Hydropower Solutions

HYPOSO

Hydropower solutions for developing and emerging countries

D4.1
Training methods and curriculum for four training workshops

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1 Introduction

HYPOSO is a multi-approach project to tackle several objectives; identification and mapping of the European hydropower industry, hydropower stakeholders in the HYPOSO target countries, education of new hydropower experts through capacity building activities and bringing together relevant actors from the EU hydropower sector with stakeholders in the target countries. Interaction with stakeholders is, therefore, an integral part of the activities, like workshops, capacity building activities and interviews with national/local stakeholders are envisaged in all target countries which are outside the European Union, namely workshops in Bolivia, Colombia and Ecuador in Latin America, and Cameroon and Uganda in Africa. Additionally, capacity building courses will be carried out in Bolivia and Ecuador, and in Cameroon and Uganda.

2 Executive Summary

This deliverable D4.1 is an outcome of Task 4.1 “Training method and curriculum for four training workshops” of the WP4 “Capacity building” (Task leader: IHE Delft, Partners: Studio Frosio, VDU, IMP PAN, TRMEW, 1to3, CELAPEH, HPAU, SHW, EPN, UMSS).

WP4 focusses on capacity building in the target countries aiming to strengthen key stakeholders in strategic development, design, implementation, operation and maintenance of sustainable hydropower and in identifying or addressing research needs in the field of hydropower.

Capacity building is the process allowing individuals, interested groups and organizations to obtain, improve, and retain the skills, knowledge, tools, equipment, and other resources needed to do their jobs competently. Capacity building mobilises the capability of a society or a community to identify and understand its development issues, to act to address these and to learn from experience and accumulate knowledge for the future. The capacity building has to be supported with the Knowledge and Capacity Development (KCD) system.

The scoping analyses have been performed in WP3 and are specified in the report HYPOSO_D3.2. This report evaluates the availability and adequacy of higher education in the hydropower field in the target countries and defines needs and gaps in hydropower education. The results of this evaluation are used as a basis for defining the educational and research needs in those target countries. Finally, this report defines the education modules and their distribution during the two weeks lecturing process with planned working loads.

3 General

3.1 Knowledge and Capacity Development (KCD) tool

The 1991 Delft Declaration (Alaerts et al. 2009a) stated that “Capacity comprises well-developed institutions, their managerial systems, and their human resources, which in turn require favorable policy environments, to make the *water* sector effective and sustainable”. Knowledge and Capacity Development (KCD) is necessary at the levels of the individual, groups and organisations to strengthen technical, financial, and managerial skills. (Alaerts, 2009a). It will change the process of work and will improve governance with an effective decision-making process, accountability and transparency under proper educational formats and training. Implementation of KCD tools will help transfer the European hydropower knowledge for institutional development and change.

Success in capacity building can only be achieved through a systematic approach. The World Federation of Engineering organizations (WFEO, 2010) suggested six essential “pillars of engineering knowledge” that must always be in place and balance. The pillars are considered as necessary for sustainability in engineering infrastructure and services. Appropriate, effective and sustainable methods mobilize sufficient and stable technical and decision-making capacity to deliver services for engineering infrastructure.

The pillars are defined below.

Individual – the needs of the individual have to be met. In the case of the engineering practitioner, this implies that his/her needs are fulfilled in terms of a career with sufficient status, standing, rewards and support for developing and maintaining professional competence.

Institutional – appropriate educational, professional, technical and statutory institutions are in place at various levels, including these:

- professional bodies that support and develop the individual;
- education providers up to and beyond the tertiary level that provide education and training;
- research and development providers that resolve technical issues; and
- statutory bodies that develop, establish, provide, monitor and enforce professional, technical and industry standards.

Technical – underpinning infrastructure including appropriate, relevant and up to date technical standards, codes of practice, procurement documents and procedures, regulations and a well-developed statutory framework, including attention to safety and health issues, technical literature and guidance material. They should reinforce and support ethical and appropriate engineering, technological and procurement practices.

Decision-making – wherever technical and engineering-related decisions have to be made, at all levels from individuals, communities and institutions, the decision-makers need sufficient information, understanding and access to knowledge and skills to make accountable and rational decisions.

