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ROSEANNA AVENTO, ELENA LAZAREVICH AND SOFIIA NISHAEVA

FishEDU: Capacity building in fisheries and aquaculture education in Kyrgyzstan

Lessons learnt from collaboration between the Kyrgyz National Agrarian University named after K.I. Skryabin and the University of Eastern Finland

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ABSTRACT

The University of Eastern Finland (UEF) and the Kyrgyz National Agrarian University named after K.I. Skryabin (KNAU) have collaborated for over a decade in the development of fisheries and aquaculture education. This report describes the FishEDU project: Capacity Building for Fisheries and Aquaculture Education in Kyrgyzstan that was implemented by the two partner universities from 2017-2021 under the Higher Education Institutes Institutional Cooperation Instrument (HEI ICI) funded by the Ministry for Foreign Affairs of Finland and administered by the Finnish National Agency of Education.

The collaboration covered training of trainers in fisheries and aquaculture-related subjects and pedagogy. Furthermore, the project included training for administrators. Fisheries and aquaculture course planning and piloting were also integral parts of the project, as was the

production of course material. Development of learning environments at KNAU was also important for supporting teaching and student learning, for example the FishEDU Aquaculture Centre and the FishEDU Demonstration Fish Farm. The main activities specifically addressed the United Nations Sustainable Development Goals (SDGs) 1: No Poverty, 2: Zero Hunger and 4: Quality Education.

This report describes some of the activities that were implemented, challenges faced and the lessons learnt.

The collaboration was on the whole successful, and the objectives of the project were met, positioning KNAU as a leading institution for fisheries and aquaculture education in Kyrgyzstan and in Central Asia, paving the way for developing the fisheries and aquaculture sector in the region. This is especially significant in terms of the creation of a skilled labour force.

Future endeavours at KNAU will include maintaining and running its fisheries and aquaculture programmes and infrastructure sustainably. The potential for promoting fisheries and aquaculture research in the region is also considerable and in this lies clear collaborative opportunities for the two partner universities, KNAU and UEF.

Kew words: Fisheries, Aquaculture, Education, Kyrgyzstan, Central Asia

Forward

Kyrgyzstan has the potential to be a forerunner in the fisheries and aquaculture sector in Central Asia. Our country's rich water resources can very well provide livelihoods for our communities, thus addressing the United Nation's sustainable development goal number one: no poverty. The main challenge affecting the sector is the lack of a skilled labour force. The Kyrgyz National Agrarian University named after K.I. Skryabin (KNAU) has stepped up to address this challenge, and in accordance with its strategy, focuses on developing of cooperation in knowledge and skills development.

Our university strategy also aims at the continual development of our education programmes, pedagogical skills, teaching and learning techniques. This is in line with the Education Development Strategy of the Kyrgyz Republic (EDS 2012-2020), which aims to create an effective system for ensuring high quality of educational services at all levels, developing curricula that facilitate the development of student competencies, and improving the pedagogical competencies of professional staff.

International partnerships are important for our university and we have collaborated with the University of Eastern Finland (UEF) for a decade in the development of fisheries and aquaculture education. Our activities have been supported by the governments of the Kyrgyz Republic and Finland, specifically: the Ministry of Education and Science of the Kyrgyz Republic, the Ministry of Agriculture, Water Resources and Regional Development of the Kyrgyz Republic and its Department of Fisheries, as well as the Ministry for Foreign Affairs of Finland.

Furthermore, our two universities have had close partnerships with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations World Food Programme (WFP). In addition, the two partner universities have collaborated with research institutions in both Kyrgyzstan and Finland and with private sector companies in Kyrgyzstan: SeverBurvod,

Aquaservice, Aquaplast and in Finland: Stimulator Ltd. and RaisioAqua Ltd. These partnerships have been important in supporting the activities implemented and are an important factor not only in improving fisheries and aquaculture education, but also in community development.

The FishEDU project (Capacity building for fisheries and aquaculture education in Kyrgyzstan) was born out of previous collaboration in curriculum development. We have been able to improve the capacity of our teachers and administrative staff. Thanks to the project, it is now possible not only to prepare students for the world of work, but also to improve the skills of existing practitioners in the field of fisheries and aquaculture. Through these activities, we have also addressed the United Nation's sustainable development goals number two: zero hunger and number four: quality education.

The activities implemented lay a strong foundation for further development of our educational programmes and also, importantly, for research in fisheries and aquaculture not only in Kyrgyzstan but also throughout Central Asia. Partnerships will continue to play a strong role in this. We always seek to widen and strengthen our collaboration with our fellow agrarian universities in the local regions as well as abroad.

Bishkek, July 2021

Rector Rysbek Nurgaziev
Kyrgyz National Agrarian University named after K.I. Skryabin

Acknowledgements

This report is the result of collaboration between the Kyrgyz National Agrarian University named after K.I. Skryabin (KNAU) and the University of Eastern Finland (UEF) from 2017-2021. We have had the privilege of working with many different people and organisations in fisheries and aquaculture, in both Kyrgyzstan and Finland. We hope this publication will provide deeper insight into our activities and how we implemented them, as well as share with the readers the experiences that we acquired on our journey in Kyrgyz fisheries and aquaculture with the ultimate goal of addressing the UN sustainable development goals number 1: no poverty, 2: zero hunger and 4: quality education.

We thank the Ministry for Foreign Affairs of Finland for the funding of the project and its activities, including the compilation and publishing of this report. We also thank the Finnish National Agency of Education for the administrative support. We would especially like to thank Rector Rysbek Nurgaziev, Vice-Rector Almazbek Irgashev, Vice-Rector Uran Shergaziev, Dean Sovetbek Derkenbaev, Professor Asanbek Ajibekov, Associate Professor Ishenbek Alykeev and Director Astra Osmonova for their support and guidance at KNAU. In addition, we also thank Rector Jukka Mönkkönen, Dean Jukka Jurvelin, Professor Maija-Riitta Hirvonen and Dr Jarkko Akkanen for their support at UEF.

We are grateful to the support the Ministry of Education and Science of the Kyrgyz Republic, the Department of Fisheries at the Ministry of Agriculture, Water Resources and Regional Development of the Kyrgyz Republic, the Kyrgyz National Academy of Sciences, the United Nations Food and Agriculture Organization, the World Food Programme, the Finnish Environment Institute, the Natural Resources Institute Finland, AquaService, AquaPlast, SeverBurvod, Stimulator Ltd and RaisioAqua Ltd.

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Most of all, we especially thank all of the FishEDU team both at KNAU and UEF, without whom, none of the activities would have been possible, and ultimately this report would never have been written. You paved the way!

Kuopio and Bishkek July 2021

Roseanna Avento
Global Development Manager, UEF

Elena Lazarevich
Head of the Department of Agricultural Studies at the Agrotechnical College, KNAU

Sofiia Nishaeva
Project Coordinator, UEF

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1 Introduction

Roseanna Avento, Raine Kortet and Almazbek Irgashev

The post-Soviet and now independent Kyrgyzstan has only relatively recently started developing fisheries and aquaculture education, despite general recognition of the national and international importance of the sector and growing interest in its revitalisation. The absence of a trained and skilled workforce in the sector has been identified as a critical hindrance for its management and development.

A need for professionals at all levels of the sector was a major driver for teaching curriculum development work at the Kyrgyz National Agrarian University named after K.I. Skryabin and its Agrotechnical College named after S. Ibraimov (both which will be referred to hereinafter collectively as KNAU), which was implemented in partnership with the University of Eastern Finland (UEF) and administered by the United Nation's Food and Agriculture Organisation (FAO), with funding from the Ministry for Foreign Affairs of Finland (MFA) in 2015-2016.

The curriculum was developed in close collaboration with Central Asian stakeholders including research institutions, government agencies, the private sector, NGOs and CSOs, resulting in two outputs: (1) a fish farming vocational programme and (2) a fisheries and aquaculture bachelor level programme. Curricula in themselves do not ensure development, but rather how these curricula are implemented and taught, and how new graduates in the field are able to utilise their newly acquired knowledge in the field. It soon became clear that the greatest challenge Kyrgyzstan and at KNAU was the lack of qualified teachers to teach and implement the newly developed curricula.

Based on the abovementioned facts, KNAU and UEF initiated a collaborative project, FishEDU (Capacity Building in Fisheries and Aquaculture Education in Kyrgyzstan), that was implemented from 2017 until 2021. In this project the focuses were on training of trainers, planning

and piloting of courses and developing learning environments to provide an enabling environment for teaching fisheries and aquaculture. This initiative aimed at simultaneously contributing to SDG1 (no poverty), SDG 2 (zero hunger) and SDG 4 (right to quality education). The premise is that societal needs can be served through developing and delivering relevant curricula developed through open and transparent multi-stakeholder processes, in which higher education institutions function as avenues and propellers of sustainable global development.

The FishEDU project was funded under the Higher Education Institutions Institutional Cooperation Instrument (HEI ICI) administered by the Finnish National Agency of Education (EDUFI) and funded by the MFA.

This publication reports some of the key activities implemented within the FishEDU project and is divided into three sections following the structure of the project, with section 1 focusing on training of trainers, section 2 on planning and piloting of courses and section 3 on the development of learning environments.

Training of trainers was an integral part of the project. At the beginning, it was identified that 18 teachers at KNAU were teaching subjects related to fisheries and aquaculture, but only two of them were actually qualified in fisheries and aquaculture, and the majority of the teachers lacked pedagogical skills training, with only 7 having undertaken some teacher training, mostly in the 1970s and having had no continuing education to update their pedagogical skills. Furthermore, the teachers were not necessarily competent to teach the subjects that they had been assigned to teach, and they were not familiar with the process of curriculum development. During the start of the curriculum development process, none of the teachers involved had ever seen the curricula as a whole. During the FishEDU project, teachers were assigned to different courses based on their expertise areas and they were trained in subject-specific topics and pedagogical skills. In addition, administrative training was also provided.

The newly developed curricula for fisheries and aquaculture, at both vocational and bachelor level, outlined the extent of courses in terms of credits and hours, course objectives and learning outcomes. However, more specific course plans to guide the teaching and learning on specific courses were necessary. Through the FishEDU project, teacher teams at KNAU and UEF worked together to define the courses further, and this work included planning and division of learning hours in terms of lectures, fieldwork and developing the course content in detail, including production of some of the training material. Some of the courses were piloted, especially for their practical parts.

At the start of the project, KNAU did not have its own training facilities to cater for fisheries and aquaculture training and was basically reliant on the private sector to provide hands-on training in the field. Training provided in this fashion was challenging due to its non-alignment to curricula objectives, and the quality of the training varied considerably especially due to the limited expertise of the trainers themselves, not only in terms of fisheries and aquaculture expertise, but also in training (pedagogical skills).

The FishEDU project developed learning environments at KNAU to cater for the training needs and also to build a system that can generate income for the university in order to sustain its training and research activities in the long term. This involved the establishment of the FishEDU Aquaculture Centre and FishEDU Demonstration Fish Farm. Furthermore, the project also enabled the refurbishment of existing infrastructure and establishment of the FishEDU Water Laboratory and the FishEDU Kitchen, and installation of the FishEDU Electronic Library (FishEDU e-library).

The abovementioned learning environments are important to enable students to learn in practice the most important elements of widely applicable fish production technologies relevant for Kyrgyzstan. After this basic improvement, university teachers can better implement their teaching and related research in the future.

The various chapters in this report provide a glimpse of good practices developed, challenges faced and how they were mitigated, in an international environment which encompassed two universities in two

different countries, with different lingua franca, and with a wide variety of disciplinary and cultural backgrounds. The wide stakeholder engagement was critical on the road to participatory community development, taking a people-oriented approach to enhance sustainability, self-reliance and improvement of the quality of participation in the development of fisheries and aquaculture education.

Section 1: Training of trainers

2 Development of fisheries and aquaculture education in Kyrgyzstan

Roseanna Avento, Mairam Sarieva, Thomas Shipton and Raine Kortet

The FAO began collaborating on fisheries and aquaculture in Kyrgyzstan in 2008, after a request for technical assistance from the Kyrgyz government. The Finnish government answered this call in 2009, with funding of a trust fund project "Support to fishery and aquaculture management in the Kyrgyz Republic" (GCP/KYR/003/FIN). Under this project, plans were made to increase the national capacity in fisheries and aquaculture through master-level training. Post-Soviet Kyrgyzstan did not have fisheries or aquaculture education at tertiary educational institutions, despite general recognition of the importance of the sector. Yerli et al. (2011) identified three organisations in the Kyrgyzstan that, at the time, provided the basic infrastructure for education, training and research in the Kyrgyz fisheries sector:

- the Kyrgyz State National University (KSNAU) and KNAU for education and training
- the Kyrgyz National Academy of Sciences' Institute of Biology and Pedology (IOB) for research
- the Kyrgyz Ministry of Agriculture's Department of Fisheries (DOF) for consultations and short training courses

However, the training that was offered at these institutions was non-continuous and incorporated into other degree programmes, or was non-existent. The provision of a trained and skilled workforce in fisheries and aquaculture was identified as a critical requirement for the management and proper development of the sector. Yerli et al. (2011) stated that the major constraints hindering the development of education, training and research in the fisheries sector in Kyrgyzstan included:

- lack of funding of research and education

- lack of suitable equipment in research laboratories
- absence of well-trained experts and limited exchange of students and teachers from leading higher educational institutions and foreign institutions
- limited practical training courses for private sector farmers
- lack of more advanced level courses for ichthyologists, fish-breeders and fish pathologists

Due to a lack of possibilities to conduct training in fisheries and aquaculture locally in Kyrgyzstan, twenty students were selected to complete fisheries and aquaculture studies at UEF, Finland. Only five students out of this initial number managed to start and complete their studies. This small number of successful students was not sufficient to create the critical mass needed to sustainably develop a skilled workforce for the sector.

In 2012, KNAU initiated two programmes: (1) a bachelor-level programme in aquaculture in the Department of Livestock Production in KNAU's Faculty of Agriculture and Processing and (2) a vocational-level programme in aquaculture at KNAU's Agrotechnical College. These curricula were developed and initiated with minimal consultation and input from experienced academics and specialists, and therefore needed urgent review. Meanwhile, FAO continued to support fisheries and aquaculture development through a second Finnish-funded trust fund project "Towards Sustainable Aquaculture and Fisheries Development in the Kyrgyz Republic" (GCP/KYR/012/FIN). FAO and UEF partnered with KNAU to update and improve the existing curricula at KNAU. An assessment of the design, content and need for improvements of the curricula was undertaken. This assessment was based on the available documentation and performed through communication and consultation with relevant stakeholders.

This participatory process was implemented by UEF and KNAU in 2015-2016, leading to the development of two curricula; one for fisheries and aquaculture managers at bachelor level (KNAU, UEF and FAO, 2016a), and the second for fish farmer technicians at vocational level (KNAU, UEF and FAO, 2016b).

In 2017, UEF and KNAU applied for funding for implementing a training of trainers component, course plan development and piloting, and development of learning environments, through the HEI ICI programme funded by the MFA, which was ultimately realized as the FishEDU project.

This chapter describes the processes in developing fisheries and aquaculture education in Kyrgyzstan, starting with the process of curriculum development in Kyrgyzstan until the present day and the related lessons learnt during the FishEDU project.

2.1 Curriculum design activities at KNAU

Curriculum design was completed in a participatory process involving the administration of KNAU (teachers, students and external stakeholders). The process comprised the following steps:

- **Desktop review of the curricula at KNAU**. Curricula at KNAU were delivered to UEF via FAO, in both English and Russian. Course descriptions were requested but these had not been developed. Meanwhile, the FAO had also developed an interim curriculum. The review involved scoping over the course modules and course names, number of credits and hours. The interim curriculum course content was also reviewed.
- **Evaluation of implementation and delivery implementation of curricula at KNAU**. The evaluation of delivery and implementation of the curricula was completed to identify the teaching resources at KNAU, to determine the existing teaching methods used, and to determine teacher and student perceptions regarding delivery. Furthermore, teacher competence was also evaluated. The evaluation was completed through focus group interviews of teachers and students, using semi-structured and structured questionnaires.
- **Stakeholder identification of the Kyrgyz fisheries and aquaculture sector**. Stakeholders in the Kyrgyz fisheries and

aquaculture sector were identified and their roles were defined. This was carried out through a snowballing technique using prior contacts, whereby each known contact was asked to connect the team to other stakeholders. In addition, information gathered through UEF and KNAU's Central Asia Finnish Education Institute Network (CAFEIN) project was utilised. The CAFEIN project was implemented from 2013 to 2015 through the North-South-South-Partnership Network Programme (NSS), funded by the MFA and implemented by the then Centre for International Mobility, Finland (CIMO), now EDUFI.

- **Training needs assessment of stakeholders**. A training needs assessment of stakeholders was carried out through face-to-face interviews, using structured questionnaires. Staff at KNAU assigned to teach fisheries and aquaculture and/or science subjects, all the staff at the DOF, and staff working on fisheries and or aquaculture issues at IOB, were all interviewed personally. Furthermore, face-to-face interviews were carried out with private sector stakeholders, as well as DOF's Ton Hatchery staff. Focus group discussions involving 40 participants were held at a workshop 'Training Needs for Fisheries and Aquaculture in the Kyrgyz Republic', which brought together stakeholders in the fisheries and aquaculture sector to discuss and determine the needs and requirements of the fisheries and aquaculture sector for well-educated and skilled professionals.
- **Review of education standards and procedures for curricula development at KNAU**. Education standards and procedures for curriculum development at KNAU were reviewed through discussions with the Head of the Department of Livestock Production, the Dean of the Faculty of Agriculture and Processing, the Director of the Agrotechnical College, the Head of the University Academic Council at KNAU and the Vice-Rector for Education at KNAU, as well as with representatives of the Ministry of Education and Science of the Kyrgyz Republic, responsible for vocational education and higher education.

