriculture and Aquatic Sciences has ten (10) qualified and experienced full time academic members of staff. This number is supplemented with other academic staffs in the university. In addition, the Department has technicians and engages part time lecturers from time to time as need arise. (See Tables 2 and 3)

- If not already carried out in the last 2-3 years UOS would recommend the School/Dept carry out a review of staff expertise and experience to ensure all the main specialist aquaculture areas and disciplines are covered – especially in fish diseases, hatchery and feed and nutrition.

Course Code / Name: AA 200 Biometry p28

The aim of the course is to provide students with an understanding of the statistical methods and data analysis techniques used in research so as to enable students to apply such methods and techniques in the field of biological sciences.

- Mainly for new potential commercial employers looking through this curriculum would recommend title changed to include the word statistics

Course Code / Name: FA 200 Principles of Aquaculture

- Generally well written and structured introductory module -This first aquaculture module should give the new students the encouragement and interest to go on and do the rest of the course.

6 Types of ponds:

- This should not just be ponds but also range of other aquaculture holding /rearing units eg tanks raceways etc

References

- Whilst already good list there are several other key texts /books that should be in this introductory module list. See earlier NRDC reading lists.

FA250 Soil and Water quality management p38

- This module a good coupling of two related disciplines clearly articulated and laid out. Good to see pond fertilisation and primary productivity taught in this context.

Course Code / Name: AA 310/AA 410 Rural Sociology and Extension p40

- Good course/module layout - but if anything almost too much in this module within teaching time allocated?

Course Code / Name: AA 400 Research Project p59

- For UOS team would be good to know more details about the Research project and to see some examples of some of the student's research theses.
-

Course Code / Name: AA 461 Industrial Attachment p60

- As above for UOS team would be good to know more details about this industrial attachment and especially to obtain a list of the current private sector companies who are taking on students for this attachment programme.
- UOS would recommend to save on resources, administration time and sending different (mixed) messages to the growing private sector that there are moves towards joint rationalising this area between the major training education institutions across Zambia for attachments, placements and then working internships.

Summary outcomes and prospects of future Collaboration from the meeting and UOS team analyses

- Mr Nyimbili earlier asked how WorldFish would help in the curriculum development process since the proposed new aquaculture curriculum was not yet approved.
- Dr Cole responded that currently the AQ TEVET consultants on curriculum upgrade were doing a pipeline analysis of curricula from Kasaka and NRDC and that the curriculum from Kapasa Makasa University could be included.
- It was agreed that the university would submit copies of the current and proposed curricula to be included in the pipeline analysis and upgrade process.
- In response to the online training platform, Professor talked about the ongoing upgrade of internet connectively so that there accessibility without password anywhere where around the 360 ha campus. He further highlighted the importance the university places on digital tools and the importance of online training tools for teaching short courses.
- Dr Cole agreed that this is one area of possible collaboration and he mentioned the possibility of opening up an internship for some students from Kapasa Makasa University (KPU) to help develop a digital platform on the upcoming project on Tilapia Better Management practices
- Mr Nyimbili asked whether it was possible for WorldFish to help the university develop a hatchery.

- Dr Cole responded that there was no direct support for infrastructure development within the project but technical support is possible. Since a contractor will be putting up a hatchery at NRDC, there was possibility of exchanging ideas and collaboration within the framework of the project.
- Dr Cole further talked about the Blueplanet online aquaculture training platform and how Kapasa Makasa University would benefit from it.

Summary from UOS : KPU

- For UOS team we think new potential aquaculture upgrade curricula is much improved, well-structured and takes on many of the concerns UOS would have with the previous existing one
- We are aware of reasons for including the three core science subjects in the first year – but would say this adds another year onto the BSc course with all of the associated administrative and resource allocations. The HEA obviously prescribe four year BSc courses across the board but we would ask if this in future can be reviewed to have a slightly different structure of a 3 year course for a BSc (General) degree and then for the best performing students they would go into a 4th year Honours programme. We believe for employers in both government and private sectors this would be welcome and another means for them to readily assess and differentiate different students. Also for the university itself a mechanism for identifying those students with promise who can go on to do well in postgraduate and further research programmes.
- UOS understand also now why KPU now running 3 separate BSc s Fisheries, Aquaculture and the joint degree in what is a transition phase. But depending on current and future demands from students and employers, and the overall strategy of the university, UOS would recommend KPU to review running the three courses alongside each other for too long in next years, due to the costs and resource implications of doing so. It depends in future if KPU want to be seen from within Zambia and outside as the top university specialising in aquaculture nationally and even regionally?