Finance and funding – it is important to ensure that adequate and affordable finance and funding are available to enable sustainable financial practice. It is important also that capital and goods can be procured in a sound accounting and legal system and within a well organised and effective administrative and regulatory infrastructure.

Resources, equipment, tools and supplies - access to appropriate, affordable and suitable materials, equipment, tools and supplies for the designing, building, implementing, operating and maintaining of infrastructure and the provision of engineering services.

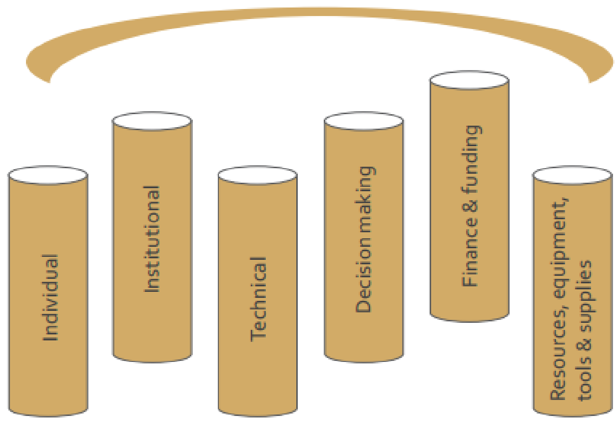

Figure 1: The six pillars of capacity building in support of appropriate, effective and sustainable services delivery (WFEO, 2010)

3.2 Objectives of Capacity Building

The value chain for networks for capacity as described by Bloom, Reeves and Leonard (2009), in Figure 2, clearly shows how interconnectivity and development contribute to a bigger capacity.

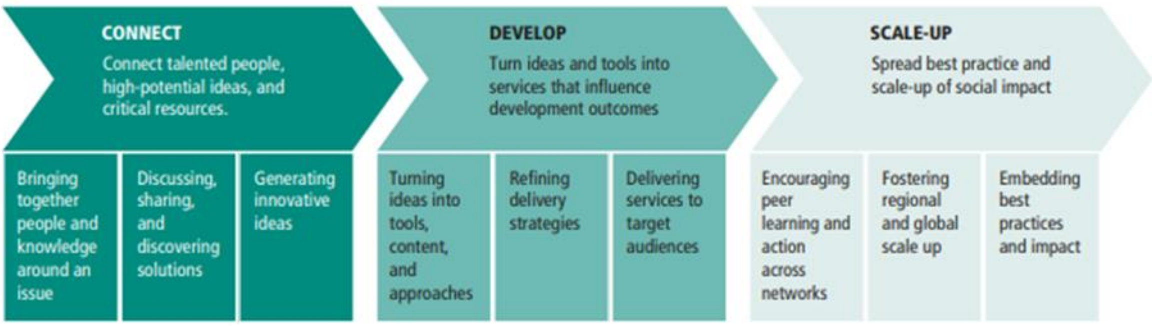

Figure 2: Value Chain for Networks for Capacity

As capacity can be defined as "the capability of a society or a community to identify and understand its development issues, to act to address these and to learn from experience and accumulate knowledge for the future" (Alaerts & Kasperma, 2009b), a KCD project should not only focus on obtaining knowledge, but rather sharing this knowledge with peers, experts and policymakers to implement changes for aforementioned issues. Strong cooperation between individuals and the organizations and institutions they work in ensures an enhanced capacity. Therefore, there are five main objectives of capacity building:

- to connect experts, professionals and policymakers to share their knowledge and discuss development issues,
- to generate innovative ideas,
- to explore and make choices regarding the implementation of these innovative ideas,
- to implement the innovation and embed it in organizations and institutions,
- to actively share innovations amongst each other.

3.3 Objectives of Capacity Building in HYPOSO Project

In the HYPOSO project, the capacity building focusses on the Work Package 4 (WP4). The goal of the WP4 is to strengthen key stakeholders in target countries in strategic development, design, implementation, operation and maintenance of sustainable hydropower, and in identifying and addressing research needs in the field of hydropower. Developing countries, as the HYPOSO partner countries in Africa and South America, often lack experienced personnel and have frequent changes in staff members, resulting in loss of knowledge and experience. For capacity development and for mitigating consequences of staff fluctuations, a Knowledge and Capacity Development (KCD) tool will be implemented. It consists of the following research lines:

- Measuring existing capacity and foreseeing future capacity and research needs.
- Analysing the dynamics of dissemination of professional knowledge and allowing access to the global knowledge pool in education, in rolling out sector programs through national and local government levels and in hydropower operator partnerships.
- Improving the use of knowledge: knowledge management for the public sector.
- Assessing (measuring) and transmitting through the adequate communication channels the economic and social value of KCD.
- Understanding the determinants of KCD effectiveness by quantitative assessment of the added-value of knowledge.
- Analysing the dynamics of the learning, competence building and innovation system for the hydropower sector.