- **Update of curricula at KNAU.** The team from UEF and KNAU engaged in a team-building exercise to exchange information, contrasting the different education systems in Kyrgyzstan, Finland and generally in Europe. The team engaged in curriculum and course development training, and guest speakers from the American University of Central Asia were invited to disseminate information on best practices regarding curricula and course development. The Kazakh National Agrarian University had previously shared, with the same team, their experiences on curriculum development of a dual-degree master level programme, during a workshop organised by UEF and KNAU's CAFEIN project. This information was utilised during the programme.

  The team identified possible organisations that could provide internships for students, through a field trip to different organisations and farms during which key personnel were interviewed. The team also defined programme objectives and competencies, based on the training needs assessment results. Furthermore, the team also defined the areas of specialisation, taking into consideration the academic level of education they are mandated to deliver and the educational background level of their student base. This was presented to the University Academic Council at KNAU for preliminary approval.

  The team then made a random list of courses for each programme. The courses were ranked and defined further, until a consensus was reached on the focuses. The team wrote the preliminary course descriptions by listing individual objectives and outcomes and content, and these were presented to the University Academic Council at KNAU. A focus group workshop was held with stakeholders to introduce them to the preliminary course listings for both the vocational level and bachelor level trainings.

  Comments received from the stakeholders and further review were utilised to refocus the programmes and a final list of courses

was then established. Course description writing tasks were divided among the team, both in KNAU and in UEF. The work was collated by the UEF team. The draft course descriptions were presented to the entire UEF-KNAU team and refined further, upon which a presentation was given to the University Academic Council at KNAU for comments. Following this process, draft programmes were presented to stakeholders for their comments and further refining. The team then produced the final drafts.

The drafts were submitted to the FAO project "Towards Sustainable Aquaculture and Fisheries Development in the Kyrgyz Republic" (GCP/KYR/012/FIN) and two external international consultants with knowledge and experience of Central Asian fisheries and aquaculture for comments. The use of external advisors was essential for quality assurance in the curriculum development process and the output, as well as to ensure regional relevance of the course modules. Upon receipt of the experts' feedback, slight amendments were made and the curricula were finalised for approval.

Curricula were approved by the University Academic Council at KNAU and submitted to the Ministry of Education and Science of the Kyrgyz Republic for licensing and approval. KNAU in principle began to implement the curricula on an interim license in 2017, and the curricula were finally ratified by the Ministry of Education and Science of the Kyrgyz Republic in 2018. In addition, the Ministry of Education and Science of the Kyrgyz Republic also endorsed scholarships for students studying in the programmes.

2.2 Content of the curricula

2.2.1 The vocational fish farm technician curriculum

The vocational fish farm technician curriculum was designed to provide farmers and farm technicians with the technical knowledge and skills required to manage and operate aquaculture production systems. The course consisted of the following four basic cycles (KNAU, 2019a):

- General Education Cycle (2006 hours of course work)
- Socio-humanitarian Cycle (18 credits)
- Mathematical and Natural Science Cycle (6 credits)
- Professional Cycle (75 credits)

The General Education, Socio-humanitarian and Mathematical and Natural Science cycles were common to other vocational courses that had previously been developed at the Vocational College and were mandatory components of the curriculum developed by the project. In contrast, the Professional Cycle represented the technical component that was unique to the fish farming training. Therefore, the project focused on the development of the Professional Cycle.

The Professional Cycle was designed to familiarize students with basic fish biology, water chemistry, culture species, and the different fish farming, fish processing and marketing systems currently used in Kyrgyzstan. The training promotes the adoption of Good Aquaculture Practices (GAqP) and the optimization of farm management practices for optimal production outcomes. The students are also taught the basics of entrepreneurship and business management. The technical component or Professional Cycle of the course was divided into the following three components and thematic modules:

- Basic Component

Basics of Water Physics and Chemistry	3 credits
General Botany and Zoology	4 credits
Basic Hydrobiology	3 credits
Fish Taxonomy, Anatomy and Physiology	4 credits
Aquaculture Principles 1	3 credits
Aquaculture Principles 2	3 credits
Aquaculture Principles 3	4 credits
Farming of Carps, Catfish and Rainbow Trout	6 credits
Total	30 credits

- Special Disciplines

Fishing and Fish Harvesting Methods	2 credits
Fisheries, Fishing Gear and Equipment	2 credits
Nutrition and Fish Feeding	6 credits
Fish Diseases	5 credits
Water Use and Management in Aquaculture	4 credits
Business Planning for Fish Farmers	3 credits
Transport and Marketing of Fish	2 credits
Fish Processing Methods	4 credits
Fisheries and Aquaculture Law	2 credits
Total	30 credits

- Variable Disciplines

Recreational Fishing and Fishery Tourism	3 credits
Basic Bookkeeping and Accounting	3 credits
Managing People in the Workplace	3 credits
Occupational Safety	3 credits
2 State Exams	3 credits
Total	15 credits

2.2.2 The fisheries and aquaculture management bachelor level curriculum

The fisheries and aquaculture management bachelor level curriculum provides the students with a basic understanding of fish biology, limnology and aquatic systems sciences, as well as an in-depth understanding of fisheries and aquaculture and production technologies, management systems and governance. The course comprises the following three cycles (KNAU, 2019b):

- Humanitarian and Socioeconomic Cycle (36 credits)
- Mathematical and Natural Science Cycle (21 credits)
- Professional Cycle (156 credits)

Except for four modules that were developed specifically for the Humanitarian and Socio-economic and Mathematical and Natural Sciences Cycles, all the modules developed by the programme related to the Professional Cycle. The Professional Cycle comprised 23 Basic Modules, 9 Variable Modules and 3 Elective Modules. The modules were designed to provide the students with a technical understanding of the aquaculture and fisheries production sectors in Kyrgyzstan. The Professional Cycle comprised the following modules:

- Basic Modules

Introduction to Specialty (Orientation)	2 credits
Water Physics and Chemistry	4 credits
Water Physics and Chemistry Practical	5 credits
Hydrobiology	4 credits
Hydrobiology Practical	5 credits
Fish Taxonomy and Identification	4 credits
Fish Anatomy and Physiology	5 credits
Age Determination of Fish	5 credits
Fish Reproduction	6 credits
Nutrition and Fish Feeding	6 credits
Fish Diseases, Pest and Predator Control	6 credits
Aquaculture Principles 1	7 credits

Aquaculture Principles 2	7 credits
Water Law	3 credits
Environmental Law	3 credits
Environmental Management	6 credits
Fisheries Management	7 credits
Fishing Gear and Fishing Methods	5 credits
Recreational Fishing and Fishery Tourism	4 credits
Fish Harvesting and Transporting Methods	4 credits
Food Law	3 credits
Quality of Fish and Fish Products	5 credits
Occupational Safety	3 credits

- Variable modules

Farming of Carps, Catfish and Rainbow Trout	6 credits
Water Usage and Management in Aquaculture	4 credits
Fisheries and Aquaculture Research Methods	4 credits
Evaluation of Fishery Resources	4 credits
Research Project in Fisheries and Aquaculture	4 credits
Policy Formulation for Fisheries	3 credits
Fish Processing Methods	4 credits
Fish Product Development	3 credits
Marketing of Fish and Fish Products	3 credits

- Elective modules

Business Planning in Fisheries and Aquaculture	6 credits
Bookkeeping and Accounting	6 credits
Project Management in Fisheries and Aquaculture	6 credits

2.2.3 Lessons learned from curriculum development work

- **Lack of experts and skills needed in the sector**

The training needs assessment revealed that there was a need for experts at all levels of the fisheries and aquaculture sector, from fish farmers and fishers to government policy makers, trainers and researchers. Although short term trainings had been provided by FAO, UEF and other international organisations, training at a local level, leading to a certification and/or degree, was not available. It was important to establish fisheries and aquaculture training as mainstream subjects at KNAU, in order to meet the local labour market demand.

Subject-wise, the following were mentioned by the majority of the stakeholders as essential: basic fish farming, fish biology, identification and treatment of fish diseases, water management, fish processing, marketing and environmental management. Fish disease management was an issue that came up most often, in every stakeholder group. Aquaculture (mainly fish farming) was the main interest area mentioned by all the stakeholders, especially the private sector.

However, from government perspectives there was also a call for fisheries and water management experts. Entrepreneurship and business development were also mentioned as required skills. Pedagogy and teaching skills were mentioned by both teachers and students alike.

- **Lack of teaching material**

KNAU also lacked teaching material to teach the courses on the curricula. UEF and FAO made some teaching material support and donations, but there remained a lack of Russian-language training material. Without reference books, teachers cannot teach or develop their own material, and learning is virtually impossible for the students. This implied that there was a need to procure Russian-language books related to fisheries and aquaculture and to develop material to be used on the courses. This need was one which the FishEDU project addressed in its aims.

- **Practical training and fieldwork**

Practical training and fieldwork are a requirement in the curricula. External stakeholder organisations interested in taking students on for internships were identified. However, KNAU had to make agreements with the individual organisations concerning the scope and practical arrangements. In addition, KNAU lacked facilities to conduct coursework easily. They were over-reliant on private sector farms, and could not affect schedules, the training given or the pedagogy provided. The situation was therefore not ideal from an educational perspective.

This problem was addressed in the FishEDU project aims, in which the project provided administrative support to facilitate the formulation of agreements with fisheries and aquaculture organisations in Kyrgyzstan, to provide internship positions for students, and also to formulate tripartite agreement templates for the organisation, student intern and KNAU. These tripartite agreements clearly indicate the roles and obligation of each party and determine the timeframe of the internship.

- **Short courses**

Feedback from fish farmers revealed that there is a need for short courses of duration between one and three days, targeted to fish farmers. These were not part of the original curriculum work. However, acknowledging the need in the field, it was deemed necessary to develop short courses as part of KNAU's portfolio in industry extension work, to address this need. Development of four short courses was then taken up as part of the FishEDU activities, to be offered as part of the FishEDU Aquaculture Centre extension services targeted to fisheries and aquaculture organisations.

2.3 Towards FishEDU: Capacity building in fisheries and aquaculture education in Kyrgyzstan

The lessons in the previous section 2.2.3, formed the basis for the activities implemented in the FishEDU project. The implementation of these activities has required engagement with all the various stakeholders in the fisheries and aquaculture sector (Figure 1).

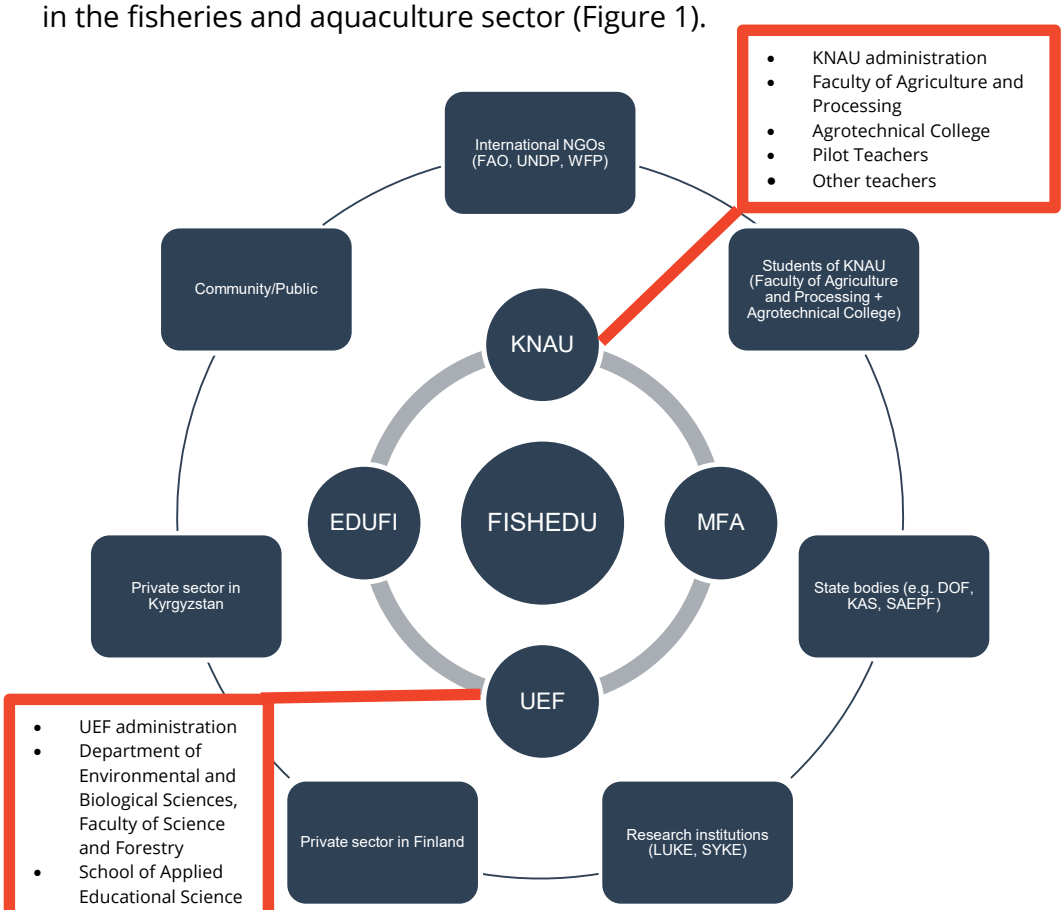

Figure 1. Primary and secondary stakeholders of the FishEDU project (Kydyralieva et al. 2021)

Stakeholders in the FishEDU project have contributed to three main result areas (Table 1): improved access to higher education, (ii) improved quality of higher education and (iii) enhanced institutional capacity identified in the HEI ICI programme funded by the MFA, which defined the framework of the project activities.

Table 1. Contribution of stakeholders to results areas of FishEDU (Kydyralieva et al., 2021)

Results Area	**Stakeholders that contribute to results area**
Improved access to higher education	KNAU, UEF, MFA, EDUFI, iNGOS, Research institutions, State bodies, Private Sector, Community
Improved quality of higher education	KNAU, UEF, MFA, EDUFI, Students, iNGOS, Research Institutions, Private Sector
Enhanced institutional capacity to support fisheries and aquaculture education.	KNAU, UEF, MFA, EDUFI, State bodies

The following chapters in this publication will provide more in-depth details of the FishEDU activities in capacity building of fisheries and aquaculture education in Kyrgyzstan. However, we can say with confidence that a decade of collaboration between KNAU, UEF, and FAO has already had a notable impact on the quality of aquaculture and fisheries and education in Kyrgyzstan.

Teachers at KNAU have learned how to engage in curriculum development, with strong participation and ownership, including that of students and external stakeholders, resulting in the development of two distinct curricula on different academic levels: vocational level and bachelor level studies. The administrative ownership of KNAU and policy level ownership on the part of the Kyrgyz Government is also evident,

through the investments made on the part of KNAU into infrastructure, licensing and assignment of staff to the activities, whereas the Ministry of Education and Science of the Kyrgyz Republic offers financial support to students studying in the sector, in the form of full scholarships. The curricula were ratified and are being implemented, and financial support is offered to those intending to study in the field. Subsequent work in the FishEDU project has had a positive impact and made KNAU well-positioned as a hub for Central Asian fisheries and aquaculture.

References

KNAU, 2019a. *Curriculum for fisheries and aquaculture*. Amended 2019. Agrotechnical college.

KNAU, 2019b. *Curriculum for fisheries and aquaculture*. Amended 2019. Kyrgyz National Agrarian University named after K.I. Skryabin.

KNAU, UEF, FAO. 2016a. *Curriculum for fisheries and aquaculture*. Kyrgyz National Agrarian University named after K.I. Skryabin.

KNAU, UEF, FAO, 2016b. *Curriculum for fisheries and aquaculture*. Agrotechnical college.

Kydyralieva, A., Nishaeva, S., Lazarevich, E. and Avento, R. 2021. *FishEDU Internal Evaluation 2021*.

Yerli, S.; Siar, S.; Fersoy, H.; Karimov; B.; and Van Anrooy, R. (Ed). 2011. Report of the regional workshop to assess the fisheries and aquaculture sector education, training and research needs in Central Asia. Tashkent, Uzbekistan, 12-14 January 2010. *FAO Fisheries and Aquaculture Report. No 945.* Ankara, FAO.

3 Planning and implementation of pedagogical teacher training at KNAU

Lais Oliveira Leite

Recent studies have indicated that higher education students need not only transfer of subject-related knowledge (expertise), but also pedagogical support from teachers to meaningfully develop professional competences (Postareff, Lindblom-Ylänne and Nevgi, 2007). The relevance of pedagogical teacher training (professional development) for improving teaching methods from a teacher-centred and knowledge transfer to a student-centred and conceptual building approach has been recognised (Gilbert and Gibbs, 1999). In addition, the literature has shown that teachers' attitudes and efficacy in teaching can be improved by pedagogical training (Gibbs and Coffey 2004; Hanbury et al., 2008; Postareff et al., 2007).