UOS Summary Review of Natural Resources Development College Fisheries Science Tracer Study Report

Figure 2 Growing commercial aquaculture sector in Zambia looking for high quality well trained young motivated staff…….

This review relates to specific text/content in the Tracer report shown in " " below with UOS team comments in bullet points. Therefore if possible this review should read in conjunction with a copy of the Tracer report.

"The 2016, 2017, and 2018 NRDC Fisheries Science graduation lists show that 35.4% of female students graduated (or will graduate) from the institute. Their intake list indicates that only 16.0% of their current students are female. A large percentage of youth (70.2%) has attended or is currently attending NRDC's Fisheries Science training program over the past few years, yet the percentage of female youth who graduated in 2016/2017 or who will graduate in 2018 was 26.2% and the percentage of those who entered into the program in 2018 was only 13.6%." P1

- Gender is obviously an area which needs to be addressed further in any future vocational training college strategies
- As mentioned previously across the continent younger female graduates are being preferentially employed in commercial aquaculture, especially in the hatchery sector. This should be noted by the two colleges NRDC and Kasaka College.

“The overall objective of the project is to increase the number of human resources working for the private sector and smallholder commercial fish farmers with enhanced aquaculture knowledge and up-to-date practical skills to help sustainably grow the sector and make it more inclusive.” P2

- UOS would wish to point out that in terms of scale from smallholder aquaculture fish farmers through mid to larger scale commercial aquaculture companies the categories and skillsets of individuals required through training programmes is very different. Therefore the approach, delivery and content of vocational training courses has to reflect this. Also increasingly more important in developing entrepreneurial, small business development skillsets for young motivated Zambians and other nationality students.
- From UOS discussions with 6 NRDC alumni 2 out of the six young people were interested in starting up their own businesses. This is very encouraging!!

“A total of 105 alumni names were obtained” P3

- Good sample framework
- Be aware of pros and cons – bias? - for using an online survey tool for collecting qualitative and quantitative data/information. There is also a need for methods for triangulating these findings.

“The alumni aged 24 years and below were the lowest number of respondents, at 13.5 percent.” P4

- Whilst this is to be expected care needs to be taken that older alumni Away from the college environment may well have changed their views from their college experiences. Also aquaculture /fisheries employment market and research priorities may well have changed in the last 10 even 5 years…

“76% of alumni who took part in the study highlighted that their attachments yielded positive results and provided them with sufficient experiences in fisheries and aquaculture, while 24 percent were not satisfied with their attachment experiences.” P4

- This is positive feedback related to this projects future development of internship and practical attachments. It can be clearly seen the value students put on good employment experience during any of these courses. This must also relate to the importance given to the finance and funding allocated to these components.

“Around 11 percent (10.8%) of the study participants explained that the current curriculum does not cover entrepreneurship, and hence, the training at NRDC could better prepare students with these skills in the event that they do not find a job in either the private or public sector after graduating.”

- This is clear message from a smaller but significant subsector of alumni who appear to be keen and motivated to start their own businesses. Again encouraging !
- UOS would point out here this component of the course should not just focus on starting up new fish farm production businesses, but must also include potential new

small business opportunities across the whole value chain – inputs, marketing, post harvest, wholesale, retail, specialist services ie fish disease/diagnostics , also including NGO's and consultancies.

"Specific modules mentioned by alumni for inclusion in the curriculum were on fish diseases, fish nutrition, hatchery management, cage culture, and research methodology." P4

- Again these especially the first four very much back up the UOS teams past dialogues with both commercial sector and students themselves. And would add that the colleges themselves must review their current staff capacities and backgrounds to be able to teach and carry out associated hands on practicals for these subject areas well.

"Of the 37 total number of alumni who participated in the study, 48.6 percent were not employed by the sector since graduating, 21.6 percent were employed within 1 year after graduating, 8.1 percent obtained a job within 1 to 2 years after graduation, and the same percentage of the alumni already had a job at the time they were pursuing their Fisheries Science diploma at NRDC" P5

- These figures are fairly equivalent to those from other vocational training colleges to our knowledge for aquaculture/fisheries courses.
- But have scope for significant improvements now the commercial aquaculture sector in Zambia across value chains in growing.
- It is noted the employment gained stated does not stipulate whether this is within aquaculture fisheries or also in other sectors.

"The findings indicate that the public sector was a major employer for this sample of NRDC alumni (74%), followed by private sector firms who employed 16 percent, and non-governmental organizations (NGOs) who employed 10 percent of this sample."P5

- Whilst UOS assume the above situation with government employer being the majority is historical with the two colleges, we strongly believe if the two colleges can address certain issues with their curricula and facilities there will be significant new market and demand for private sector employment opportunities in the future.