The scope of the HYPOSO project is to develop and implement procedures and tools to improve systematic learning at all levels, i.e. individuals, groups/teams and whole companies. The groups approached by the project should include consultants, engineers, technicians, governmental and financing bodies and all other stakeholders. The KCD system must provide a measure of the added-value brought by highly trained cadres, which should be the basis for faster and more effective planning and efficient and straightforward permit process and will give the basis for the planning of future KCD activities.

Capacity building emphasizes the following topics:

- strengthening project preparation capacities,
- reinforcing project design and project implementation,
- improving ESIA (Environmental and Social Impact Assessment) compliance,
- strengthening of operation and maintenance,
- researching the specific and target country-oriented topics.

Capacity building has to be a life learning process, and the KCD is conceived to follow this perspective. Long-term objectives, beyond the project duration, will provide participants with a continuous opportunity for learning and deepening their knowledge in the field of hydropower. Additionally, the KCD will be conceived in such a way that new participants, from partner countries and also other developing countries, could access the system and get information and improve their knowledge in the field of hydropower and European hydropower information. These long term objectives are summarized as follows:

- Formation of the knowledge system on important subjects and for all phases in the hydropower life cycle; planning, design, construction, operation and maintenance.
- Formation of the tools and methods to continuously train the staff and to introduce and train new staff members.
- Formation of the research basis for continuous improvement of the specific hydropower needs.

For the implementation of the project and the long term objectives these specific objectives have been defined:

- to develop a pool of professionals for sustainable hydropower, who will be able to manage and actively support the planning, design, construction, operation and maintenance of hydropower projects,
- to strengthen hydropower capacity based on problem-solving multidisciplinary project development and training on-demand,
- to develop a knowledge base and to build human and institutional capacity through the process of knowledge sharing, creation, dissemination, and application of challenging hydropower themes between all personnel involved in hydropower,
- to develop a sound monitoring and facilitation mechanism to guide and support the development of new company hydropower staff.

The training of hydropower professionals will be prepared as on-the-job, mobilizing water education networks, promoting joint research, giving policy advice, supporting distance & e-learning, facilitating participation in innovative projects and facilitating knowledge sharing.
Thus, HYPOSO plans to prepare a new generation of hydropower experts who will enhance sustainable energy production with the help of European hydropower know-how and equipment.

4 KCD in hydropower

From the phase of project identification over design and until construction, operation and commissioning of the components, hydropower projects should be economically, technically, socially and environmentally feasible. In any hydropower project, KCD is important to achieve the above-mentioned criteria incorporating sustainable goals. Every stakeholder involved in hydropower should participate in the process of KCD.
The KCD system must provide a measure of the added-value brought by highly trained cadres. This should be the basis for faster and more effective planning and efficient and straightforward permitting process supporting and strengthen the planning of future KCD activities.
The blended approach chosen for training is supported by the use of a Moodle platform for online learning in this project. Moodle is a learning platform that provides educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments. Moodle has been used at IHE Delft for seven years for all

types of education; MSc. and PhD programs, short courses, training on demand and online courses. Online learning can enhance face-to-face learning and vice-versa, especially when both are interconnected.

Online learning is focused mainly on cognitive skills (thinking) rather than affective and psycho-motoric skills, which are best learned in a face to face setting. Therefore, it is advised to set up an online component in the participant's preparation strongly focused on knowledge, for example by knowledge clips. An advantage of these knowledge clips is that these can be used multiple times. During the training days, teachers and participants can then focus more on practical applications.

During the training, the Moodle platform can act as a repository for training materials, and as a virtual meeting space where participants and others may interact with each other in forums and web conferencing. Online interactivity is essential when participants are asked to share from their own experience and can be done in words (forum, chat) and video (a vlog, or a video conference). When participants are immersed in a good online social environment, they tend to return faster to an online course and retain more knowledge from it.