In alignment with the literature overview, one of the biggest challenges of higher education institutions in the Kyrgyzstan, also recognized at KNAU, was the lack of qualified teachers to teach and implement new curricula with a student-centred approach. As an illustration of KNAU teachers' competences at the baseline of the FishEDU project in 2017, six teachers in the university that were teaching subjects closely related to fisheries and aquaculture had out-dated pedagogical skills training, completed during the Soviet era in Russia. To directly tackle this challenge, the envisaged collaboration of KNAU and UEF under the FishEDU project aimed to improve capacity and promote teachers' professional development in pedagogical competences, and multiply its impact through the training of trainers model (Avento, Nishaeva and Eshimbekov, 2018).

This chapter reports the stages of planning, implementing and multiplying the impact of training KNAU teachers on their pedagogical skills and on course development. To better understand these processes, both KNAU and UEF teachers answered questionnaires in English/Russian in the timeframe 2019-2021 to express their personal and pedagogical

experiences over the pedagogical training period (2018 – 2019). Questions covered issues such as workload, meeting the objectives of the course, planning and implementing the course, its further practical applicability, benefits for the teachers of taking the training, and materials used. Answering the questionnaire was voluntary, and the participants provided their informed consent for data analysis and reporting.

3.1 Planning: aligning UEF pedagogical expertise to KNAU teachers' needs

Based on the project aims, the School of Applied Educational Science and Teacher Education at UEF planned a pedagogical training, targeting teachers at KNAU who teach fisheries and aquaculture-related subjects at bachelor and vocational level. The whole study module was planned based on the pedagogical studies in UEF Philosophical Faculty, taking into account the background and limited resources of the teaching staff and students of KNAU.

The training targeted eight university and vocational school teachers at KNAU and comprised five modules of 3 ECTS[1] each, totalling 15 ECTS in pedagogical studies with students' grading varying from 0 to 5[2] (Table 2). The courses had different distributions of hours for lectures, workshops and independent work/assignments, but they were all planned to offer more practical, hands-on learning experiences (workshops) than instructing and knowledge transfer time (lecture). All but one of the courses were implemented in KNAU during the academic year 2018-2019. Thus, four modules were organized at the KNAU campus in Bishkek, while one took place at the UEF campus in Kuopio. At the end of the training, the teachers received a certificate.

[1] European Credit Transfer and Accumulation System 1 ECTS = 27 hours

[2] Evaluation scale: 5 (Excellent), 4 (Very good), 3 (Good), 2 (Satisfactory), 1 (Passable), 0 (Fail)

After the structure of the pedagogical training was planned and approved, but before its implementation, a pedagogical orientation event in the format of a learning café was held in July 2018. Its purpose was to introduce the KNAU teachers to the pedagogical training, identify further needs from the KNAU teachers for implementation in the pedagogical training, and gather background information from the KNAU teachers for the UEF teachers.

During the learning café, several issues relating to how teaching and learning were organised at KNAU were addressed. Among the topics discussed during the orientation, the teachers expressed their expectations of improving their teaching competences with new teaching methods and they recognised that, to be a good teacher, they needed not only to be knowledgeable and have practical know-how (as expected by their students), but also to be able to connect with students to sustain their interest and motivation in learning (Avento, Nishaeva and Eshimbekov, 2018).

In addition, they indicated that teachers need support to provide quality education and develop their skills, such as having proper materials, a favourable working atmosphere and positive relationships with the team members, as well as to have possibilities for research and continuous professional development (Avento, Nishaeva and Eshimbekov, 2018). Finally, they were willing to engage in continuous professional development because this "would help their students learn and change for the better", which was considered by them as the positive and enjoyable aspect of being a teacher (Avento, Nishaeva and Eshimbekov, 2018).

Table 2. Description of courses by name and date of implementation, main learning objectives, module content and activities

Course name / Date	**Learning objectives: after the course, a successful student is able to …**	**Content and activities**
Introduction to Higher Education Institution Instruction and Seminar planning / November 2018	1) become aware of the instructional process and orientate to develop their own teaching, 2) reflect carefully about their own teaching and develop teaching approaches concretely in practice, 3) understand the basic elements of lectures and seminar planning in HEI, and learn to create lesson plans for their own needs	Instructional process, lecture plans. Learner's prior knowledge and attitudes as a starting point to teach, and the possible needs of learners for special support. The student is challenged to critically evaluate her/his knowledge, attitudes and values with respect to her/his actions.
Teaching and learning as an interactional process in Higher Education Institutions / February 2019	1) understand the basic elements of student-centred instructional processes and the role of a teacher, 2) become aware of different methods of fostering social interaction to develop their own teaching, 3) become aware of the research outcomes for developing interaction in teaching, and 4) apply teaching methods to develop social interaction in learning groups.	Role of social interaction in learning, motivation, student engagement. Pedagogical models and approaches to develop social interaction in HEI instruction. Active participation in lectures and workshops, conducting the independent work and assignments.
Inquiry-based learning approaches and sustainable education in HEI instruction / May 2019	1) describe the methods and the nature of different science disciplines, 2) design, implement and evaluate small scale science experiments and hands-on activities for the HEI students, 3) integrate different fields of sustainable development to the content of science education, and 4) use information and communication technologies to support her/his thinking and teaching processes and as an auxiliary tool for demonstrations and evaluation.	Inquiry-based learning and experiments are used to familiarize students with the vital phenomena related to teaching topics. Information and communication technologies, learning environments outside schools, and experts are utilized in communal and collaborative learning. Active participation in lectures and workshops, conducting the independent work and assignments.

Course name / Date	Learning objectives: after the course, a successful student is able to …	Content and activities
Flexible and digital learning environments / March and May 2019	1) understand the role of a flexible and digital learning environment in the teaching process, 2) become aware of a few digital technological tools to apply in teaching, 3) use information and communication technologies (ICT) to support teaching processes and as an auxiliary tool for demonstrations and evaluation, 4) integrate the use of ICTs into her/his own pedagogical thinking, and to learn the most important subject-specific scholarly information sources of research publications, basics of analysis of information search topic and search query formulation, and skills in systematic information retrieval.	Opportunities and restrictions of using ICT in the teaching process, learner's prior knowledge and attitudes as a starting point to use ICT as a part of digital learning environments. Examples of the current digital technology. Information retrieval from available e-sources
Assessment and evaluation in educational contexts / October 2019	1) understand the theoretical basis of assessment and evaluation, 2) understand the role of assessment in HEI teaching and learning, and 3) become aware of methods of assessment and evaluation and to use some of these in one’s own teaching	Key concepts and definitions of assessment and evaluation. Different approaches to assessment, different methods and tools of assessment. Ethics of assessment and evaluation

Next, in order to support the UEF teachers in preparing a pedagogical training suited to the KNAU context and needs, an information package was compiled, giving a brief introduction to the project background; practical information for travelling from Finland to Kyrgyzstan; the Kyrgyzstan and its education system; KNAU and, most importantly, the KNAU teachers.

The information package presented the results of the learning café, and a short written and video introduction of KNAU teachers and what they teach. The UEF teachers were also informed that they would have an intermittent interpreter during the classes, and that they should deliver their teaching materials at the latest 2 weeks prior to their arrival in Kyrgyzstan, so that the materials could be translated into Russian for posterior use and reference of the KNAU teachers.

On the other side, an information package was also developed and distributed to the teachers and administration of KNAU. This package contained the pedagogical training plan, curriculum, and background information about the UEF School of Applied Educational Science and Teacher Education and its trainers involved in FishEDU.

The UEF teachers prepared themselves for this international cooperation in various ways. According to what they reported through the questionnaires, it was a common practice that the teachers who went to Kyrgyzstan first shared their experiences with the ones who went next. In addition to such discussions, the teachers prepared their pedagogical materials by reading relevant and recent literature on their module content and edited PowerPoint slides and instructions in A4 papers in collaboration with each other (in pairs).

During the preparation, the UEF teachers created materials that would guide the KNAU teachers towards group work and hands-on learning activities among themselves, so that not much time would be required for intermittent interpretation during the class time.

One teacher particularly prepared to teach mostly in Russian, thanks to his language skills. This teacher also considered that in Kyrgyzstan, some teachers may not have access to licensed scientific e-books and articles, so he used Russian and Western open access article databases such as Google Scholar, cyberleninka.ru and doaj.org in his teaching.

3.2 Implementation: voicing teachers' experiences

As stated by Leite et al. (2020), "everyday classroom situations demand flexible pedagogical practices from teachers", which was also strongly experienced by the UEF trainers. According to what the UEF teachers expressed in the questionnaire, all of them had to change something in their course when implementing it, for different reasons. One teacher, for example, became sick during the trip and had to adapt the activities because of that. Another teacher reported the need to produce more material during the course, for example posters and activity materials for individual or group works. Other teachers modified and added some content during the week at KNAU, because the skills and possibilities to use ICT in the venue varied (for example connections, applications).

In general, the UEF teachers realized that the knowledge and experiences of the KNAU teachers were different from what they were expecting and, to adjust the training accordingly, they had to change some activities originally planned and improvise with other pedagogical methods. Despite some challenges and the need for improvisations, the UEF teachers considered that the objectives of their modules were met. All modules were conducted in an interactive manner, which ensured the active involvement of KNAU teachers. Workshops during pedagogical training took place not only at the campuses of KNAU and UEF, but also included field visits in order to demonstrate possibilities for arranging interactive and inquiry-based learning for students.

On the other side, KNAU teachers were satisfied with the courses in general. They reported that the course workload was suitable, and they had enough time to study (Arziev and Avento, 2021). The KNAU teachers

also expressed that the objectives of the courses were met and that they received sufficient guidance and support for the module activities. Materials used on the courses were also deemed suitable. The teachers responded in the questionnaires that the study atmosphere was supporting and that their learning from the courses will be useful for their future teaching (Arziev and Avento, 2021).

Examples of practical uses of what they learned during the courses for their future teaching were: applying new teaching methods, such as mind-mapping, group work, inquiry-based learning, social and interactive techniques; developing lesson plans; encouraging students to use Internet as a learning resource; using online tools for teaching purposes (e.g., google forms, kahoot etc.); employing different monitoring of learning and assessment methods. The majority of the teachers reported that their understanding of the subject covered by the modules increased during the course (Arziev and Avento, 2021).

Finally, both UEF and KNAU teachers indicated aspects of the courses that could have been better, such as more practical and hands-on learning activities for different teaching situations and less lecturing time and amount of information; more provision of self-study materials and resources; better differentiation of assignments according to each teacher's prior knowledge on the topic; and better resources for some of the courses (e.g., computer laboratory) (Arziev and Avento, 2021).

In relation to this matter, when the UEF teachers had the chance to express what further information they would have liked to have in order to prepare for their course better, some of them suggested having more information about the KNAU library and how teachers actually use books and articles as sources for teaching and scientific writing; more information about the KNAU teachers' pedagogical skills in the format of a written description or a video recording of a class time; and to have an opportunity of an online encounter with the teachers before meeting them personally.

3.3 Results: multiplying impact

Although only eight teachers participated in the direct pedagogical training from UEF, Arziev and Avento (2021) reported that, from the lessons learned and new pedagogical competences developed by the KNAU teachers, they have:

- Planned and piloted 26 new courses at KNAU.
- Used the new pedagogical methods in current existing courses at KNAU.
- Developed a new, online, self-paced course on water sciences, fisheries and aquaculture. The course will be offered in English and Russian to pre-university students. At the time of writing this article, the course was in the piloting phase, in partnership with FAO and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

In addition to these direct results, Arziev and Avento (2021) also indicated that a total of 15 multiplying and disseminating events have been arranged so far: ten in 2019, four in 2020 and one in 2021, reaching a total of 248 teachers (92 male and 156 female). These actions took place in both university-level faculties and their colleges and were organized in the format of:

- Continuous seminars and open lessons at KNAU to demonstrate how the teachers put into practice the lessons learned from the project.
- Five modules developed and implemented by the teachers to train their peers at KNAU.

Although some clear changes in teaching methods and approaches may not have been systematically evident immediately after the pedagogical training, such professional development interventions and dissemination events are powerful strategies for consolidating lessons learned and exchanging them with peers. They consist of concrete opportunities to help all teachers involved to be more aware of their approach to teaching and their teaching methods. Consequently, they become more capable of

analysing and reflecting on their behaviour in teaching. Developing awareness of one's own approach to teaching is essential in improving teaching practices (Gibbs and Coffey, 2004). In addition, the literature points out the relevance of continuous professional development efforts at the institutional level, rather than isolated punctual interventions (Postareff et al. 2007).

In alignment with this, the KNAU team has disseminated the training very widely and the impact has been considered by the participants to be profound. Therefore, the project leaders and stakeholders consider that they have reached the objective of improving capacity and multiplying its impact through the *training the trainers* concept. In addition, Arziev and Avento (2021) also reported that the KNAU administration has indicated that all the institution's teachers shall go through similar training to improve the quality of teaching in the future.

We conclude that the pedagogical training undertaken at KNAU in cooperation with UEF has improved the teaching competences of all project participants (initial trainers and disseminated trainees). The resulting effect is that students will appreciate instruction by the teachers who have undergone the pedagogical training, resulting in more learning and professional development skills. Ultimately, this cascade impact will help the whole country to improve higher and vocational education, its labour force, resources and the economic situation in water sciences, aquaculture and fisheries.

References

Arziev, K. and Avento, R. 2021. Trainer to trainer pedagogical training organised by UEF's School of Applied Education Science and Teacher Education. *FishEDU Feedback Report*.

Avento, R., Nishaeva, S. and Eshimbekov, T. 2018. FishEDU: Capacity building in fisheries and aquaculture education in the Kygryz Republic. *Information Package for Teachers in the UEF School of Applied Educational Sciences and Teacher Education*.

Gibbs, G. and Coffey, M. 2004. The impact of training of university teachers on their teaching skills, their approach to teaching and the approach to learning of their students. *Active Learning in Higher Education*, *5*(1). pp. 87-100.

Gilbert, A, and Gibbs, G. 1999. A proposal for an international collaborative research programme to identify the impact of initial training on university teachers. *Research and Development in Higher Education*, *21*(2). pp. 131-143.

Hanbury, A., Prosser, M. and Rickinson, M. 2008. The differential impact of UK accredited teaching development programmes on academics' approaches to teaching. *Studies in Higher Education*, *33*(4). pp. 469-483.

Leite, L. O., Go, W. and Havu-Nuutinen, S. 2020. Exploring the learning process of experienced teachers focused on building positive interactions with pupils. *Scandinavian Journal of Educational Research*, pp.1-15.

Postareff, L., Lindblom-Ylänne, S. and Nevgi, A. (2007). The effect of pedagogical training on teaching in higher education. *Teaching and Teacher education*, 23(5). pp. 557-571.

4 Training in aquaculture

Mairam Sarieva, Roseanna Avento and Thomas Shipton

One of the aims of the FishEDU project was to increase the capacity of the teachers at KNAU to teach the aquaculture subjects included in their fisheries and aquaculture curricula (FishEDU, 2017).

In the bachelor level curriculum, the subjects include: Introduction to Speciality (Orientation), Fish Taxonomy and Identification, Fish Anatomy and Physiology, Fish Reproduction, Age Determination of Fish, Nutrition and Fish Feeding, Fish Diseases, Pest and Predator Control, Aquaculture Principles 1, Aquaculture Principles 2, Fish Harvesting and Transporting Methods, Farming of Carps, Catfish and Rainbow Trout, Marketing of Fish and Fish Products, and Fisheries and Aquaculture Research Methods (KNAU, UEF, and FAO, 2016a).

On the vocational level curriculum, the subjects include: Fish Taxonomy, Anatomy and Physiology, Aquaculture Principles 1, Aquaculture Principles 2, Aquaculture Principles 3, Farming of Carps, Catfish and Rainbow Trout, Fishing and Fish Harvesting Methods, Fisheries, Fishing Gear and Equipment, Nutrition and Fish Feeding, Fish Diseases, and Transport and Marketing of Fish (KNAU, UEF, and FAO, 2016b).

The main team to be trained consisted of a selected group of ten teachers at KNAU. Seven of this team had a background in veterinary medicine, one in ecology, one in processing technologies and one in fisheries and aquaculture. In some of the training programmes the entire KNAU's FishEDU team was involved, bringing the total number of persons trained to 12. In situations in which the entire team did not participate in the training, dissemination of information was organised so that all the team members became privy to all the information provided in all training sessions.

Training consisted of short sessions ranging from one day to one week in various subjects, visits to fish farms and aquaculture research stations in Finland and Kyrgyzstan, as well as practical training on fish farms. Some of the trainings were organised by the University of Eastern Finland, whereas others were organised by other organisations in Finland and Kyrgyzstan and some trainings were organised by FAO.

This chapter describes the trainings provided and the lessons learnt from the trainings.

4.1 Aquaculture training

4.1.1 Trainings organized by UEF

The following three training programmes were organised for the team:

- **Fish farming training**

  During piloting of the fish farming courses (see Chapter 7), training was also given to the KNAU team in fish farming (12 persons) in the autumn of 2019. The training was given at a private fish farm, Aquaservice, in Bishkek, Kyrgyzstan, where rainbow trout and sturgeon are grown.

  The training lasted five days, during which time the team became acquainted with simple farming routines: how to observe fish, how to measure water quality parameters, how to handle fish, how to administer anaesthetics to fish, how to feed fish, etc. The training also included a visit to the fish farm's rainbow trout breeding unit, where the team was introduced to observing, handling and feeding fry and fingerlings. During the training, the principles of GAqP were introduced.

  A pre-test was organised before this training started and a post-test after the training was complete. The pre-test – post-test model is a common technique for evaluating changes due to interventions, in which the difference between test results collected prior to the training programme and after the programme often reveal the programme effects (Pratt et al., 2000).