"Of the 37 study participants, 11 (or 29.7%) indicated they were self-employed running their own aquaculture businesses after graduating. Roughly 73 percent of those who indicated they were self-employed were also employed by the sector (indicating a double-income source), while the other 27 percent were strictly self-employed." P6

- As above this encouraging and further reinforcing need for colleges to address entrepreneurial development in younger people.

"Only female study participants believed there was gender discrimination when hiring by the sector, be it favoring men (10.8%) or women (2.7%)." P6

- Issue of gender discussed earlier in this Gap analysis report. This feedback illustrates perceptions of gender bias in employment in aquaculture split between male and female.

"Conclusions: The public sector is a major employer for most of the alumni, suggesting a strong need to engage the private sector in ways that increase the opportunities NRDC students have to be employed by private companies. The NRDC Fisheries Science training lacks some focus as indicated by study participants. It does not prepare graduates with sufficient practical skills. The majority of the alumni called for intensification of the field attachment program so that students are equipped with more opportunities to gain practical experience."

- These are points well taken and repeatedly come out throughout this Gap Analysis report concerning the private sector
- This project itself is proactive in encouraging the increased dialogue and links between the colleges and this new commercial sector in Zambia. But would caution this should not become a competitive, counter constructive process between the colleges and in fact also including KPU and MU if the later also get involved with new programme
- UOS would recommend a joint shared approach - A working group ? Six monthly committee between all the major players to develop a positive joint approach
- This group or committee should also start to explore other mutually beneficial possibilities between training institutes and private sector eg sponsorship, guest lectureships, applications for grant and investment funding.

"A good proportion of the alumni study participants feels that the Government does not prioritize jobs creation, training, or creation of other opportunities (e.g., cooperatives) for the sector targeting youth and/or women. This resonates as the Government recently started the Zambia Aquaculture Enterprise Development (ZAED) project that aims to explicitly address youth and women integration in the sector."

- UOS would caution against the college and also universities staff planners and students focussing too much on government being the only organisations and funders for providing employment opportunities and programmes for young people per se in aquaculture and or fisheries.
- Evidence base from countries like Nigeria where commercial aquaculture has flourished in last 20 years employing thousands of young people and growing and selling now over 300,000 Metric Tonnes of catfish (FAOStat 2016) is that virtually all of these jobs have emanated from non-government funded investment from the private sector itself, also interestingly for some through the chieftancy and tribal institutions across this the most populous African nation. The Kenyan example from 2009 of their Economic Stimulus Programme (ESP) has clearly shown that such (misdirected) government funded programmes aiming to develop youth and female employment and benefits in aquaculture have poor record in concrete impacts and results.
- One final recommendation. We would recommend – if not already exisiting ! – as an outcome from this project a joint alumni network between the two colleges being set up. This can be at low cost initially through a Facebook and or Whatsapp group, with the dual purpose of firstly being beneficial for the students with contacts, relevant news and employment opportunities, but also equally importantly for the colleges themselves to keep in touch and

monitor the progress of the students after they leave, collecting regular feedback on the courses and how they can be improved year on year. As this develops it will create pride and ownership for alumni and for the colleges but also provide a window for the outside world looking in especially commercial sector, and for potential students and collaborators from outside Zambia.

Summary Review Private Sector Needs Assessment Report

This review also in same format as Tracer study review above with UOS team comments and feedback to particular sections in the report.

Figure Potential employment prospects for college alumni throughout the value chain. But they must have the required skillsets…….

"The assessment had three specific objectives: (i) to identify private firms who employ or wish to employ aquaculture graduates; (ii) to assess the human resource training needs of these firms and assess how women and female youth can be afforded more opportunities to work for private firms

and what barriers need to be addressed to enable this to happen; and (iii) to ascertain which specific content should be included in the NRDC Fisheries Science curriculum, training tools, online training platform and the internship program. Ten (10) commercial firms in Lusaka and Southern Provinces of Zambia took part in the assessment during Quarter 4 of 2018." P2

- A good sampling framework and this study probably the first of its kind carried out in Zambia giving a voice to those who were not heard before

"The firms who were interviewed have a total of 2,048 employees, and 72% are employed in the aquaculture unit. Youth (especially male) form the majority (81%) of the workforce at the 10 firms." P2

- This again: total of employees within these 10 companies is again very encouraging and in UOS viewpoint only likely to increase in the near future
- The preponderance towards males and physically based jobs is not unusual in the rest of SS Africa in countries where aquaculture is even more developed eg Nigeria, Ghana. However certain subsectors across aquaculture value chains have competitive advantages for females. These should very much be developed within the colleges strategic future planning.