<u>Moodle set-up</u>

IHE Delft has two different Moodle platforms available: The open courseware website (OCW) and eCampus, the internal online learning environment. A distinction can be made between participants at the different training locations in the course itself. For eCampus, all participants need to be registered in IHE Delft's systems, whereas the OCW has a more openly accessible setup and participants can self-register. However, it should be noted that also on the OCW, the course can be designed in such a way that only certain participants can see some parts of the course. The OCW option is encouraged especially when there are components that can be made open for the public, thus giving non-participants access to certain knowledge.

4.1 Methodologies

To fulfil the objective of capacity building and achieve the target of training, it is essential to choose an appropriate training method. Voith Hydroschool has introduced Systematic Approach Training (SAT) which includes five phases (Figure 3).

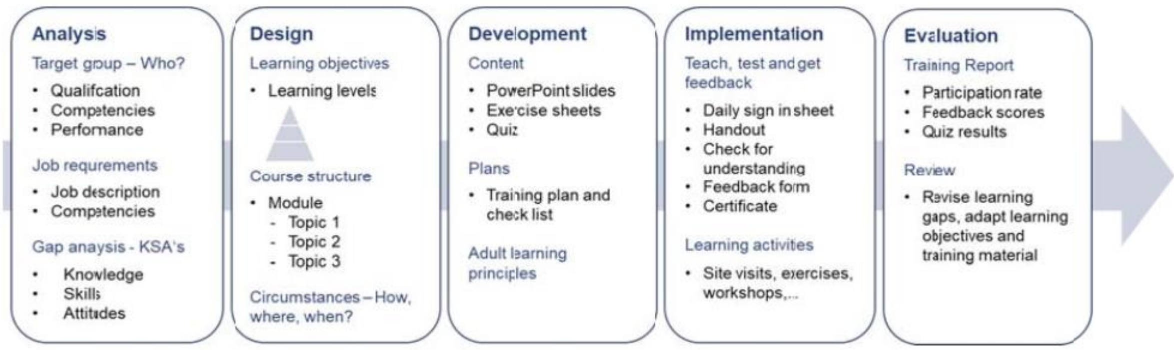

Figure 3: Flowchart of five phases of the Systematic Approach to Training in the Voith Hydroschool (Henkes, 2019)

Firstly, a gap analysis has to be done to identify the learning demand of the trainees. Second, during the design phase the selection of the training and teaching method with location and date should be fixed based on the analysis done in the first phase. Third, in the development phase, the training content is prepared. Fourth, the content is implemented by the instructor to convey the knowledge with different training activities. Finally, in the Fifth phase there should be an evaluation of overall training, to determine its effectiveness.

Additional to the Voith Hydroschool's systematic approach, knowledge from other capacity development researchers will be integrated and an iterative component implemented (Morrison et al. 2013). The iterative component means that after evaluation of the processes the course is updated with the knowledge earned through evaluations and a new improved version of the training is prepared. This method will be used in the project when the knowledge and data collected during preparation and executing the training in Africa will be used for improvements in the training in South America.

4.2 Learning and teaching activities

Learning is an active process that requests teachers to activate the learning and it requests from participants to invest in their active learning. The connection between 'theory' and 'practice', as proposed via the template projects is very effectively supporting the active learning process. The training approach will ensure the specialized knowledge to be understood as well as the overall understanding in the context of entire projects.

All training and teaching sessions will consist of a mix of lecturing and active learning activities, making learning an interesting experience. Depending on the competency framework and its components, the more skill-based competencies will be delivered as practical exercises, while the information-based parts will include individual and/or group exercises or tasks.

An interesting line is to build up connections with one or a few top universities in the target countries active in hydropower education or teaching topics that are important for hydropower development. Collaboration with these universities can bring benefits for both sides in innovating and updating their knowledge and expertise, but also in cooperative research work between European universities and the universities in the target countries. The universities in target countries will be a place for recruiting of the new specialist in a later stage and will be collaborators for answering the research questions.