- **Daily routines on fish farms**

  This training was a follow-up of the fish farming training mentioned above, in the autumn of 2019. In this training, the FishEDU Demonstration Fish Farm technicians (three persons) worked hands-on with a UEF trainer at the FishEDU Demonstration Fish Farm site, at KNAU's main campus in Bishkek, Kyrgyzstan. For a period of one week, they reviewed all the tasks that should be done daily on a fish farm, including measuring water quality parameters, observation of fish, cleaning of tanks, feeding of fish, etc. In addition, the training also entailed the team drawing up templates, with the guidance of the UEF trainer, for recording different parameters and activities on a fish farm. During the training, the principles of GAqP were presented once again.

- **Aquaponics**

  In this training session, the KNAU team (12 persons) visited an aquaponics experimental site at UEF's Department of Environmental and Biological Science in Kuopio, Finland. They were familiarised with the concept of aquaponics and how to grow berries or vegetables with fish, the techniques utilised, and the equipment used. The training was part of a larger study visit to Finland, organised for the KNAU team in the spring of 2019.

4.1.2 Trainings organised by FAO

4.1.2.1 Carp reproduction and hatchery management

Common carp *(Cyprinus carpio)* reproduction and hatchery management training was provided at the "Kolden Toru" Association hatchery in Tup, Issyk-Kul Province in Kyrgyzstan, in spring 2018. The practical training was provided over a two-day period and comprised all aspects related to intensive artificial common carp hatchery production. The major training topics addressed comprised:

Broodstock conditioning prior to the reproductive season - broodstock selection and the separation of males and females into broodstock conditioning ponds in order to prevent natural spawning.

Hatchery preparation protocols – setting up the broodstock tanks, "joug" jars, water heating and water flow systems in preparation for artificial propagation.

Broodstock spawning protocols – broodstock handling in the hatchery; preparation of gonadotrophic hormone injections (dose calculation and use); spawning, fertilization and egg cleaning.

Egg incubation protocols – use of "joug jars"; monitoring of egg quality, maturation and hatching; use of disinfectants to maintain health.

Pond preparation protocols – pond preparation and manuring protocols to support natural feed production for newly stocked larvae.

Larval, fry and fingerling rearing protocols – pond maintenance, feeding regimes, and sampling protocols.

Transport protocols – transport of eggs, larvae, fry and fingerlings

4.1.2.2 Fish health management

Fish health management training was provided for veterinarians at both theoretical and practical levels. The training courses were provided as short courses during the summers of 2018, 2019 and 2021. This training was attended by the KNAU team with veterinary backgrounds (seven persons). In 2018, theoretical fish health management training was

provided in a two-day course. The training addressed the following technical aspects of fish health management and disease diagnostics:

- An introduction to aquatic animal health and biosecurity
- Interactions between fish and the aquatic environment
- Fish as poikilothermic animals, with specific reference to aquatic diseases
- Role of technology in disease mitigation and prevention
- Role of the farmer in disease management
- Parasitic diseases of fish
- Fungal diseases of fish
- Bacterial diseases of fish
- Viral diseases of fish
- Prevention vs treatment and farm biosecurity
- Socio-economics and profitable fish culture

In 2019 and 2020, a series of practical and in-service training courses was held for KNAU veterinarians at the Center for Veterinarian Diagnosis and Expertise (CVDE), Bishkek, Kyrgyzstan. The courses included half-day visits to different fish farms in order to assess their biosecurity and fish health status, and to collect samples for laboratory-based disease diagnostic work at the CVDE.

The theoretical training reiterated the basic issues of biosecurity and fish health management, and special features of cyprinid and salmonid diseases were presented. The role of the aquatic environment in the outbreak of fish diseases was demonstrated by using practical examples from both cold and warm-water aquaculture. Detailed information on parasitic, fungal, bacterial and viral diseases was also discussed. Methods of diagnosis, prevention and treatment were also introduced.

The role of the state in establishing a favourable socio-economic environment for preventing disease outbreaks and transmission, and for their management, was also discussed, and the need for establishing close contacts between fish farmers and veterinarians to monitor and maintain

farm biosecurity was emphasized. During the training, Standard Operation Procedures (SoP) were introduced. Where appropriate, these were demonstrated under laboratory conditions or at farm sites. The SoPs comprised:

- Evaluation of the general status on the fish farm
- Collection of data related to disease outbreak
- Sampling of fish for fish disease analyses
- On-farm observation of disease prevalence
- Transportation of fish samples to the fish disease laboratory
- Necropsy procedures of fish in the laboratory
- Macroscopic and microscopic investigation of fish
- Veterinary preparations
- Recognizing fish pathogens under the microscope
- Measuring the size of fish pathogens
- Agar and broth preparation
- Blood agar media
- Inoculation of bacteria on agar
- Bacteria isolation from fish using Tryptic Soy Agar (TSA)
- Gram staining
- Antibiotic susceptibility testing
- Testing an antibiotic using a disk diffusion assay
- Treatment of external fish parasites

4.1.2.3 Farming of rainbow trout, carp and catfish

FAO developed a 12-week course for fish farm technicians at the Kyrgyz Lyceum No. 81 in Ton. Teacher training was provided by FAO to deliver this course. The FishEDU Demonstration Fish Farm technicians and one of the coordination team (four persons in total) participated in the technical training focusing on the Principles of Trout Culture, the Principles of Carp Culture, The Principles of African Catfish Culture and Farm Design and Planning.

4.1.3 Trainings organised by other partner organisations in Finland and Kyrgyzstan

Four trainings were also organised by partner organisations thus:

- Fish feeds and fish feeding training by RaisioAqua Ltd, in Raisio, Finland
- Recirculation systems in aquaculture by Clewer Ltd., in Turku, Finland
- Aquaculture research by the Natural Resources Institute Finland (LUKE) in Laukaa, Finland
- Fish feeds for the Kyrgyz Republic by Kyrgyz Forel LLC in Bishkek, Kyrgyzstan

These trainings were given by experts in the above-mentioned organisations and all of the team of 12 from KNAU participated, except for the training given by Kyrgyz Forel, in which only one of the team attended. This team member, however, subsequently disseminated information from the training to the rest of the team.

In Finland, trainings were given as study visits at the facilities of the organisations, and thus there was a practical element in the training. Only in RaisioAqua Ltd.'s facilities was it not permissible to enter into the production area. This is due to the strict compliance to food safety and quality management regulations, according to which visitors are not allowed into the production area. However, an in-depth overview was given on how to select feeds for different fish at different stages of their development, the quality parameters of different types of feeds and how to feed fish. Training materials were also provided and even after the training, RaisioAqua Ltd. provided additional material to the team.

4.1.4 Practical training on fish farms

The aim is that in the future, the farm technician team (three persons) and the coordination team (two persons) will be in charge of running the FishEDU Demonstration Fish Farm. This team of five is well positioned to perform the necessary tasks and its members also have a suitable background, as they are all veterinary doctors. With this in mind, the team participated in practical training on fish farms in Kyrgyzstan and Finland, thus:

- Toktogul, Kygryzstan, three days
- Sosnokova, Kyrgyzstan, three days
- Laukaa, Finland, five days
- Tokmok, Kyrgyzstan, three days
- Issyk Kul, Kyrgyzstan, three days

During the trainings on the fish farms, the team was acquainted and familiarised with all aspects of the daily running of a fish farm, from feeding fish to measuring water quality parameters, observing fish, removing dead fish from tanks and ponds, cleaning of tanks and ponds, disinfection procedures, and equipment used on fish farms. The farms were of different size and with different species of fish (common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*), rainbow trout (*Oncoryhncus mykiss*), whitefish (*Coregnous lavaretus*) etc.). In addition, the development stage of fishes on the farms varied, from fry to table fish, thereby giving the team good hands-on experience with working with fish of different ages.

4.2 Challenges and lessons learnt

On the whole, training in aquaculture has improved the capacity of the KNAU teachers, as set out in the aims of the project. The pre-test and post-test (section 4.1.1) indicated that the team's competence had increased on average by 13%.

Not only was their participation in the training extensive, but they also disseminated information from the training to their peers and also to their other colleagues within the institution.

Feedback from the team showed that the knowledge and skills attained through the training is utilised in their course planning and training of students. In addition, the knowledge and skills attained was useful specifically for the work of establishing the FishEDU Demonstration Fish Farm (Chapter 10).

Furthermore, the team will be able to utilise their newly attained knowledge and skills in the planning of students' practical work on the FishEDU Demonstration Fish Farm and in their internships. Moreover, the knowledge and skills attained are necessary for managing the FishEDU Demonstration Fish Farm. KNAU thereby has a pool of professionals trained in aquaculture subjects, that are now able to deliver training to their students, both theoretically and on a practical level.

Training in teams has also improved general teamwork skills of the KNAU teachers. Not only do they share responsibilities, but they have created a support circle in which they can operate.

Teachers with increased competence, who can utilise the learning environments that have been installed, now represent a unique and innovative resource to support teaching and student learning. This can further increase the attractiveness of the university. Moreover, it also certainly opens a path towards the development of research collaboration in aquaculture, both locally and internationally (Kydyralieva et al., 2021).

Engagement with external stakeholders and the private sector was crucial for delivering the aquaculture training. It was important that the

team gained practical experience in aquaculture, and hence the training was delivered by practitioners.

The main challenge faced was time. In all training feedback, time was mentioned as a constraint, with there not being sufficient time on any of the trainings. Obviously, the subject was new for all of the team, and thus it is understandable that the amount of information coming out of every training may have seemed overwhelming. Sometimes the opportunity to participate in trainings, especially those organised by external stakeholders, came at short notice, which caused challenges especially in terms of internal procedures at KNAU (Kydyralieva et al., 2021). This requires improved communication with external stakeholders to ensure that there is clear understanding between all parties on the goals, expectations and logistics involved (Kydyralieva et al., 2021).

In addition, in most of these trainings, the language of the training was English, interpreted to Russian, which is definitely tiring for the participants and is also a case for concern where capacity building is concerned. The hegemonic position of English, when the beneficiaries speak Russian, indicates the need for linguistic support for both partners. Roth (2019) emphasises this point, saying that it is important to acknowledge the crucial language skills of national staff that can communicate both with international staff and with local beneficiaries.

References

FishEDU, 2017. *FishEDU Project Brief*.

KNAU, UEF, FAO. 2016a. *Curriculum for fisheries and aquaculture*. Kyrgyz National Agrarian University named after K.I. Skryabin.

KNAU, UEF, FAO. 2016b. *Curriculum for fisheries and aquaculture*. Agrotechnical college.

Kydyralieva, A., Nishaeva, S., Lazarevich, E. and Avento, R. 2021. *FishEDU Internal Evaluation 2021*.

Pratt, C. C., McGuigan, W. M., & Katzev, A. R. (2000). Measuring program outcomes: Using retrospective pretest methodology. *American Journal of Evaluation, 21(3*), pp. 341–349

Roth, S. 2019. Linguistic capital and inequality in aid relations. *Sociological Research Online*. 24 (1). pp 38-54. [online] available at: https://journals.sagepub.com/doi/pdf/10.1177/1360780418803958 accessed 8.7.2021

5 Administrator training for managing fisheries and aquaculture programmes

Bermet Tazhibaeva and Elena Lazarevich

The main objective of the FishEDU project was to strengthen capacity in fisheries and aquaculture education in Kyrgyzstan. While the main aims centred around building the capacity of teachers to deliver the curricula in fisheries and aquaculture, develop course plans and course material and develop learning environments, the role of administration is also critical.

Administration in higher education is essential to guide the teaching and research staff, as well as students in the institution. Webber (2016) highlights several roles that administrators have to fulfil in higher education:

- engagement of individuals and organisations in the communities they serve, for example, through networking, service learning, policy development and responsive programming (McRae, 2013)
- meet the needs of learners to access education and training in order to increase their success in the workplace (Adamuti-Trache and Schuetze, 2009)
- create financial stability to support social and economic growth, scholarly inquiry, and enhanced capacity for learners to participate in a civil society (Alstete, 2014)
- planning and implementing practices that focus strategically on creating short- and long-term opportunities for learning that will make a significant difference for individuals and their societies (Webber and Scott, 2008).

The FishEDU project also sought to strengthen the capacity of administrators at KNAU, in order to enhance the roles mentioned above. Capacity building was implemented by arranging training to develop the skills necessary for engagement, both nationally and internationally (ICT skills, language skills, etc.), recruitment of students and awareness creation

of the new fisheries and aquaculture programmes, resource management, and development of financial stability and sustainability. This chapter describes these activities and the lessons learned.

5.1 Training to enhance national and international engagement

At the inception phase of the FishEDU project, it was identified that teachers at KNAU on the FishEDU team had only very basic level ICT skills. Due to the evolving learning and teaching environment in Kyrgyzstan, and to keep up with global changes in the digital space, it was important to arrange training for the teachers in the use of email, social media applications and in the basic Microsoft Office programmes, Excel and PowerPoint as well as PhotoShop.

These were also essential programmes used in all aspects of administering the tasks of the FishEDU project itself. Correspondence management via email was not familiar to the teachers, and training therefore also entailed the basics of professional communication. Furthermore, training also focused on how to make presentations for use in teaching, report writing, as well as data management.

English language training was requested for KNAU's FishEDU coordination staff to ease communication with their counterparts at UEF, as well as with the project funder and other international funders. At UEF, on the other hand, Russian language training was arranged. English and Russian were the main project languages, whereas Kyrgyz and Finnish were languages spoken by KNAU, and UEF, respectively.

Training was provided in the use of social media and quick messaging applications such as 'WhatsApp', especially in marketing of the fisheries and aquaculture programmes, as well as for rapid internal communication between the team members. Lack of internet connectivity is still a problem in many of the rural areas of Kyrgyzstan, where the teachers mostly reside, and 'WhatsApp' has proved to be even more reliable than email, due to its low data usage and costs.

5.2 Student recruitment and awareness creation

Since the fisheries and aquaculture programmes at KNAU were relatively new, it was important to market them to potential students. At the inception phase of the FishEDU project, the recruitment activities at KNAU were handled by personnel that had no knowledge of the programmes. It was therefore necessary to create a student recruitment team that included recruiters, the selection committee and two teachers, one from the Faculty of Agriculture and Processing and one from the Agrotechnical College at KNAU, who were positioned as advisors at the FishEDU Aquaculture Centre.

Student recruitment planning was initiated through a Learning Café activity whereby the participants together determined their targets for student recruitment and defined how, when and with what resources the activities would be realised.

Furthermore, administrators at UEF also shared their experiences with teachers at KNAU on student recruitment, as well as on marketing channels of UEF programmes, both nationally and internationally. These experience-sharing discussions aimed at sparking ideas into defining new channels for student recruitment and marketing the fisheries and aquaculture programmes at KNAU, in their own local context but also throughout Central Asia.

The FishEDU project facilitated the formulation of an annual student recruitment plan at KNAU for the duration of the project, its implementation and also follow-up reporting. Student recruitment has been achieved through open days at KNAU, recruitment seminars, awareness-raising events at local schools, hosting of school debates at the FishEDU Aquaculture Centre and participation in educational fairs. In addition, teachers and students are also widely involved in student recruitment, by visiting schools in regions across Kyrgyzstan when they travel back to their rural homes.

Finally, social media such as Facebook and Instagram have also been widely used in student recruitment. The FishEDU project has also

supported production of material such as the brochures used to market the fisheries and aquaculture programmes at KNAU.

5.3 Development of financial stability and sustainability

Running training programmes requires resources. Teachers, materials, reagents and maintenance of equipment and facilities all require financial resources. While the FishEDU project has been able to provide financial inputs to cater for the developments at KNAU, the project is only an intervention, meaning that financial support will, at some point, end. At that juncture, it is imperative to have a plan in place to ensure that operations can continue without compromising the financial stability of KNAU.

For this reason, the FishEDU project already undertook as one of its tasks to develop extension services and other educational services to ensure income generation. Since KNAU is a public institution, it is a non-profit organisation, but income generated can be utilised to maintain both education services and infrastructure. Students on the programmes are not a source of income tuition-wise, since they all have full government scholarships.

An essential part of developing financial stability and sustainability entails income-cost mapping and defining of a service portfolio for targeted groups. The FishEDU project activities have included training in business planning and utilising the Business Model Canvas for strategic definition of a business model suitable for KNAU. A team of seven was convened to participate in the training and to develop the business model. Training comprised three sessions by Stimulator Ltd., three sessions with UEF teachers and finally a three-day workshop organised by a local Kyrgyz organisation, the Lotus Public Foundation.

The team identified their main clients and customer groups, as well as channels to reach them, and also developed packaged services that can be offered. These include advisory services to stakeholders in the fisheries

and aquaculture sector, research services for fish farmers, short courses, summer and winter schools, and also selling a small quantity of fish from the FishEDU Demonstration Fish Farm. However, it should be noted that the FishEDU Demonstration Fish Farm is an educational and research facility and thus the amount of fish that can be sold is very limited and hardly even advisable in all cases.

Short courses are in high demand from fish farmers, and KNAU is well positioned to provide courses to meet these demands, in addition to provision of commissioned research services. Provision of extension services also increases engagement with local communities, since knowledge gained from education and research is brought directly to local people in their communities in order to create positive change.

Facilities at KNAU allow for experiential learning, which in turn allows for the promotion of youth interest in the fisheries and aquaculture sector. One good example is an online course 'FishKA', designed under the compass of the FishEDU project to promote youth interest in aquatic environments and fish (see Chapter 8).