The 10 firms employ a small number (1.5%) of graduates with certificates, diplomas, or degrees in fisheries or aquaculture. According to the firms interviewed, they are sceptical about hiring graduates because the quality of the skills a graduate would bring to the firm are not very different from those who have not studied fisheries or aquaculture. Firms indicated they wish to hire employees with technical knowledge and practical experience in aquaculture and who have a high level of commitment to work for their firms. Firms thus prefer to hire school leavers instead of fisheries or aquaculture graduates who lack especially practical skills training on account that both groups would be required to undergo in-house training. Many firms interviewed source technical expertise from outside of Zambia to train their employees.

- This perhaps one of the most important paragraphs in this whole Gap Analysis Report taken from this Private Sector Needs Assessment
- It requires no further words but should inform the process that follows in this project
- One other important related point from UOS team experience in Kenya Ghana Tanzania Malawi and other is about Students and alumnis attitudes and expectations when they finish their courses. UOS have found that this view and expectations engendered by some of the colleges/university staff and promotional materials that the students will leave the courses as "experts" in their fields and can become management material, consultants etc. This is a dangerous precendent and UOS are very well aware of many smaller scale farmers experiences with graduates coming to visit their farms as "experts" who actually have no practical hands on experience of growing a fish themselves, or have never taken on any risks themselves in setting up their own aquaculture sites. This is plainly obvious to all small scale and also I would say larger scale commercial players in Zambia. And probably why one of the key reasons why the 10 companies interviewed gave the views they did above.

"A semi-structured questionnaire was designed to capture the human resource training needs of 10 private firms sampled to take part in the assessment." P5

- UOS would concur with this type of methodology for assessing private sector needs
- However would recommend simple low input low cost mechanisms and processes are put in place for industry to more regularly express its (changing?) views and opinions on a more

regular basis – Roundtable for Aquaculture Committee or sub committee for Education and Training ?as set up in Kenya in last five years containing wide range of stakeholders.

"Ten (10) private sector firms located in Lusaka and Southern Provinces took part in the study (see Table 1), including 3 aqua-feed mills; 3 hatcheries supplying fingerlings; 3 vertically integrated fish farms that produce and sell fingerlings, cultivate fish, process and/or retail and wholesale fish; and 1 major fish wholesaler who buys and resales domestic and imported fish." P6

- Good cross section of participants. But would ask about coverages in other regions of Zambia and also with smaller scale producers and other value chain private sector?

"Students should be able to understand nutritional requirements for fish so that they are able to advise on the types of feed to use at what stage and the right quantities. They explained that students need to learn intensively on feed because it accounts for about 60% of fish production costs. The attachment or internship program should aim at exposing students to working with smallholder fish farmers to enable them to understand their behavior so that when they are employed to work with smallholder farmers, graduates would be able to help the sector grow by introducing the Best Aquaculture Practices (BAPs) based on the available local technologies." P7

- Fish feeds fish nutrition increasingly important private sector in Zambia. Message back from this sector is alumni not coming out of colleges universities with necessary skillsets. Their point about students learning how to visit and work with smallholder fish farmers. This very much in agreement with UOS views of student "experts" going out to try to work or do research with smallholder or other scale private sector.

The hatchery operators who took part in the study expressed concern that graduates faced challenges in application of knowledge in fish breeding, particularly the process of collecting eggs up to point of sale of fingerlings. They also explained that graduates they had previously hired were usually not familiar with some of the fish breeding technologies that they use.

- This again valuable feedback from specialised hatchery sector that the hatchery genetics broodstock related courses are not meeting their employment needs and thus need revising. It sounds from their words this again relates to alumni (lack of) hands on experience in their training in a sector which is highly hands on, skilled and valued.
- UOS recommended earlier in this Gap Analysis report related to the training colleges/universities on farm facilities, but to reiterate, in terms of setting up these on farm and hatchery facilities, each institute should carefully consider in their business models other than to be used for training students these facilities should also be income generating to at least cover their operating costs if not well managed to produce operating profits. Hatcheries and fingerling production if well managed lend themselves to this because of short production cycles and regular cash flow. With the students carefully incorporated into this this on a daily and weekly basis this is a win win scenario.