HYPOSO strives to deliver an "impact-based training program", i.e. 'the training shall enable people to perform'. This means that the training needs to be related to the job(s), leading to improved performance on the job. The effect of continuous learning and life learning will be achieved by creating of the Knowledge and Capacity Development (KCD) platform. The platform will be organised by IHE Delft and will include all lecturing material prepared during and for the course. The participants, visitors and also further interested persons will be allowed to log in on the platform and refresh or learn additional topics and, in that way, engage in a continuous learning process.

5 Scoping of the Status of the Hydropower Sector in Target Countries

During scoping of the framework analysis and research needs a gap analysis had been done to determine the learning needs in each of five target countries and identified in the report HYPOSO_D3.2. Here, the summary of the educational and research situation is given together with the detected needs for capacity building and hydropower education for four target countries, as there will be no course in Colombia.

5.1 Bolivia

5.1.1 Education organisations teaching hydropower topics

There are 10 state-founded and 23 private universities, but without any hydropower specialised study program. The hydropower and hydropower relevant topics are included partly in different programs as a part of renewable energy studies and also in civil, mechanical and electrical engineering. The summary of these universities is given in HYPOSO_D3.2, Table 7.

5.1.2 Current situation and requirements

Existing hydropower research infrastructure:

- Institute for Hydraulics and Hydrology, IHH is an experienced research unit for micro and small hydro technology
- Hydraulic lab at Universidad Mayor de San Simon (UMSS) has been involved in numerical modeling river flow and hydropower operation for more than 30 years.
- 19 R&D projects were identified, conducted over the period of 2011 to 2019 (HYPOSO D3.2, Chapter 7.1).

The main gaps in knowledge for the hydropower sector have been detected in the areas of operational, legislative and environmental levels but also in technical operation, maintenance and operability of the plants.

The lack of knowledge has been identified especially on the level of detection and preparation of the studies that are used for project preparation, but also during operation, for example these:

- Hydrological studies, including the analysis of short and long term climate change impact.
- Evaluation of multi-purpose projects from the hydroelectric industry perspective.
- Diagnostic studies of the current state of micro and small hydro plants, evaluating their operability and efficiency.
- Studies to increase efficiency in hydroelectric power plants (upgrade and adding capacity)
- Studies of new technologies that allow the maintenance of the facilities with minimal outages.
- Improvement in home electrical connection systems in rural areas.

- Hydropower socio-environmental and economic impact studies

5.2 Cameroon

5.2.1 Education organisations teaching hydropower topics

There are nine state-run universities in Cameroon and several private universities, but there is no specialised hydropower study programmes in the country. Hydropower is usually a part of the renewable energy studies, some hydropower topics and included in civil, mechanical and electrical studies. The universities in Cameroon deal with hydropower in some extent, mostly as part of renewable energy Master or Bachelor programs. These are specified in HYPOSO_D3.2, Table 23. There are also several NGOs in the country that are promoting hydropower (HYPOSO_D3.2, Table 24)

5.2.2 Current situation and requirements

Existing hydropower research infrastructure:

- Only one R&D project conducted by the University of Yaoundé has been reported related to the establishment of a small hydro laboratory. A couple of applied projects dealing with micro-hydropower plants were completed at the National Advanced School of Engineering, University of Yaoundé. The laboratory needs an equipment upgrade.

There is an interest in hydropower education but curricula for small hydropower have to be developed. The research is mostly in the application and practical issues connected with projects of micro-hydropower.

Small hydropower research is needed and recognized as essential:

- further recognition of the hydropower potential of the country;
- development of technologies suited for electrification of remote areas;
- a better understanding of hydropower multi-aspect environmental impact;
- establishment of hydrological gaging stations and preparation of hydrology studies aimed at the development of ever more detailed hydrological characteristics of rivers and other watercourses, including the climate change impact on the country water balance;
- identification of the most suitable small hydro development sites to prepare the basis for developing the national small hydro master plans;
- analysing technical and economic feasibility of applying some innovative technologies (e.g. hydrokinetic turbines) in remote areas of the country;
- hybrid installations with hydropower components for isolated grids in remote areas, including dedicated smart grid software;
- optimised management of multipurpose river cascades;
- environmental studies aimed at determining the current status at selected watercourses to streamline future environmental decisions;
- environment friendly hydropower technologies;

- development of local workshop with the European partner for local turbine manufacturing.