In addition, and in keeping with other universities in the region, for example in Kazakhstan, the arranging of summer or winter schools is another activity which can provide potential additional income and increased engagement with stakeholders in the Central Asian fisheries and aquaculture sector, as well as with international actors, not to mention increased international higher education collaboration. The first research seminar on fisheries and aquaculture, at KNAU, was launched during the FishEDU project and constitutes a foundation for these future engagements.

Financial stability and sustainability was also explored during a study visit to UEF, where administrators of KNAU were introduced to the concept of sharing facilities and resources between different organisations. UEF shares some research and educational facilities with other educational institutions and research institutions. This has enabled more substantial investments in facilities, but simultaneously reduces the costs of maintenance for any one organisation, and fosters improved cooperation

between the organisations as well as internally, allowing for more interdisciplinary and multidisciplinary cooperation. KNAU has traditionally had separate facilities for each department and each faculty, with little interaction between disciplines. Through the support of the FishEDU project, the learning environments developed at KNAU have become open to other disciplines, departments and faculties, still a rather novel approach for Kyrgyzstan.

5.4 Lessons learnt

Administrator training has impacted positively on KNAU. Providing training for administrators and increasing their engagement was beneficial in terms of ensuring that the FishEDU project was managed effectively and efficiently, ensuring that personnel had the knowledge and skills needed to complete their tasks in a timely and effective manner. In addition, it ensured that data was managed in an orderly fashion. However, most importantly, administrator training has ensured that those trained have the tools and capacity to make strategic choices based on the strength of the institution, to build their position and competitive edge, and to communicate effectively with the surrounding community.

KNAU has been able to identify its areas of strength and the services that it can offer. In addition, it has also identified its marketing strategies to reach its desired target groups. With the digital leap, it has also become easier and faster to reach especially potential students.

On a more specific level, computer literacy was increased and allowed teachers to complete their tasks, eased their participation in trainings where digital skills were needed, and also enhanced their pedagogical skills. In addition, the English language level of the KNAU team increased, as did the Russian language level of the UEF team, which in turn facilitated several of the project activities, and sometimes additional interpretation and translation services were not needed. It might have been beneficial to have a programme on ICT training that continued for a longer period, or

intermittently at different stages of the project, in order to more adequately address the training needs of the teachers as they developed new skills and needed more advanced training to address their new needs.

In addition, language skills training could have been offered for a longer duration and to a wider base of beneficiaries. Furthermore, it should be emphasized that the Russian language skills of the UEF team were much lower than the English language skills of the KNAU team. Where partners aim to engage equally, it is important that the partners in the Global North also address their weaker capacities so as to engage with the partner in the Global South. Capacity building does not only have to take place in a North-South direction, but in fact can and should be encouraged to occur in both directions.

Introducing new ways of operating cannot be effected without the approval, support and cooperation of university administration. Training for administrators also ensured that administrators and academics at KNAU are able to close possible gaps in their own understanding of the various tasks that need to be completed in order to fulfill the mission of teaching and learning of fisheries and aquaculture. Dissemination of the FishEDU activities to other staff at KNAU, outside the project, was important, increasing the number of beneficiaries and building capacity on a far wider scale than was initially estimated.

It is important to note that although business planning training was provided, universities are not the same type of institutions as businesses are. Rather, they have their own cultures, practices and organizational structures. Contemporary business models cannot therefore be translated directly to a university setting. The business planning activities at KNAU utilized and applied the Business Model Canvas into the context of a higher education institution setting in Kyrgyzstan.

Leaders at universities are also usually academics. Successful management of university programmes will require a combination of not only academics, but also exposure to business practices and broader perspectives on management, leadership and engagement with the community. Administrator training offered through the FishEDU project

provided a holistic perspective especially on community engagement. After all, educational institutions are established to serve their communities and are only as strong as the communities around them. There was, on the other hand, less managerial and leadership training. In retrospective, there would have been a need for more focus on this aspect, especially for the younger scholars who may at some time find themselves in leadership roles. This is therefore an area for future development.

References

Adamuti-Trache, M. and Schuetze, H.G. 2009. Demand for university continuing education in Canada: Who participates and why? *Canadian Journal of University Continuing Education*, 35(2). pp 87-108.

Alstete, J. W. 2014. *Revenue generation strategies: leveraging higher education resources for increased income* (1st ed., Vol. 41). Wiley. California.

McRae, H. 2013. Reframing university continuing education's role in community engagement. *Canadian Journal of University Continuing Education*, 38(1). pp 1-10

Webber, C. F. 2016. Higher education administration and leadership: Current assumptions, responsibilities and considerations. *Research in Educational Administration and Leadership*, 1(1) pp.61-84

Webber, C. F. and Scott, S. 2008. Entrepreneurship and educational leadership development. Canadian and Australian Perspectives. *International Electronic Journal for Leadership in Learning*. 12(14). [online] available at: https://files.eric.ed.gov/fulltext/EJ940594.pdf accessed 8.7.2021

Section 2: Course planning and piloting

6 Planning and piloting of aquatic sciences courses at KNAU

Elena Lazarevich, Eliza Asanova, Sofiia Nishaeva and Liisa Nurminen

Water is an indispensable component of food production, which affects the quality and safety of food products in all stages of their production and consumption. Water quality parameters at fish farms determine the effectiveness of fish feeding, overall fish metabolism, fish growth and fish well-being. Moreover, the properties of water in a water body, such as temperature and organic load, define the fish species to be farmed. Monitoring of water quality is one of the most crucial activities to be carried out routinely on fish farms in order to ensure high quality of farmed fish (Avento and Von Wright, 2020).

Topics on physical and chemical parameters and properties of waters, biological processes and interactions in water bodies are present throughout the entire fisheries and aquaculture curricula in both vocational and bachelor's programmes at KNAU (KNAU, 2019; KNAU, UEF, and FAO, 2016). Curricula in fisheries and aquaculture at KNAU offer a wide variety of aquatic sciences courses for students. Among them, hydrobiology and limnology courses were selected for piloting within the framework of the FishEDU project, due to their importance within fisheries and aquaculture development.

This chapter describes how the development of course plans on hydrobiology and limnology (Table 3) was accomplished and how the piloting was implemented by three teachers from KNAU and two teachers from UEF, with assistance from the FishEDU coordination team. The course plans for the aquatic sciences courses are a set of schedules and topics, indicating what topics are taught on the course and when. In addition, the course plan directs the field-, laboratory and independent work to be

completed by students on the course. The course plans were developed in compliance with the curricula.

Table 3. Aquatic sciences courses in the vocational and bachelor curricula for fisheries and aquaculture

Title of the course	Aim of the course	Number of credits*	Study programme
Limnology	A general introduction to freshwater ecology, focusing on the physical, chemical and biological processes occurring in inland waters (lakes, reservoirs, rivers, streams and wetlands). The course covers the physical and chemical aspects of aquatic systems, life cycles and adaptation of organisms to the aquatic environment.	2	Bachelor, Vocational
Hydrobiology	Introduces freshwater environments and their basic properties, important for fisheries and aquaculture. The course includes study of the physical, chemical and biological functions of the aquatic environment, and familiarization with aquatic plants and animals.	4	Bachelor
Practicals in Hydrobiology	Continuation of the hydrobiology course and introduction of students to hydrobiological fieldwork and analysis.	5	Bachelor
Basics of Hydrobiology	The course introduces students to the study of living organisms in the aquatic environment and their main characteristics. Students study biological functions in relation to the physical and chemical properties of the aquatic environment. The course will introduce and discuss various aquatic plants and animals important for fish farming.	3	Vocational

***1 credit – 30 study hours**

6.1 Course plan development of aquatic sciences courses

Development of the course plans started with a discussion of the goals, objectives and content of each course, that are reflected in the curricula. Then credit hours were divided between lectures, practicals and laboratory sessions as well as independent work of the students. The roles and responsibilities among UEF and KNAU teachers in the course planning were also determined and tasks were assigned.

After drafting the thematic plan for the courses, the content of each lecture, practical and laboratory session was discussed during face-to-face and online meetings of the UEF and KNAU teachers. During the meetings, terms, definitions and concepts were identified. Some topics were removed as irrelevant and replaced by other, more specific content.

Course planning also entailed developing evaluation methods to be used within the courses. The evaluation of the knowledge obtained by students is carried out by multiple-choice testing, held twice a semester, and a final exam. The multiple-choice testing consists of 25 questions with a total score of 25, whereas the exam questions are evaluated from 1 to 5. There was little opportunity to affect the evaluation methods, since these are set according to official standards.

The content of the courses, multiple-choice test and exam questions for water-related courses at the Faculty of Agriculture and Processing and the Agrotechnical College vary, since the vocational curriculum is more practically-oriented, while the bachelors' courses demand more in-depth study and understanding of theoretical material.

Practical and laboratory lessons for aquatic sciences courses were designed accurately to fit the capacities of the refurbished FishEDU Water laboratory at KNAU and utilize available equipment. Some instruments, such as plankton and benthos nets and secchi-disks, were made by the teachers at KNAU under the guidance of the UEF teacher team.

Teachers from KNAU were also simultaneously undergoing pedagogical training (see Chapter 3). The new pedagogical skills and methods they acquired were introduced into the course plans, including elements of diagnostic and formative assessment, interactive methods in teaching, active use of ICT and creation of tasks for inquiry-based learning.

Challenges were inevitable. The language barriers faced when working in a combination of Kyrgyz, Russian, Finnish and English required a lot of financial and temporal resources. The teacher team included teachers from different units at KNAU, which resulted in much discussion regarding the structure of course plans. The study units at KNAU had to provide clarification in this issue.

6.2 Piloting of aquatic sciences courses: learning by doing

The aim of the course piloting was to demonstrate and test, along with the teachers at KNAU, real examples and possibilities for arranging practical training in hydrobiology and limnology, using the available study facilities and in local conditions. Piloting of the aquatic sciences courses was conducted at KNAU's facilities and on water bodies in the capital city of Bishkek. Two water bodies – the Ala-Archa river and a pond near Bishkek - were chosen for practical training. The main criteria for the choice of a water body were the proximity to KNAU's campus and ease of access by students using public transport. Field sampling and analysis of water and aquatic organisms from the pond and the river would allow the teachers, and later their students, the possibility to examine differences in the physical, chemical and biological processes in lentic and lotic waters.

Nets for plankton and benthos sampling are not readily available in Kyrgyzstan, and therefore the teachers made them. The principles and methods for net preparation were explained and demonstrated during training sessions. A bathometer was temporarily provided by FishEDU's partner project FinWaterWEI, "Programme for Finland's Water Sector Support to Kyrgyzstan and Tajikistan", implemented by the Finnish

Environment Institute (SYKE) and the Kyrgyz State Agency on Environmental Protection and Forestry. Other necessary equipment was donated by FAO, UEF or purchased separately through the FishEDU project.

Piloting began with an introduction to the field course in hydrobiology and limnology. A teacher from UEF presented a lecture on the rules and methods of water and biological sampling and their analysis in the field and in the laboratory. Lectures were based on the following: Wetzel & Likens, 2000; Goldman & Horne, 1983; Wetzel, 1983; Bond, 1979; Lagler et al., 1977; Zilov, 2013. Instructions for the field and laboratory work were provided, and the equipment was checked and prepared for further use in the field.

Piloting was carried out in a "learning-by-doing" modality. Teachers tested the piloting courses, participating in them as students. This was a good way to learn how to run the courses in practice. Teachers went to the water bodies, took water samples, gathered biological samples, measured temperature, pH, oxygen concentration and water transparency in the field and delivered samples for analysis to the FishEDU Water Laboratory. They also analyzed CO_2 concentration and colour in the laboratory. Key species of plankton and benthos in samples were also determined. All results were recorded in tables, developed during this same piloting phase. The results obtained enabled the assessment of water quality in the pond and river, and comparison of the results.

Piloting, the instructions developed, and the blank tables served as a basis for the further development of a guideline: 'Practicals in Hydrobiology and Limnology' for use by fisheries and aquaculture students at KNAU.

6.3 Outcomes of planning and piloting aquatic sciences courses

The joint collaboration of UEF and KNAU on capacity building in teaching aquatic sciences courses has resulted in:

- 5 course plans in hydrobiology and limnology developed and approved
- Guideline on Hydrobiology and Limnology Practicals developed and approved
- The FishEDU Water Laboratory refurbished, equipment and instruments for the field and laboratory works produced or procured and accessible
- Books on hydrobiology and limnology are readily available in the FishEDU Aquaculture Center and in the FishEDU e-library

The UEF teacher team set the piloting teachers of KNAU a pre-test before piloting, to assess their level of knowledge. A post-test was conducted after piloting to evaluate the teachers' progress and the efficiency of piloting.

In planning and running courses it is useful to know what the basic subject knowledge level of the participants is. In this piloting, most of the teacher students already knew the subject. However, there was a clear difference between the pre- and post-test, with a 13% improvement in the average score on the post-test.

Those to whom the subject was less familiar learnt more, and for others it was a good revision. Piloting gave new ideas to run these courses in the future, using more of the learning by doing method, with learning environments such as the FishEDU Water Laboratory and the FishEDU Demonstration Fish Farm providing good facilities for practical work.

A pre- and post-test system will also be a good tool to plan and later to modify courses each year in the future. This takes time, but makes teaching more efficient and more suited to the target group.

The entire teachers' team, involving both UEF and KNAU, worked harmoniously and productively throughout development of the course

plans, guideline and piloting. The commitment of the teachers and their motivation was evident through both online and contact meetings. Flexibility was important on the part of all participants, taking into account different opinions when developing the courses and deciding on tasks to be done within the course.

The support of the administration is also important when consolidating different practices between several faculties and institutions.

The pond and the river where piloting was implemented were well suited for the purpose. After a few years of monitoring these two same water bodies, students and teachers will be able to assess long term changes that may occur. This will provide a good basis for research at KNAU and water research collaboration with UEF. In future, some practicals will be arranged at the FishEDU Water Laboratory and the FishEDU Demonstration Fish Farm. This will contribute to deeper understanding from a practical perspective of the importance of hydrobiological and limnological sciences for fish farming.

References

Avento, R. and Von Wright, A. 2020. *From farm to fork: A guide to Finnish food safety and quality management*. Publications of the University of Eastern Finland, General Series. No. 34. Kuopio. [online] available at: http://urn.fi/URN:ISBN:978-952-61-3453-6 accessed 9.7.2021

KNAU, 2019. *Curriculum for fisheries and aquaculture*. Amended. Agrotechnical college

KNAU, UEF, FAO. 2016. *Curriculum for fisheries and aquaculture.* Kyrgyz National Agrarian University named after K.I. Skryabin.

Bond, C. 1979. *Biology of fishes*. W.B. Saunders Company. Toronto.

Goldman, C. & Horne, A. 1983. *Limnology*. McGraw-Hill Book Co., New York.

Lagler, K., Bardach, J., Miller, R. & Passino, D. 1977. *Ichthyology.* John Wiley & Sons. London.

Wetzel, R. 1983. *Limnology*. Saunders College publishing. New York.

Wetzel, R. & Likens G. 2000. *Limnological Analyses*. Springer. New York.

Zilov, E. 2013. *Basic Limnoecology*. Irkutsk State University. Irkutsk.

7 Planning and piloting fisheries and aquaculture courses

Bermet Tazhibaeva and Roseanna Avento

Fisheries and aquaculture are a growing sector in Kyrgyzstan, with aquaculture production up at 2558 tonnes in 2018, compared to 12 tonnes in 2003 and 974 tonnes in 1991(FAO FISHSTAT, 2021). Growing interest in the sector has also implied that education and training must be provided in order to ensure a skilled labour force.

The fisheries and aquaculture programmes at KNAU cover a wide range of subjects critical to development of the sector (KNAU, 2019; KNAU, UEF and FAO, 2016). At the vocational level there are 75 credits of fish farming-related courses in the Professional Cycle, whereas at the bachelor level there are 156 credits of studies in fisheries and aquaculture in the Professional Cycle (see Chapter 2).

At the inception of the FishEDU project, the most important fisheries and aquaculture courses were selected for course-planning work and for piloting. Some of these courses include the following: Introduction to Specialty, Principles of Aquaculture 1 and 2, Farming of Carps, Rainbow Trout and Catfish, and Recreational Fisheries and Fishery Tourism (Table 4).

This chapter describes how the development of course plans on these courses was carried out and how piloting of the courses was implemented. These activities were implemented by five teachers from KNAU, and four teachers from UEF, with the facilitation of the FishEDU coordination team.

Table 4. Some fisheries and aquaculture courses selected for course-planning and piloting

Title of the course	Aim of the course	Number of credits*	Study programme
Introduction to Specialty	Provides an overview of the fisheries and aquaculture management studies in the Department of Livestock Production and other departments where the studies take place.	2	Bachelor
Aquaculture Principles 1	Explains the difference between fisheries, aquaculture and fish farming, and includes an overview of aquaculture, part of which is fish farming. As part of the course, students study general aquaculture and species of farmed fish throughout the world and in Central Asia. The course introduces students to the history of aquaculture, its goals and position on a global scale. The course places special emphasis on the study of aquaculture in the Eurasian region. It provides an introduction to various types of fish farming systems practiced in Central Asia. This course also examines in detail the various fish farming systems and the principles of their organization.	7 3	Bachelor, Vocational
Aquaculture Principles 2	Examines in detail different structures in aquaculture and the design of aquaculture systems. The course provides a detailed introduction to how to establish a fish farm, as well as to pond construction and maintenance. Water requirements are discussed. Species selection is introduced, and monoculture and polyculture systems are discussed. Integrated fish farming is introduced. Breeding methods, hatchery and farm management and Good Aquaculture Practices are also focused on. The course provides a detailed introduction to how to establish a pond fish farm (including pond construction and maintenance, water requirements and management), as well as how to establish tank and cage farms and how to select species for them.	7 3	Bachelor Vocational

Title of the course	Aim of the course	Number of credits*	Study programme
Farming of carps, rainbow trout and catfish	Studies various farming methods for specific fish species (carps, catfish and rainbow trout). As part of the course, each fish species is studied separately with an emphasis on the techniques of growing fry, fingerlings and market-size fish, and describes the practices of fish farming and management for different types of fish.	6 6	Bachelor Vocational
Recreational fisheries and fishery tourism	Introduces students to the concept of tourism, its role and the potential for fisheries tourism in the Kyrgyzstan. The course also discusses challenges facing the development of recreational fisheries.	4 3	Bachelor Vocational

***1 credit = 30 study hours**

7.1 Course plan development, fisheries and aquaculture courses

The course plan development process started by identifying the aims, objectives and the content of each course according to the curriculum descriptions. The course contents were divided into lectures, practicals, laboratory sessions and independent work for students. The credit hours were divided between these different components. Responsibilities were divided between the teachers.