"Respondents from private sector firms also explained that graduates from vocational training and higher-learning institutes have continually exhibited a negative attitude towards work. They pointed out that their employees who graduated with a Bachelor's Degree preferred spending much of their time at work in the office on the computer and rarely moved around the farm, for example, monitoring how fish respond to different feeding practices or technologies. Three (3) respondents from private sector firms said that graduates they employ from vocational training and higher-learning institutes

often look forward to finding jobs in government or non-government organizations, and once offered, leave the private sector." P8

- This again is key and very valuable feedback for this project and the institutions concerned and something which UOS would very much concur with. Personal experience in Malawi (and other countries) where aquaculture graduates not actually willing to get in the water in ponds or tanks to demonstrate best management practices. Perhaps the reasons behind this are more complex, but UOS would point to some of the courses having very limited practical hands on practical time of students on farms. We would also add that view expressed that students just want to go into government jobs is also well founded and continually seen across our work in SS Africa. These students looking for desk job for life with at least some form of financial security. In a way we cant blame young people for this but would hope in years to come there will be more successful role models in commercial aquaculture both male and female to whom students of the future can aspire to
- This again related to providing Zambian and wider African success story case studies fairly early on in the course curricula to inspire and motivate the new students.
- Motivation methods for students and potential students should be reviewed, discussed and considered by the different teaching organisations concerned.

Some respondents from the private sector firms interviewed reported that interns who performed well during their internship were given full time positions after they graduated. P8

- This again is encouraging feedback, but needs to be worked on to increase more

"Eight out of the 10 respondents from the private sector firms interviewed for the assessment indicated that online training would provide a good opportunity for their employees to advance their knowledge about aquaculture in and outside of Zambia. It was further discussed with some respondents that the online training platform could act as a refresher course for some of their employees" P9

- This also useful feedback but in some ways not surprising to UOS team, since most modern private sector persons will always welcome online knowledge transfer and information sharing. But for most of these people they have 24 hour per day internet connectivity and also run their businesses through this. However we know in the real world the situation for students at Kasaka (definitely) and NRDC most probably is quite different in terms of them being able to access internet. A scenario where students are having to use their own smart phones and internet connectivity (if they have them) to access and interact with such online training courses and materials is not sustainable. This should be carefully noted by the project and Blue Planet in particular.
- Such now essential services /resources must be integral to the business models for both colleges and universities. And should again be linked in to income generation mechanisms.

"For example, one commercial fish farmer who has been in the business for more than three years explained that he has never received an application from a woman or female youth.
A few respondents from larger commercial fish farms that provide accommodation on site indicated they struggle to maintain women and female youth over the long run given that men employees tend to engage them in relationships. Such relationships result in unwanted pregnancies or women and female youth leaving the farm for personal reasons. One large commercial farm indicated that their Human Resources Department receives countless complaints from staff and their family members

living in housing quarters on their farms, although the nature of the complaints was not revealed." P10

- The issue of gender has been discussed before in this report. But this private sector feedback just reinforces what has been stated before. But even more reason for the courses and their curricula to proactively promote case studies of female success stories. There are good examples online – The Fish Site - which runs a regular Women in Aquaculture feature from round the world. This could be at very little cost be replicated and promoted on an African based online network like SARNISSA. The last sentence above is rather worrying to hear…...

"The firms only employ a small number of graduates with certificates in fisheries or aquaculture. This is because employers are not confident in the quality of graduates who have studied aquaculture in Zambia." P10

- This quote within the conclusion of the Needs Assessment report summarises the situation well with the private sector and we hope should be used as a positive, constructive motivation for this project and the institutions themselves to act on.

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Appendix 2 Photo Gallery

Figure 1 Arrival at NRDC. Board showing nine courses offered at the college

Figure 2 UOS Team meeting with NRDC staff

Figure 3 IT Computer room at NRDC college

Figure 4 NRDC Vision statement

Figure 5 The library at NRDC

Figure 6 UOS Team visit Kasaka Fisheries Training Institute

Figure 7 Kasaka college objectives board at entrance to the building

Figure 8 Kasaka college earthpond on day of visit stocked with tilapia

Figure 9 UOS team given tour around college earthponds

Figure 10 UOS team visit to Mulungushi University

Figure 11 UOS, WFC and NRDC team visit to Lotuno Enterprises Fish processing facility, owner Kasazi Nywenda

Figure 12 Team visit also to commercial tilapia hatchery and fingerling producer Mukasa Agrosolutions, River Kabwe, Mulungushi.

Figure 13 Mukasa Agrosolutions lined and concrete tilapia broodstock ponds. Water source pumped water from adjacent Kabwe river.

Figure 11 TVET Team visit to Kapasa Makasa campus January 2019

Figure 12 Poster at the entrance of the campus showing courses offered at the University


Figure 13 Concrete ponds (30 m X 20 m) constructed for production and practical purposes

Figure 14 Concrete ponds initially constructed at the front of the institution

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