5.3 Ecuador

5.3.1 Education organisations teaching hydropower topics

Out of 59 universities in Ecuador, 23 universities in the country are offering study programs that include water-related subjects which constitutes a necessary background for hydropower engineering. There is no specialised hydropower or hydropower engineering study program in the country education system. Hydropower is usually part of civil, renewable or environmental engineering. (HYPOSO_D3.2, Table 30)

5.3.2 Current situation and requirements

There is no specific course for hydropower or any topic related in the new syllabus for civil engineering at public universities. The civil engineering study is focused on structural design and only a few subjects for basic knowledge in hydrology or hydraulics have been kept, but it is very difficult that hydropower education can be taught in more detail. Therefore, courses and training workshops in hydropower have to be developed to cover the gap that affects the study field in hydropower.

There are also some organised training workshops or specialised courses in civil, mechanical and electrical engineering for the staff of hydropower plants.

29 R&D projects were identified and conducted throughout the period 2013 to 2019 (HYPOSO_D3.2, Table 32). Twelve of them are dealing with medium or large hydro, only one is a demonstration project. Almost all the projects were conducted by universities, most frequently by Escuela Politécnica Nacional (EPN). No fundamental research (also known as basic research or pure research) elements have been identified. For some applications, the state-of-the-art numerical modeling (CFD, 3D Flow) is used.

The survey conducted in Ecuador revealed the following research topics to be undertaken in the future, among other:

- Sediment management in civil works for hydropower plants,
- Solid flow production in Andean micro-basins,
- Sediment transport in mountainous rivers and increased downstream sediment concentration due to the operation of hydropower plants,
- Hydrologic variability and climate change in high elevation mountain rivers,
- Geological information survey in micro-basins,
- Definition of potential hydropower sites
- Promotion of hydraulic modeling for civil works optimization (water intake, desilting basin),
- Electromechanical equipment for small hydropower plants,
- Environmental flow assessment in different micro-basins,
- Sharing best practices of international environmental policies to be potentially applied in Ecuador,

- Downstream channel stability and environmental impact due to flow releases of dams and reservoirs (including hydropeaking issues).

5.4 Uganda

5.4.1 Education organisations teaching hydropower topics

Makerere University in Kampala has about 95 % of the total student population in Uganda's universities. The rest is distributed on 20 private universities and a smaller number of non-university institutions providing higher education. There is no hydropower engineering study program in the country education system. Hydropower is usually part of renewable or energy studies (HYPOSO_D3.2, Table 38). In the master program of renewable energy, the development, design, installation and operation of small hydropower plants is included.
Availability of manpower to operate and manage the smooth running of power stations is a challenge. Main weaknesses of the education system and gaps to bridge the knowledge for the hydropower sector are as follows:

- The general level of understanding hydropower is low,
- No university/technical education programs specifically on hydropower,
- Technicians get hydropower training only on the job,
- Technical training generally is too theoretical,
- O&M personnel lack re-training & expansion of skills,
- Reliance on outside expertise not only technically but also for studies, design & equipment,
- The link between classroom and field/industry training missing or inadequate,
- Capacity building aspect not backed up by energy policies,
- Limited hydrological data and consequently a lack of specialists for hydropower assessment.

5.4.1 Current situation and requirements

The previous section outlines that high education programs for hydropower are weak and inadequate. Renewable energy programs proposed by universities are not offering in-depth or sufficient knowledge of hydropower issues. Only the main features and challenges of hydropower plants projects under development or already under operation, including a few of them of demonstration type are provided.
Therefore, since hydropower development is starting to progress in this country the basic hydropower knowledge would be advantageous. There is a need to transfer European-top-level experience, knowledge, available state-of-the-art hydro technology to Ugandan researchers. There is a strong need for knowledge transfer from basic, root level to the applied and especially operational and maintenance issues.

5.5 Summary

Based on scoping the status of the hydropower sector (HYPOSO_D3.2) in the targeted countries, there is a huge potential for construction of new powerplants and also there is the need for optimization, maintenance and refurbishment of the existing powerplants. Hydropower research and development in the African countries is lagging in comparison to the South American countries. Overview of the existing high educational system on hydropower shows that skilled manpower is produced in the region, but education does not give a possibility for the education of hydropower experts. Hydropower personal is normally educated and trained during the work. No target country has a master's program in hydropower development. Defining and organising hydropower research and development, under such conditions is not easy and not effective, therefore more skilled persons are needed.