The first draft plan for each course was developed during the first face-to-face meeting of the assigned teachers. There, the content of each lecture, practicals, laboratory sessions and independent work for students were discussed and developed. However, this was just beginning of the process. There were several face-to-face meetings between the KNAU teachers and online meetings with UEF teachers. Topics, definitions and concepts were identified and irrelevant content removed or replaced with more appropriate content. The content of the bachelor level courses was

more advanced and included more theory than that for the vocational level courses. Furthermore, the number of hours spent on course work at the bachelor level was higher than that at the vocational level.

The design of all practicals and laboratory sessions was dependent on the available resources and facilities at KNAU. The learning environments developed through the FishEDU project (FishEDU Demonstration Fish Farm, FishEDU Water Laboratory, FishEDU Aquacentre and FishEDU Kitchen) were critical in enabling the successful implementation of the courses.

Evaluation methods were developed during pedagogical training that was organized in parallel with course development work, and the new pedagogical skills and knowledge obtained were applied in the courses. Evaluation methods at KNAU are quite stringent and rely heavily on the use of tests and exams. Multiple-choice testing is conducted twice per semester and a final exam is held at the end of each semester.

There were several challenges in the process. Language barriers existed and there was a heavy dependence on translators and interpreters in all of the processes. Furthermore, most of the teachers from KNAU were not familiar with the subjects and had to basically familiarize themselves with and study the subjects from new. Furthermore, in the beginning a change of personnel in both KNAU and UEF caused a delay in the process of course planning, with progress paused for a while until new personnel could be reassigned to the work. At that point, it was not possible to just proceed, but a lot of time was taken in reviewing the work and mutual updating about where the work had been left off and how it should be continued.

7.2 Piloting fisheries and aquaculture courses

The main aim of piloting the above-mentioned courses was to demonstrate and test how to plan, implement and hold practicals and laboratory sessions, utilizing the available resources and facilities.

Piloting of fisheries and aquaculture courses started from the 'Introduction to the Speciality' course. This piloting was carried out by a KNAU teacher with 1st, 2nd and 3rd year bachelor level students. A local carp farm in Ozernoe village, and two rainbow trout fish farms in Tokmok and Kant in the Chui region, were visited. Students were introduced to the main aquaculture fish species, their living habitats, farming conditions, feed and feeding methods, and to the equipment and facilities used in farming these fish species.

The 'Recreational Fisheries and Fishery Tourism' course was piloted at the Ala-Archa water reservoir. Students from both the bachelor and vocational level programmes participated in this piloting. Since this piloting also included piloting on the Fish Anatomy and Fish Handling courses, all of the KNAU FishEDU team as well as three UEF teachers participated in the piloting. Students were acquainted with fishing methods, equipment and gear used for fishing. Prior to the practical session, they had lectures on the use of water bodies and fish farms in organizing recreational fishery and fishery tourism. They also received lectures on fishing methods, equipment and gear.

All other fish farming-related courses were piloted simultaneously over the space of one week. At that time, the FishEDU Demonstration Fish Farm was not yet in operation and piloting was therefore held at the facilities of the company Aquaservice, and specifically at a rainbow trout and sturgeon farm unit.

All of the KNAU FishEDU team participated in this piloting in a learning-by-doing modality. In this piloting, exercises such as calculation of fish biomass, fish density and measuring water quality parameters were performed. Furthermore, daily feed consumption of fish was measured.

This piloting also touched on the courses 'Fish Diseases' and 'Nutrition and Fish Feeding' in the vocational level curriculum and 'Fish Diseases, Pest and Predator Control' and 'Nutrition and Fish Feeding' in the bachelor level curriculum, the courses of which were also planned in the same way as described in section 7.1. A pre-test and a post-test were held before and after this piloting

7.3 Outcomes of planning and piloting of fisheries and aquaculture courses

One of main outcomes of planning and piloting fisheries and aquacultures courses are 9 developed course plans. Furthermore, the teachers at KNAU are able to collaborate on an inter-disciplinary and multi-disciplinary level on developing teaching and learning. In addition, the concept of co-teaching is also more elaborate and can be easily implemented, not just within the KNAU teacher team, but also with the UEF teacher team.

The process also assisted the teachers in active use of their locally available teaching resources. To help the course plan development and piloting, literature on fisheries and aquaculture was procured by the FishEDU Aquacentre and these resources remain readily accessible to KNAU teachers and students.

The difference in the average score between the pre-test and post-test as a result of piloting was 13%, indicating an increase in competence.

The process of planning course plans was not easy for either partner, due to the language barriers and the highly varied background education of the KNAU team. This meant that a lot of time of self-study (in addition to organized trainings in the FishEDU project) and focusing was required. This extra time and energy could not always be arranged easily, and staff in both partner institutions were at times quite exhausted from this process. Possibly the team was being overly ambitious, and efforts could have been made early on to decrease the number of courses to be developed.

However, all the courses are in fact essential for the sector and it would have been a difficult choice to make in terms of prioritization.

Future processes on course development will be easier to handle due to these experiences. In addition, having the FishEDU Demonstration Fish Farm functioning and operational helps in implementing the courses more easily, with less time being spent in travel to alternative locations, and autonomy to implement the course work set, rather than to have to negotiate the course content each time with private operators. Teaching duties have now been divided among the pilot teachers at KNAU, allowing for a smooth continuation of the planned operations and tasks.

References

FAO FISHSTAT. 2021. Food and Agriculture Organization of the United Nations (FAO) *Fisheries and aquaculture statistics* FishSTATJ software [online] http://www.fao.org/fishery/statistics/en available 9.7.2021

KNAU. 2019a. *Curriculum for fisheries and aquaculture*. Amended 2019. Agrotechnical college

KNAU, 2019b. *Curriculum for fisheries and aquaculture*. Amended 2019. Kyrgyz National Agrarian University named after K.I. Skryabin

8 Planning and piloting of an online course on aquatic sciences, fisheries and aquaculture

Svetlana Tarasova, Elena Lazarevich, Sofiia Nishaeva and Oksana Skaldina

Nowadays, high-quality education in higher educational institutions is impossible without the use of novel information technologies. This ensures the development of skills and competencies that meet the requirements of the modern labour market (Torres Martín et al., 2021). In its various models, online education has been growing steadily worldwide and is currently on track to become mainstream by 2025 (Palvia et al., 2018).

The online learning process opens new opportunities for students, teachers and educational institutions. Students can choose the educational institution despite territorial boundaries and increase the internationalization dimension as they want. Thanks to online platforms and online courses, it is possible to obtain a high-quality and internationally relevant education without leaving one's home country. The general flexibility and the possibility to study at a suitable time are other major advantages of the online learning process which are highly appreciated by the students (Coldwell-Neilson et al., 2006).

For teachers, online education creates new possibilities for professional development, improvement of communication and teaching skills, the establishment of international networking and cooperation and creation of new connections and useful contacts. International online projects expose teachers to novel cultural environments and favour their further successful career development. It has been reviewed by Palvia et al. (2018) that across almost all disciplines, training of teachers through online cooperation increases their technical skills and diversifies their competence.

For educational institutions, online education brings an opportunity to compete with other educational institutions at a new level. For example, by using the online format it is possible to improve curricula by cooperating

with the best experts in the fields. Thus, educational institutions expand their horizons, extend international cooperation, and can create up-to-date and practically relevant programmes and courses.

The historical development of online education had four basic stages (Palvia et al., 2018). The first one appeared in the USA in the early 1990s as a learning trend based on Internet-propelled distance education. The second stage referred to the years 2000-2007, with the global increase of Learning Management Systems (LMS). The third stage emerged at the end of the first decade of the current century, together with the new education trend – Massive Open Online Courses (MOOCs). About this time, many education institutions throughout the world switched over to online enrolments, outpacing old traditional styles.

However, during the active development of online education in some regions, in many developing countries of the world teachers and students did not even think about using the online format. This was often ensured by several factors such as limited access to the Internet and an insufficient level of digital competence and literacy of both teachers and students (Spante et al., 2018).

The Covid-19 pandemic has spread rapidly around the world and brought with it changes in many areas of life, including education. According to the UNESCO COVID-19 monitoring programme (UNSECO COVID-19, 2021), the pandemic which started in 2020 forced nearly 63 million educators and 1.5 billion students to modify their teaching-learning environment and lifestyle. To reduce the risk of spreading of the disease, countries were forced to introduce quarantine and lockdown measures.

Most educational institutions had to master new formats and teaching methods in the shortest possible time, since face-to-face teaching was extremely difficult, and in many cases impossible. Therefore, there was an urgent need to switch to online format and distance learning using modern information computer technologies (ICT). At that time, there were already several platforms for conferences, such as ZOOM and Skype, and educational platforms such as Avn, Moodle and others, which were user-

friendly and easily accessible even in low-level resource environments. However, they were used situationally and were not systematically involved in training, especially in the post-Soviet countries as well as in the other developing countries of the world.

This chapter is dedicated to the planning and development of an online course on aquatic sciences, fisheries and aquaculture entitled FishKA, within the framework of the FishEDU project. The FishKA course is the result of joint work by teachers from UEF and KNAU. It was designed during the current realities of limited mobility between countries, aiming to ease the distance learning of students in the context of the COVID-19 pandemic.

8.1 How the idea of the online course FishKA appeared

A state of emergency due to the COVID-19 pandemic was introduced in Kyrgyzstan in March 2020, which led to the closure of all higher and vocational education institutions and a transition to remote (online) education. Due to this situation, the work on the FishEDU project was also suspended. As a result, several planned activities, such as for example piloting of practical training on fish product development and fish processing in cooperation with the FAO, remained unfulfilled.

Instead, the idea of creating an online course on aquatic sciences, fisheries, and aquaculture appeared. Thus, the project FishKA was born. One of its significant objectives was the demonstration and training of the KNAU teachers in the principles of creating online courses and providing an opportunity for students to participate in a supplementary online course for more comprehensive development of the specialty "Fisheries and Aquaculture". The course FishKA appeared as a valuable addition to available training programmes, which should diversify the knowledge and competence of both students and teachers.

The online course FishKA is aimed at creating motivation and stimulating interest among students to further study aquatic sciences, fisheries and aquaculture. The course was conceived as an original

educational project that combines the features of the academic and popular science styles.

Earlier, in the years 2018-2019, KNAU teachers participating in the FishEDU project were provided with a set of training, aiming to improve their pedagogical skills (see Chapter 3). Teachers completed this training successfully. The training covered such topics as interactive and inquiry-based learning, digital learning environment, and the use of ICT in teaching practices, as well as other elements of pedagogical excellence. Pilot teachers who had passed the pedagogical training participated in the development of the FishKA course. This participation allowed them to implement the acquired knowledge and skills in the process of the course development, and enriched the course with new approaches and teaching methods.

The online educational course FishKA can be used as an informative platform to provide students with interesting and useful information to increase awareness about the fisheries and aquaculture sector both in Central Asia and specifically in Kyrgyzstan.

8.2 Aims and objectives of the online course FishKA

The aim of the educational project FishKA is to create a sustainable interest and increase maximum personal involvement in the study of modern aquatic sciences, aquatic organisms, fishes, fisheries and aquaculture. While maintaining a scientific approach, the course invites students to see the aquatic world from a bright, engaging perspective, and to generate further interest in a deeper study of the topic as well as promoting career guidance.

The course also introduces students to the activities of international organizations in the field of ecology, environmental protection and aquatic sciences. It contributes to the UN sustainable development goals: SDG 5, SDG 6 and SDG 14. Currently, the online course FishKA is being developed in two languages: in English and in Russian.

As a result of completing the course, students will have additional, more in-depth knowledge in the field of aquatic sciences, fish biology and ecology, fisheries and aquaculture. Students will understand the importance of the role of water in nature and for human life, they will have an idea of the possibilities of assessing water quality, will be guided in the main environmental challenges associated with water, and will be able to comprehend the importance of the role of each individual for meeting these challenges.

Furthermore, students will be able to independently determine the conservation status of fishes and other organisms, formulate the concept of ecosystem services and determine the characteristics of ecosystem services provided by freshwater fishes. Students will know the main reservoirs and features of the aquatic ecology of Central Asia and Kyrgyzstan, recognize the main commercial and protected fish species, and navigate promising occupations in the field of fisheries and aquaculture in the region. They will also become acquainted with successful practices in the development of fisheries and aquaculture in other developing countries.

Besides subject-specific knowledge and skills, students will also acquire a variety of soft skills such as essay writing, opinion formulation, communication in the e-environment, critical thinking and the ability to search for scientific information using diverse Internet resources, as well as elements of personal career planning.

8.3 Pedagogical design of the online course FishKA

The self-determination theory (SDT) is one of the universal and basic principles of pedagogic design (Deci & Ryan, 1985). According to this macro-level theory of human motivation, all individuals possess three basic needs: 1) autonomy (the feeling of self-endorsement); 2) relatedness (the feeling of connection); 3) competence (the feeling of effectiveness). Although SDT theory was widely implemented in face-to-face teaching-learning environments, it was frequently overlooked in e-learning projects

(Chiu, 2021). To overcome the existing gap, the online course FishKA was designed based on the SDT theory.

The content of the course was designed to steadily develop these three components already from the first lesson. For example, students are asked to generate and express their personal opinions and attitudes through essay writing (autonomy); they are exposed to knowledge about international programmes (e.g. World Water Day) in which the contribution of every individual is valuable (relatedness); they are invited to participate in playful test tasks, in which individual competence is combined with the feeling of achievement and accomplishments (competence).

8.4 The structure and features of the development of the online FishKA course

To create a modern and accessible online course, programs and platforms were carefully chosen to meet the requirements of the course objectives. They had to be simple, user-friendly, interactive, convenient and accessible. To ensure the sustainable functioning of the online course FishKA after the completion of the FishEDU project, it was decided to use platforms that do not require financial expenses for the annual renewal of user rights. The course was posted on the Udemy platform in Russian and English languages.

While creating the online course FishKA, open informational and open visual resources have been used. Scientific information is taken from the materials of the FishEDU project, encyclopedia “Britannica” and scientific peer-reviewed publications from leading international journals. Visual resources such as photos and pictures are obtained from the FishEDU project, open photo stock Pexels and the design program Canva. For the creation of some tasks, members of the public can access information from the web pages of UNESCO, World Water Day, International Fish Migratory Day, Eurofishion, and IUCN RED LIST, and some others have also

been utilized. For lesson three dedicated to global water challenges, the authors used publicly available news on the topic with the reference's citations. In all these cases, references to all sources were provided.

The planned duration of the FishKA course is eight weeks. Students have 5-6 days to complete one module. Mastering the materials of one lesson requires 5-6 hours of study time. The course is designed for 3 ECTS[3], and is planned to be held once a year during the spring semester.

The FishKA course consists of 10 lessons, combined into three sections: 1) water and water resources; 2) freshwater life and fishes; 3) fishes, fisheries and aquaculture in Central Asia and Kyrgyzstan (Fig. 2).

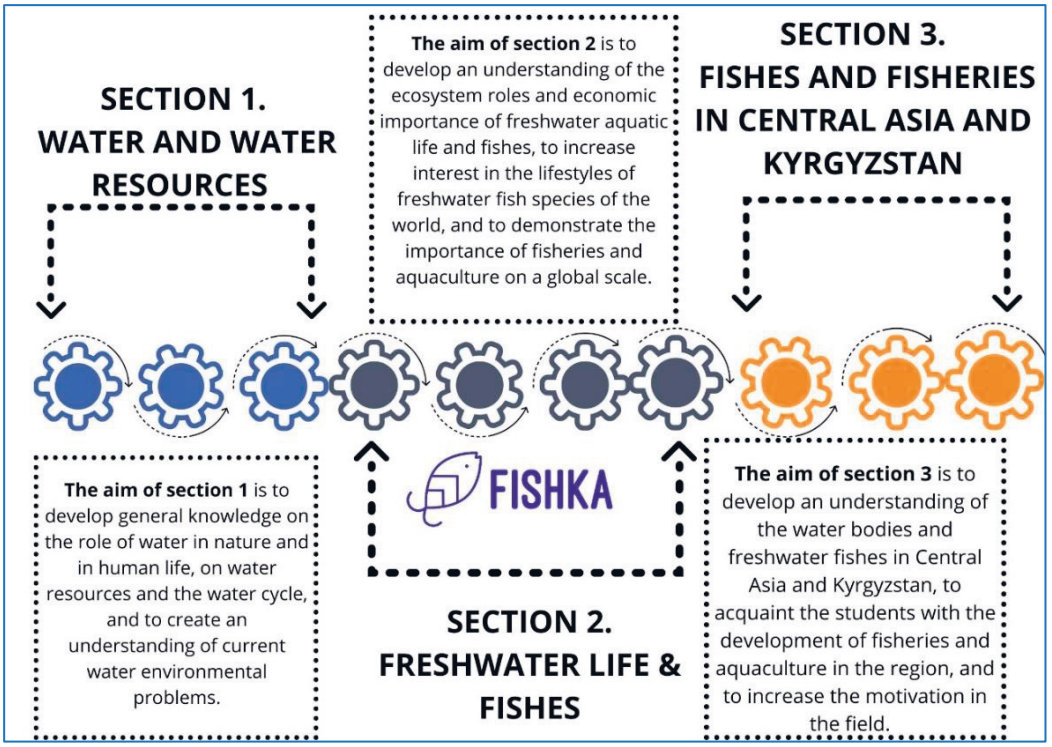

Figure 2. Overview of the thematic structure of the online course FishKA

[3] European Credit Transfer and Accumulation System 1 ECTS=27 hours

The idea of the course outline was to lead students from general understanding of the role of water in nature and in human life, water environmental problems, diversity and ecosystem functions of freshwater organisms and primary fishes to the specific knowledge of fishes and fisheries in Central Asia and Kyrgyzstan. Therefore, the diversity of the task types was increased, including motivational, informational, creative and test tasks.

Each lesson includes a short motivational video (which brings the students into the focus of the topic, makes them think about important and relevant issues, encourages the formation of a personal attitude to the topic, as well as providing additional material and resources). Subject resources include information posters, scientific presentations, forms and tests in the programs Kahoot and LearningApps.

After completing each lesson, the student sends part of the material (for example, forms, essays or screenshots of completed assignments) for verification by the teacher (course moderator) of the course to a specially created e-mail address.

Each lesson also contains detailed instructions, according to which students can navigate in the order of passing the assignments and the need to send material for verification. Each lesson is evaluated as 1/10 of the course. The course is considered to be completed when all 10 assignments are fulfilled. In addition, each lesson is graded on a scale from 1 to 5. The overall grade for the course is calculated as a grade point average.

The teacher (or course moderator) will conduct ZOOM meetings with students during the course to familiarize them with the rules and deadlines for completing assignments and help them complete the course. It is planned to conduct at least two online meetings – one at the beginning of the course and the second in the middle of the course. Students will receive certificates after successful completion of the course FishKA.

8.5 Piloting of the online course FishKA

The FishKA course was piloted over a duration of ten days in July 2021 by five KNAU teachers and two representatives of FAO and UNESCO. The piloting started with an introductory lecture on the course objectives and goals, its pedagogical design and its specific features.

The participants were also given instructions on how to proceed and complete the course, with the request to read all the material and complete 50% of the tasks. The number of obligatory tasks per lesson was the same for all the participants and each lesson had a separate instruction sheet describing what should be completed.

Over the next ten days the participants familiarized themselves with the course material, completed the course tasks and sent them to the course's email account. A WhatsApp group was created to ease communication between the participants themselves and the course developers and to allow for quick clarifications when needed.

Upon completion of the course, the participants gave their feedback by responding to an online questionnaire. The questionnaire included questions on the course load, overall assessment of difficulty, time spent on completing individual tasks, the course content, the strengths and weaknesses of the course and suggestions for further improvement of the course.

8.6 Reflections on the online course FishKA

Five out of the seven participants responded to the questionnaire. Three of the five respondents said that the course was interesting and further increased their interest in the subject further. However, it is important to note that the participants already had an interest in aquatic sciences, fisheries and aquaculture, since they work in the field. Three of the respondents said their expectations were met and four were of the opinion that they acquired new knowledge. Four of the respondents

expressed that there was a good balance between the theoretical and practical tasks, and all five indicated that they had enjoyed the tasks.

The tasks that were most interesting for the participants included the forms and tests in LearningApps. Topic-wise, the lessons on water, aquaculture and sustainable development of aquaculture were deemed the most interesting.

Four of the respondents reported that there was sufficient time for the course and that the information provided was also sufficient. The time spent on completing the tasks for each lesson varied between one and four hours. The FishKA course is an online course and thus it is evident that time spent on completing tasks depends on personal experience, IT skills and level of digital literacy. It should also be noted that the participants in the pilot course had only one day on average to complete each lesson's assignments, whereas students in the final version of the course will have up to six days.

Suggestions were made to reduce the amount of text in some lessons, whereas some proposals were made to expand information in other lessons. The participants also suggested a reward system for students as they advance on the course. This feedback will be useful for further development of the course before its launch to students.

The co-creation of this online course by KNAU and UEF teachers increased intercultural collaboration and improved teaching capacities, especially in online pedagogy and soft skills. Offering the course in both Russian and English also allows for a wider participation of students. The online course FishKA opens up promising future perspectives for co-teaching and developing online pedagogy between the two partner universities KNAU and UEF.

References

Chiu, T.K.F. 2021. Applying the self-determination theory (SDT) to explain student engagement in online learning during the Covid-19 pandemic. *Journal of Research on Technology in Education*. [online] available at: DOI: 10.1080/15391523.2021.1891998. Accessed 18.6.2021

Coldwell-Neilson, J., Craig, A., & Goold, A. 2006. Students' perspective of online learning. *Proceedings of the International Conference of the Association for Learning Technology* (ALT-C 2006). pp- 94–107.

Deci, E.L., Ryan, M.R. 1985. Intrinsic Motivation and Self-determination in Human behavior. *Perspectives in Social Psychology*, Book Series, Springer Nature. Plenum Press. New York.

FishEDU, 2017. *Project document*.

Palvia, S., Aeron, P., Gupta, P., Mahapatra, D., Parida, R., Rosner, R., Sindhi, S. 2018. Online education: Worldwide status, challenges. *Journal of Global Information Technology Management* 21 (4). pp. 233-241.

Spante, M., Sofkova Hashemi, S., Mona Lundin, M. & Algers A. 2018. Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1), 1519143. pp 1-21.

Torres Martín, C., Acal, C., El Honrani, M. & Mingorance Estrada A.C. 2021. Impact on the virtual learning environment due to COVID-19. *Sustainability Journal* 13 (2), 582. pp. 1-16.

Section 3: Developing of learning environments for fisheries and aquaculture

9 The FishEDU Aquacentre as a resource centre for fisheries and aquaculture

Elena Lazarevich and Bermet Tazhibaeva

In 1990, the World Declaration on Education for All (EFA) made a new commitment to improve the provision and quality of education, paving the way for teacher resource centres (TRCs) to be common features of educational reforms and improvement programmes in developing countries, aiming at administering support for teachers (Giordano, 2008). TRCs have functioned as places to provide teachers with access to teaching materials and have served as centres for peer interaction. Teacher resource centres have since then evolved into learning resource centres (LRCs) and they function as a place to introduce, reinforce and expand student learning, providing access to learning materials, serving as peer learning centres. However, LRCs function not only to serve students, but also teachers. Community resource centres (CRCs), on the other hand, function in a similar fashion, but are geared to providing community support in whatever area specified by the community that has established the centre.

The FishEDU Aquacentre at KNAU is a combination of an LRC and a CRC, functioning as a place to provide teaching and learning support for teachers and students, but also to serve anyone in the community that is interested in fisheries and aquaculture in Kyrgyzstan. The FishEDU Aquacentre is a modern facility located in KNAU's main administrative building on the Bishkek Campus.

This chapter describes the rationale behind the establishment of the FishEDU Aquacentre, the services provided, and feedback from users of the FishEDU Aquacentre from 2017-2020.

9.1 Rationale for establishment of the FishEDU Aquacentre

At the inception phase of the FishEDU project, KNAU deemed that it was imperative to have a central focal point from which to run and coordinate the project activities. The project's wide scope and infrastructure development activities, especially in the shape of the FishEDU Demonstration Fish Farm, required that there was an office from which to run the activities.

KNAU invested its own funds to renovate the facilities. Once the renovation was complete, the FishEDU Aquaculture Centre was furnished, and previously donated fisheries- and aquaculture-related literature, from UEF and FAO, was shelved into the facility, creating a small library. It was the intention at this point that the FishEDU Aquacentre would function as the main office for the FishEDU Demonstration Fish Farm. In addition, project meetings between KNAU staff, with UEF and with other partners, would be held in this facility, as would training for the project beneficiaries.

Thus initially, the centre grew out of the needs of the project activities, but it was anticipated that it would very quickly evolve to encompass a wider scope of activities. The activities which have developed naturally, have subsequently moulded the FishEDU Aquacentre into its current form.

9.2 Description of the FishEDU Aquacentre

The FishEDU Aquacentre is essentially a multi-functional work environment and the furniture can be quickly and easily rearranged to meet the needs of individual work, group work, boardroom meetings or seminars. Multimedia equipment and a stable internet connection have also been installed to allow for good connectivity and to ease communications between the partners, KNAU and UEF.

The FishEDU Aquacentre's library currently has 192 book titles. Most of these books were donated by UEF, and some were donated by FAO, SAEPF, the University of Central Asia, SYKE, and LUKE. Most of these books are

English-language books, and therefore the FishEDU project has also procured Russian-language books on fisheries and aquaculture. A book loaning system has been developed.

Alongside this library, the FishEDU Aquacentre also houses the FishEDU e-library. This library contains 67 titles of fisheries- and aquaculture-related digital material. The e-library is composed of a main server to which one pc-station and 5 tablets are connected, allowing for several users to access material simultaneously. For copyright reasons, the e-library material is only accessible at the FishEDU Aquacentre and only from the designated workstations. All of the FishEDU team have been trained on how to use the e-library, and training is provided to other teachers and students as they come and use the FishEDU Aquacentre. New fisheries and aquaculture students will be given training on using the e-library as part of their orientation when they start their studies.

9.3 FishEDU Aquacentre Services

The FishEDU Aquacentre has continued to be used by the FishEDU project as the main working area for the coordination team, advisors, teachers and the FishEDU Demonstration Fish Farm technicians. Dissemination activities of the project have also been held in the FishEDU Aquacentre. Short courses and events are also held at the FishEDU Aquacentre.

In addition, the FishEDU Aquacentre also functions as a learning environment for students in the fisheries and aquaculture programmes. Times have been set aside to ensure that lessons can be held in the centre, and at those times, other users do not have access. The library at the FishEDU Aquacentre can be used by students and teachers alike, and also by project staff. The FishEDU Aquacentre is a key facility when it comes to student recruitment. Open days also include a tour of the facility.

Fish farmers and other stakeholders are also able to utilize the FishEDU Aquacentre, for instance they can come to seek advice and counselling from the FishEDU Aquacentre Advisors, and they can also use the library and available multi-media resources freely.

9.4 FishEDU Aquacentre User Experiences

From 2017-2020, the number of visitors to the FishEDU Aquacentre amounted to 647, of whom 275 were male and 372 female. A random selection of 46 users was made and an online questionnaire was sent to collect feedback on their user experiences in the spring of 2021. Questions were in both English and Russian and respondents could freely choose the language in which they wanted to respond. There was a 46% response rate.

The main reason for visiting the FishEDU Aquacentre was either lessons (in the case of students 38%) or for FishEDU project-related activities (38%) (Figure 3). Use of the e-library and research activity were also popular reasons for visiting the FishEDU Aquacentre (both 33%). Other reasons included attending events (19%), consultation services (14%) or attendance at open days (10%). In addition, other reasons (14%) for visiting the FishEDU Aquacentre included guest lecturers at KNAU and other ad-hoc visitors.

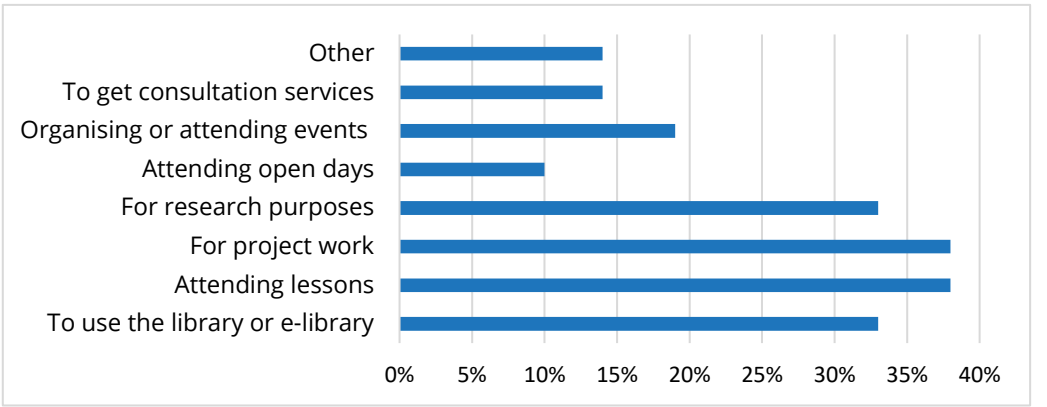

Figure 3. Reasons for using the FishEDU Aquacentre

The highest frequency of visits was 1-5 times (48%), whereas over 20 visits was also quite common (33%), although this latter figure clearly reflects those FishEDU project staff that work in the facility.

The satisfaction rate with the services provided at the FishEDU Aquacentre was very high, at 95%. Reasons mentioned were that the facility has a good library, good connectivity and that the staff are polite and provide good service. Most respondents (85%) indicated that they would use the services again. However, 15% indicated they would not, but this is attributed to these being users from abroad, who would not have the possibility to use the FishEDU Aquacentre nor have the need for it.

Respondents were requested to make suggestions on how to improve the service provision in the FishEDU Aquacentre. Suggestions included: increasing the number of computers, increasing the number of resources on Kyrgyz fisheries and aquaculture, conducting more lessons, organizing events for school children, developing research projects, developing short courses and providing consultations to fish farmers.

It should be noted that some of these services are already on offer and are being further developed, such as developing of short courses, provision of consultations to fish farmers and events for school children. In terms of equipment, it is not plausible to increase the number of computers in the resource centre without compromising the flexibility of the space.

As for increasing the number of resources with information on fisheries and aquaculture of Kyrgyzstan, this will remain the work of the team and KNAU as well as its partners such as UEF. At the moment, there are hardly any such resources; since the collapse of the sector after the Soviet era, no systematic research has taken place in the country, and fisheries and aquaculture research material formerly existing is now outdated. As fisheries and aquaculture education and research continues to be developed at KNAU it follows that the available material will increase, and this will be made accessible.

References

Giordano, E.A. 2008. *School clusters and teacher resource centres. Fundamentals of Educational Planning*, 86. UNESCO: International Institute for Educational Planning. Paris.

10 Developing the FishEDU Demonstration Fish Farm

Sovetbek Anarbek Uulu, Solakhidin Turatov, Baktiiar Nadyrbekov, Kudrat Arziev and Roseanna Avento

At the inception of the FishEDU project, KNAU did not have a learning environment for teaching and learning about fisheries and aquaculture. They were mostly reliant on external government-owned fish farm facilities or on the private sector for hands-on practical training of students.

While private sector involvement in education has been advocated on the basis of increasing financial resources, strong regulatory frameworks are vital to ensure high quality and equity (Lusk-Stover and Patrinos, 2015). For KNAU, practical training and supervision in private sector facilities was ad-hoc and sometimes unaligned to curriculum objectives.

This over-reliance on external stakeholders for training, in turn made teaching of fisheries and aquaculture at KNAU rather vulnerable, and increased autonomy over teaching the fisheries and aquaculture curriculum was deemed necessary. Indeed, Lusk-Stover and Patrinos (2015) corroborate that autonomy has been found to improve learning outcomes, when institutions are able to make their own decisions about teacher hiring practices, curriculum development and resource allocation.

The FishEDU project aimed to develop learning environments at KNAU to cater for the training needs and to also build an income-generating system to sustain its training and research activities in the long term. The FishEDU Demonstration Fish Farm was designed to provide an area where: (i) students could learn the most important elements of widely applicable fish production technologies and practices and (ii) research work and programmes could be implemented. The FishEDU Demonstration Fish Farm was planned to be a self-sustaining unit where fish is farmed from pond to plate, run by trained farm technicians and providing an area for students to practice. Surplus fish from the facility could be sold as an

extension service, when possible, the income from which is then put back into running of the fish farm and other infrastructure (FishEDU Aquacentre, FishEDU Water Laboratory, FishEDU Kitchen), development of the two curricula and teaching and learning activities.

10.1 Description of the FishEDU Demonstration Fish Farm

The FishEDU Demonstration Fish Farm is located at KNAU's main campus in Bishkek. The fish farm consists of three units (Figure 4 and 5). Unit A is a rainbow trout production unit which consists of three 15 m^3 tanks and three smaller 0.5 m^3 tanks. The smaller tanks are meant for student and research work; when coursework, practical lessons or research is taking place, they form the primary stations to which the fish being used is transferred to, from the larger tanks. The tanks are all bottom-drained with filters. Each tank has its own water inlet with a trickling cascade. Unit A is covered with a corrugated fibre cement roofing sheet and the sides of the unit can be closed off using tarpaulin sheets.

Unit B is an earthen carp pond of 100 m^2, lined with geomembrane and surrounded by vegetables on the dykes and fruit trees in the surrounding area. The carp pond is covered with a net to protect the fish from predators such as birds.