Another big problem in developing countries is a big fluctuation of skilled manpower. The main reasons for the strong fluctuation of site personal are that the personal trained during the work especially in operation and maintenance of the powerplants are desired persons for other industries and are often headhunted. Also, higher salaries and more attractive working places are found at the municipalities and towns than at the hydropower plants situated mostly remote areas.

The short course will allow participants to learn more and deeper about hydropower, giving them an overview of the whole life cycle process. Data collection, hydraulic and structural design, construction, operation, maintenance and refurbishment issues will be covered, together with important topics such as environmental and social impacts and financial possibilities.

Knowledge and Capacity Development (KCD) will be prepared, giving participants support during and after the course. Also, KCD will be used by persons participating on the course and by other persons interested in learning about hydropower and/or broadening of their hydropower knowledge. KCD will be used as a platform for knowledge exchange and recruiting of the new hydropower personal.

6 Selection of Training/Teaching Method

The short course is specified with two weeks lecturing. Intensification of the teaching quantity and quality will be enriched by activities before and after the course lecturing. Overall teaching/training method, therefore, consists of virtual class before the course, face-to-face course during the actual course and virtual class after the course. The face-to-face courses are planned as 8 days in each of the target countries, Cameroon, Uganda, Bolivia and Ecuador. The schedule of the courses is modified based on the COVID-19 restrictions and is discussed in HYPOSO_D4.2.

The first online section aims to introduce to the topics and explain hydropower basics such as; function, types, operation of hydropower; also, it will give a comprehensive overview of the subject matter. This part of the virtual class consists of a set of video lectures performed by lectures explaining the topic. It is combined with other educational materials such as publications, reading material, videos, etc. Assignments (quiz and group work) will be incorporated into the lectures.

The face-to-face part will be a system of lectures and discussions that will be performed in the target countries. These lectures will go more into topic's details, explaining the specific parts of the topics, design and calculation methods, examples for practical use. The education material will be presented in more detail to describe the subject and making it clearer to the participants. Discussions during the lecturing will help clarify doubts and answer questions from the participants. During this part, the understanding of the participants will be evaluated too.

In the third part, there will be an online class after the course with additional assignments (individual or group). In case that during the face-to-face course topics will be detected that are of participant(s) interest and not adequately treated during the course, these detected topics will be extra prepared for the third part of the short course.

During the third online phase after the final (second) week, the work on the selected feasibility study is planned for the participants. In this work, the participants will implement the knowledge collected during the short course and will present their knowledge and skills. In the third online section, discussions and meeting (evaluation) with the participants is foreseen. This is important to get a participant's feedback and improve the lecturing for future courses.

Table 1: Teaching plan for the hydropower short course

	Topic	Responsibility	Days		
			Online	Face-to-face	Online
			Preparation before course	Short course	Assignments after course
Week 1	Basics of hydropower exploitation	IHE	0.5	0,5	
	Hydrology	IHE	0.5	1	1
	GIS & HP potential	VDU	1	0.75	1
	Hydraulic design	IHE	1	1	1
	Computer based tools for hydropower resources	VDU	1	0.75	1
	Dams and storage basin	IHE	1	1	1
	Weirs and water intakes	SF	0.5	0.5	0.5
	Power waterways	IHE	1	0.5	1
	Total week 1		**6.5**	**6.0**	**6.5**
Week 2	Hydraulic Units	IMP	0.5	1	1.0
	Electrical equipment & lines	IMP		0,5	0.5
	Hydropower systems	SF IHE	1	1 0.5	1.5 0.5
	Operation and maintenance	IMP/TRMEW/ SF		1	1
	Financial analysis	1to3			1
	Design training	SF		1	3
	Total week 2		**2.5**	**6**	**9.5**
Total study load (week 1 + week 2)			**9**	**12**	**16**

During each face-to-face teaching week of the course, a two-day study trip to hydropower site(s) will be organized. The plan is made based on the original course schedule (Uganda M13, Cameroon M18, Bolivia M27 and Ecuador M28). The first week is planned in country 1 (Uganda, Bolivia) and the second week in country 2 (Cameroon, Ecuador). Because of COVID-19 restrictions in Uganda expected for September 2020 the course will be newly scheduled in April 2021.

7 References

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