Unit C is the water storage facility, which consists of two tanks of size 12 m^3 each. The main source of water for the farm is groundwater, which is pumped from a borehole of depth 150 m into Unit C. Water flows into each unit and tank/pond separately. Outflow water is filtered and in the summer it is directed into an irrigation canal leading to agricultural fields of KNAU. In the winter, outflow water is directed to the municipal wastewater system.

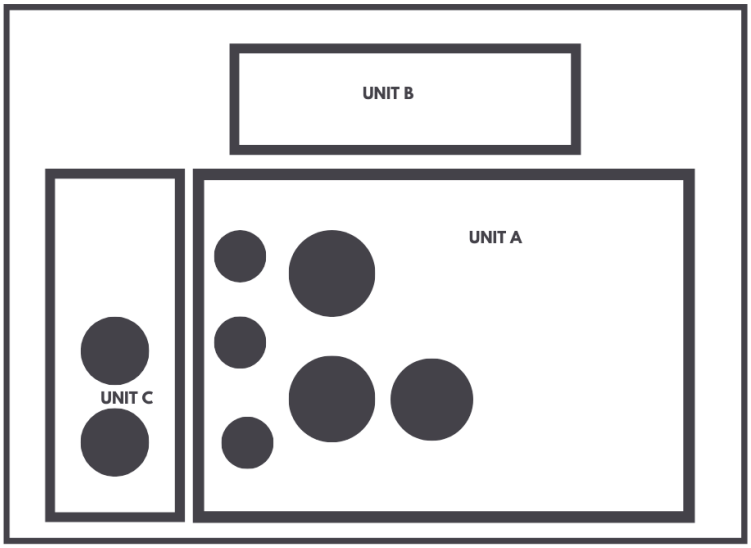

Figure 4. Layout of the FishEDU Demonstration Fish Farm

Figure 5. The FishEDU Demonstration Fish Farm under construction

10.2 Procedures for construction of the FishEDU Demonstration Fish Farm

10.2.1 Site and species selection, farm planning and design

10.2.1.1 Site selection

At the inception phase of the project, in August 2017, the site selection was initiated. Three alternative sites proposed by KNAU were considered (Woynarovich, 2017):

- Site 1: KNAU property in Ozernoe village, 22.5 km from Bishkek and KNAU's main campus. The Big Chui Channel supplies water to other ponds in the nearby area. The property also has a 130m deep borehole with water discharge of 25m^3/hour.
- Site 2: KNAU main campus in Bishkek. The area proposed was used for hydraulic experiments during the Soviet era. There is a small seasonal irrigation canal nearby, flowing in April to September, with a low amount of water.
- Site 3: Ponds in Studencheskoe Village, 33.6 km from Bishkek and KNAU's main campus. The land belongs to KNAU but has been leased out to a private citizen. There are fish ponds in this area but the water is of poor quality, even though it comes from the Big Chui Channel.

Site 2 was initially rejected because there was no water source. Site 3 was also not selected, because there was high potential for a lengthy negotiation process before the establishment of a new fish farm in the area. In addition, the site was relatively far from Bishkek and the main campus of KNAU, and also the water quality problems would have needed a lot of resources to rectify. Site 1 was therefore first considered as the best option. However, on close examination, it was realised that the distance from Biskhkek to this site would mean that students and teachers would have to travel rather a long way to the site. This would put students and teachers in unequal positions if they did not have the financial means to

travel. Furthermore, it would have required a lot of effort to arrange for proper security and monitoring of the fish farm at this distance, and would also have required building living quarters for the technical staff. Further investigation revealed that it would be possible to drill a borehole on site 2. This changed the situation considerably and site 2 was then selected rather than the other two sites.

10.2.1.2 Water source and quality

The site is located in the region of the Ala-Archa Freshwater Aquifer, and the geology is characterized by large boulders with sand and gravel. The level of groundwater ranges from 50 to 100 meters. A 150 m borehole was drilled with a diameter of 159 mm and capacity 16 m^3/hour. Three main permits were needed to ensure that a borehole could be drilled and the groundwater utilized, thus:

- **Permission to drill a borehole**
  This permit was issued by two organisations: (i) State Committee of Industry, Energy and Subsoil Use of the Kyrgyz Republic and (ii) Chui-Bishkek Territorial Administration of the SAEPF. The permit required the submission of the contract and design of the drilling work to be completed.
- **Registration of the borehole**
  The borehole had to be registered with the PEU Bishkekvodokanal. Once registered, a permit is issued to use the groundwater for two years at a time.
- **License for groundwater use**
  This license is issued by the State Committee for Industry, Energy and Subsoil Use of the Kyrgyz Republic. It requires submission of the following:
  - Consent or refusal of the Authorized State Body for Water Resources to obtain rights to use subsoil and

conduct work in the beds of banks of rivers and other water bodies

- Consent or refusal of the Authorized State Body for Emergency Situations to obtain the rights to use subsoil and conduct work in the beds of banks of rivers and other water bodies
- Certificate of Tax proving that the applicant has no tax debt
- Technological Specifications
- Approval of the Authorized State Health Authority
- Approval of the State Enterprise Kyrgyz Complex Hydrogeological Expedition under the State Committee for Industry, Energy and Subsoil Use of the Kyrgyz Republic
- Groundwater Utilization Programme Description
- One-time bonus payment
- Project description for withdrawal and use of groundwater of the Ala-Archa Freshwater Aquifer
- State Expert Appraisal of the Project (after completion of the borehole)

The license is valid for 10 years but requires submission of an annual report on the use of groundwater. Water quality has been assessed as good and the water is potable (Table 5). Water pumped from the borehole is directed into two storage tanks as mentioned in section 10.1. Water sprinkles down from the water piper, to help in the degassing process.

Table 5. Water Source at the FishEDU Demonstration Fish Farm: Main quality parameters

Indicator	Content
Calcium	81 mg/l
Magnesium	9 mg/l
Potassium	2 mg/l
Sodium	16.6 mg/l
Total iron	<0.1 mg/l
Ammonia	<0.1 mg/l
Chlorides	19 mg/l
Sulfates	39.92 mg/l
Nitrates	27.2 mg/l
Nitrites	< 0.003 mg/l
Hydrocarbonate ions	238 mg/l
Carbonate ions	< 1.5 mg/l
Total hardness	2.38 mmol/l (4.76 mg-equiv/l)
Solid residues	364 mg/l
Silic acids	16.576 mg/l
pH	7.5
Chemical oxygen demand	1.024 mg/ml

10.2.1.3 Soil analyses

Soil analyses of site 2 were completed by KNAU's Department of Soil Science, Agrochemistry and Agriculture, to assess the suitability of the soil for construction of earthen ponds for carp farming. According to Orozakunova et al. (2018), soil sampling was conducted using the open pit method at 5 sampling points, starting at 2 m from the site of the borehole and 15 m from the site of the planned carp pond, and through to each corner of the area of the planned carp pond (Figure 6). The first pit was of size 2.2 m length x 1.5 m width and 1.9 m depth and was dug using an excavator, whereas the other four were dug manually, so that all the top soil was removed down to the beginning of the layer of rocky soils (30-40 cm deep).

Stony pebble and gravel deposits from a depth of 45 cm downwards indicated that the area has highly permeable soils with low water-holding capacity. The recommendation given by Orozakunova et al. (2018) was therefore that after excavation it would be necessary to line the pond with a plastic sheet or tarp and line with clay soils. It was also recommended to store the top fertile layer (0-45 cm) on the north side of the site and (20-30cm) on the east side and to use it on the dykes of the carp ponds for the cultivation of green plants or vegetables.

Figure 6. Sampling points for soil sampling (Orozakunova et al., 2018)

10.2.2 Design and construction of the FishEDU Demonstration Fish Farm

The FishEDU Demonstration Fish Farm was designed to cater for two fish species: rainbow trout (*Oncoryhncus mykiss*) and common carp (*Cyprinus carpio*) in Units A and B, respectively (Figure 4). The reason for selecting these two fish species was that they are the most popular commercial aquaculture species in Kyrgyzstan and it is fitting that teaching and learning revolve around these two species.

The design was initially drafted within the FishEDU project team, and consultations with experts from LUKE were made for improving the design. After selection of a contractor, the design was finalized. The design and construction procedures took place in three stages:

- Stage 1: design approval from the authorities, excavation and pond preparation as well as preparation of tanks
- Stage 2: preparation of the floor and installation of the tanks and installation of pipers for incoming and outgoing water.
- Stage 3: trial run and finalization of the construction

Stage 1 was the most time-consuming due to the large number of approvals needed by different authorities. Stage 2 proceeded quite well, but just as it was being completed, the Covid-19 pandemic hit and interrupted all activities. The construction work was paused for a year. This caused further challenges with the harsh winter and some damage occurred to the carp pond, Unit B (Figure 4). This was however resolved, and the final stages of construction were then finalized.

Fencing of the area and construction of storage facilities was also completed and equipment procured. The equipment was marked, washed and disinfected. Preparation measures for stocking the carp pond were taken, including lining with soil, liming and fertilization. Rainbow trout tanks were washed and disinfected and preparations for stocking were also made.

Northern white cedar (*Thuja occidentalis*), oak (*Quercus sp.*), chestnut (*Castanea sp*.), apple (*Malus domestica*) and apricot (*Prunus armeniaca*) trees were planted in the surrounding area. Vegetables such as zucchini (*Cucurbita pepo*) , cucumber (*Cucumis sativus*), lettuce (*Lactuca sativa*), sunflower (*Helianthus annuus*) , maize (*Zea mays*), parsley (*Petroselinum crispum*) and dill (*Anethum graveolens*) were planted along the dykes of the carp pond (Figure 7). The aim is to also demonstrate the principles of integrating fish farming with vegetable farming.

Figure 7. Carp farming integrated with vegetable farming at the FishEDU Demonstration Fish Farm

10.3 Legal and regulatory compliance

The process for establishing and licensing of the FishEDU Demonstration Fish Farm was not at all straightforward. First, none of the team had ever gone through the process. Second, there was no central place to find information on the required permits and licenses. Often the obtaining of a license or permit required the submission of other licenses and permits. The documentation of this process is therefore highly important, to serve as a guide for other actors intending to establish and register a fish farm in Kyrgyzstan. We can establish that there are six main permits and licenses that were required:

(1) Electricity permit
(2) Architectural and planning approval for the fish farm
(3) Engineering and technical approval for the fish farm
(4) State Expert Appraisal of the fish farm
(5) Registration of the fish farm with the Department of Fisheries at the Ministry of Agriculture, Water Resources and Regional Development
(6) Registration of the fish farm with the State Inspectorate for Veterinary and Phytosanitary Safety

More specific information concerning each of these permits is provided in Table 6.

Table 6. Licenses and permits required for the FishEDU Demonstration Fish Farm

Licence/ Permit	Issuing Organisation(s)	Other documents / permits needed	Other information
Electricity Permit	OAO Severelektro		Permit is valid for two years
Architectural and Planning Approval for the fish farm	Municipal Enterprise Bishkek State Architecture	(1) Topographic survey of the site (2) Approval of the Centre of State Sanitary and Epidemiological Surveillance, Bishkek (3) Approval of the Chui-Bishkek Territorial Administration of the State Agency for Environmental Protection and Forestry of Kyrgyzstan. (4) Approval of the Ministry of Culture, Information and Tourism of Kyrgyzstan	
Engineering and Technical Approval for the fish farm	Municipal Enterprise Bishkek State Architecture	(1) Architectural and Planning Approval (2) Electricity Permit (3) Borehole Registration Document (4) Approval of the Loads from the Fish Farm from Municipal Enterprise Bishkek State Architecture (Water, Wastewater, Electricity and Air Emissions)	
State Expert Appraisal	Department of State Expertise under the Agency of Architecture, Construction, Housing and Communal Services of Kygryzstan	(1) Architectural and Planning Approval (2) Engineering and Technical Approval (3) Project Design (4) Confirmation that the infrastructure is operational (5) Approval of the Chui-Bishkek Territorial Administration of the State Agency for Environmental Protection and Forestry of Kyrgyzstan. (6) Financial value of the infrastructure	

Licence/ Permit	Issuing Organisation(s)	Other documents / permits needed	Other information
Registration of the fish farm and Fish Farm Passport	Department of Fisheries at the Ministry of Agriculture, Water Resources and Regional Development	(1) Legal charter of the operator (2) Certificate of tax (3) Land and/ or water registration document (4) Report on the stocking of fish	
Registration of the fish farm (animal production and sales)	State Inspectorate for Veterinary and Phytosanitary Safety	(1) Legal charter of the operator (2) Certificate of tax (3) Land and/or water registration document (4) Report on the stocking of fish	

10.4 Lessons learnt

The establishment of the FishEDU Demonstration Fish Farm has been the most challenging and time-consuming component on the FishEDU project. Due to the lack of information on administrative processes, the entire process was learning-by-doing and trial-and-error. The amount of time needed to obtain the licenses and permits was underestimated. These delays then resulted in further delays due to weather constraints.

The harsh Kyrgyz winter first delayed the drilling of the borehole, and then the following winter delayed the excavation work for the carp pond. When the Covid-19 pandemic hit the globe, the FishEDU had already received a no-cost extension. The pandemic restrictions in Kyrgyzstan had not eased out even towards the end of the no-cost extension, and a second no-cost extension was granted by the funder. However, this extended time did not benefit the project in terms of construction, due to the oncoming winter, and the partners were compelled to request for a third extension. The funder was very flexible and understanding of the situation and thus the activities were able to continue.

The licensing and permit process and weather-related constraints could have been better estimated in the risk assessment of the project during planning. However, the Covid-19 pandemic was not something that could have been foreseen. These three phenomena were enough to cause all of the project staff to grow thick heads of grey hair!

However, the team persevered and continued to work through the hardships. Their steadfast commitment and motivation have been an enabling factor in delivering the expected outputs.

KNAU now has:

- A new and reliable source of groundwater
- A learning and research environment for aquaculture with other supporting infrastructure (FishEDU Aquacentre, FishEDU Water Laboratory, FishEDU Kitchen)
- Qualified, knowledgeable and skilled staff that have established the fish farm themselves and who know all the procedures
- A demonstration fish farm that uses simple, modern and affordable technologies in an environmentally sustainable manner

KNAU is thereby excellently positioned to become a leading education and research institution in fisheries and aquaculture in the region.

References

Lusk-Stover, O. and Patrinos, H.A. 2015. *Education for all: the private sector can contribut*e. Private Sector Development, Proparco Blog, April 6, 2015. [online] available at: https://blog.private-sector-and-development.com/2015/04/06/education-for-all-the-private-sector-can-contribute/ accessed 9.7.2021

Orozakunova, R. Nadyrbekov, B and Nishaeva, S. 2018. *Soil analysis report, FishEDU Demonstration Fish FARM*. FISHEDU Report. Kyrgyz National Agrarian University.

Woynarovich, A. 2017. *Site Selection for FishEDU Demonstration Fish Farm*. Travel Report.

Appendix 1. List of Authors

1. Kyrgyz National Agrarian University named after K.I. Skryabin
Mederova 68, Bishkek, Kyrgyzstan

Professor Almazbek Irgashev, Vice-Rector of Academic Affairs

Elena Lazarevich, FishEDU Aquacentre Advisor & Head of the Department of Agricultural Studies at the Agrotechnical College

Kudrat Arziev, FishEDU Academic Coordinator & Senior Lecturer at the Department of Infectious and Parasitic Diseases of Animals

Svetlana Tarasova, Senior Lecturer at the Department of Agricultural Products Processing

Eliza Asanova, Acting Associate Professor at the Department of Biotechnology and Chemistry

Bermet Tazhibaeva, FishEDU Aquacentre Advisor & Lecturer at the Department of Livestock Production

Sovet Anarbek Uulu, Fish Technician & Senior Lecturer at the Department of Anatomy and Physiology of Farm Animals

Salokhidin Turatov, Fish Technician & Senior Lecturer at the Department of Veterinary and Sanitary Expertise, Histology and Pathology

Baktiiar Nadyrbekov, Fish Technician & Senior Lecturer at the Department of Anatomy and Physiology of Farm Animals

2. Food and Agriculture Organisation of the United Nations
26 Orozbekova St., Bishkek, Kyrgyzstan

Mairam Sarieva, National Consultant

3. Rhodes University
Department of Ichthyology and Fisheries Science
Grahamstown, Eastern Cape.
South Africa

Dr Thomas Shipton, Research Associate

4. University of Eastern Finland
Department of Environmental and Biological Sciences
P.O. Box 1627, 70211 Kuopio, Finland

Sofiia Nishaeva, Project Coordinator FishEDU & Doctoral Researcher

Liisa Nurminen, University Lecturer

Dr Oksana Skaldina, Post-Doc Researcher

Roseanna Avento, Global Development Manager (Development Services)

5. University of Eastern Finland
Department of Environmental and Biological Sciences
P.O. Box 111, 80101 Joensuu, Finland

Professor Raine Kortet

6. University of Eastern Finland
School of Applied Education Sciences and Teacher Education
P.O. Box 111, 80101 Joensuu, Finland

Lais Oliveira Leite, Project Researcher

ROSEANNA AVENTO,
ELENA LAZAREVICH AND
SOFIIA NISHAEVA

This report shares the experiences and lessons learnt during the FishEDU project (Capacity building for fisheries and aquaculture education in Kyrgyzstan) implemented by the University of Eastern Finland and the Kyrgyz National Agrarian University named after K.I. Skryabin from 2017-2021. Through this collaboration, the Kyrgyz fisheries and aquaculture sector has gained the potential to increase its skilled labour resources sustainably, and the two partner universities have laid the foundation for the development of future fisheries and aquaculture research in Central Asia.

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